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THE ROLE OF LOCAL GOVERNMENTS IN CREATING SUPPORTIVE ENVIRONMENTS FOR PHYSICAL ACTIVITY

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July 31, 2012

Signature Date

Statement of Contribution of Others

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Abstract

Physical inactivity is a significant public health issue hence developing supportive community and workplace environments to enhance opportunities and motivation for physical activity is a public health priority. Despite international and Australian recommendations that adults should participate in 30 minutes of moderate activity on most days of the week and continuing strong, supportive epidemiological evidence describing a range of health and social benefits for participation in regular moderate intensity physical activity, physical activity rates in many parts of the world continue to decrease. In Australia, in 2000, 57% of the population were sufficiently active for health and in Queensland, in 2003, 55% were sufficiently active for health.

There is some evidence that changes to the physical environment influence physical activity behaviour and from a public health perspective, environmental modification has the potential to increase physical activity at a population level. This is likely to be more effective and sustainable than working at an individual level. Beyond the health sector there are other sectors that have a role in addressing physical inactivity. Local government is one such sector which plays a key role in developing and maintaining physical environments which support physical activity. The research described in this thesis examined the impact of local government initiatives in promoting active lifestyles and increasing physical activity both at a community neighbourhood level and at a workplace level.

Firstly the role of local government at a neighbourhood level is examined through a study that evaluated the impact of recreational environmental modifications (the Riverway project) on the physical activity levels of neighbourhood residents. The Riverway project used a quasi experimental design with a pre and post intervention and comparison group. The intervention group comprised people residing within 1.5kms of the modified environment (Riverway complex) and the overall redevelopment that extends 5kms from the Riverway complex and is referred to as the Riverway precinct. The comparison group comprised residents outside the 1.5km area. The modification consisted of construction of swimming lagoons, a cultural centre and grassed outdoor amphitheatre, river edge development including boardwalks, decks, bridges, picnic facilities and playgrounds and upgrade of and landscaping around existing paths along the river which stretched for 5 kms. Data collection included a postal survey,

observation study and Global Information System data. While there was no significant increase in the percentage of respondents sufficiently active for health post intervention, there were positive associations between environmental change and perceptions of the environment and usage of modified areas. Participants were significantly less likely to state that there was a lack of a pleasant environment in which to be active in 2006 compared to 2004. There was a significant increase in path use by participants in the intervention group in 2006 compared to the comparison group and significantly more participants from the intervention group walked to the paths and used the paths for walking compared to the comparison group. Participants who use any of the paths along the river were significantly more likely to be sufficiently active for health. Global Information System data showed that in 2006, participants who used the Riverway complex lived significantly closer than those who did not use the complex. These same patterns were observed in relation to those who walked to the 5 kms of modified areas (the Riverway precinct), with those residents living closer to the modified areas being more likely to walk to these areas.

The workplace component of the thesis consisted of three consecutive studies conducted with employees from a local government organisation. There were 340 employees in this organisation all of whom were invited to participate.

The first study used a qualitative approach to explore employee perceptions about the role of the workplace in promoting physical activity. Forty seven employees participated in focus groups and interviews. Results demonstrated that employees were interested and willing to participate in workplace physical activity although perceptions of physical activity need varied between indoor and outdoor employees. Most outdoor employees felt they were active enough in work time and were opposed to workplace physical activity interventions. Despite differences in the indoor and outdoor employee perceptions, there was overall consensus that physical activity in the workplace was an important health priority and that workplace interventions could impact on employee physical activity levels, particularly those engaged in indoor work. Some suggestions of appropriate interventions were made and laid the foundations for the two subsequent studies that were conducted.

In the second study indoor and outdoor local government employees participated in a pedometer study aimed at assessing occupational and leisure time physical activity levels. One hundred and seven participants wore a Yamax Digi-walker (SW 200) pedometer for a one week period after which time they completed the Long Version of the International Physical Activity Questionnaire (IPAQ) to allow a comparison between objective and subjective measures of physical activity. IPAQ results showed that employees working in indoor positions undertook significantly less MET minutes of activity per week (median: 3594.0 METmin/week; IQR = [1982.5, 6265.4]), compared to employees working in outdoor positions (median: 8277.0 METmin/week; IQR = [4818.25, 30813.0]; $p<0.001$). Pedometer results demonstrated that outdoor employees were significantly more active than indoor employees overall (median: 11987 steps compared to 9832.4 steps; $p=0.016$), and in work time (median: 5862.6 steps compared to 3282.1 steps; $p<0.001$), in this workplace setting. There were no significant differences between outdoor and indoor employees in leisure time (median: 5862.6 steps compared to 6594.9 steps; $p=0.212$). To achieve sufficient levels of activity, outdoor workers still needed to participate in leisure time activity. When comparing sufficient levels of activity, as defined by pedometer and the long version of the IPAQ, there were significant discrepancies. On pedometer assessment, 49% of participants were defined as being sufficiently active for health, compared to 91.9% of participants defined as sufficiently active using the IPAQ.

The third study evaluated a 10,000 steps workplace challenge undertaken by Council employees. Twenty teams participated in the Challenge with a total of 99 participants. The average number of steps taken each day per person was 10803. There was a significant difference when comparing the steps taken at baseline (median: 8766; IQR = [6847, 11252]) compared to those during the Challenge with employees taking more steps during the Challenge (median: 9666; IQR = [8084, 12935]; $p = 0.004$). At the six month follow up there was no significant difference between the baseline and the follow up step counts (median: 8766; IQR = [6847, 11252] at baseline compared to a median of 9609; IQR = [7644, 11637] at six month follow up; $p=0.588$).

Addressing physical inactivity requires a comprehensive approach that involves multiple strategies, multiple organisations and approaches that are delivered in multiple settings including the community and workplace setting. The role of local government in supporting physical activity at a community and workplace level is supported by the research described in this thesis. Neighbourhood proximity to recreational areas such as Riverway (parkland, walking trails and paths and other recreational facilities) is an important predictor of neighbourhood usage and local government should be encouraged to develop such areas within local neighbourhoods. At a workplace level, local government employees are interested and willing to participate in workplace physical activity but single interventions such as the 10,000 steps challenge are insufficient to sustain physical activity changes. This further supports the role of environmental change in supporting physical activity, not only at a community environment level but also at a workplace environment level.

Discrepancies as to who is "sufficiently" active can occur depending on the measurement tool used and objective measures such as pedometers are feasible tools to use within workplace settings. Outdoor employees need to be cautious in assuming that work time activity is enough for them to be sufficiently active for health.

Local government organisations can provide an important contribution in enhancing overall population levels of physical activity and good health by supporting community members to be active, through creating supportive environments that are conducive to physical activity, as well as providing opportunities for their own staff to engage in workplace physical activity initiatives.

List of Abbreviations

ABS	Australian Bureau of Statistics
ACT	Australian Capital Territory
AIHW	Australian Institute of Health and Welfare
BMI	Body Mass Index
CASP	Critical Appraisal Skills program
CDHAC	Commonwealth Department of Health and Aged Care
CVD	Cardiovascular Disease
GIS	Geographical Information Systems
IPAQ	International Physical Activity Questionnaire
IQR	Interquartile Range
NSW	New South Wales
RCT	Randomised Control Trial
TPB	Theory of Planned Behaviour
TRA	Theory of Reasoned Action
SD	Standard Deviation
USDHHS	United States Department of Health and Human Services
WHO	World Health Organisation

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Introduction to the Thesis

Structure of the thesis

The doctor of Public Health degree is a professional doctoral degree and is different from a “traditional” doctoral thesis, as it comprises several components that come together to demonstrate overall competence in the public health discipline. The structure of this thesis is also non-traditional as this document comprises a collection of work with each chapter presented as a standalone item in whole or in part that has been used in the production of a report, a publication or is being prepared for publication. Each of the chapters is therefore presented with its own abstract, introduction, methods, results and discussion, and the specific references for each chapter are provided at the end of each chapter and may be duplicated in other chapters.

Content of the Thesis

The work presented in this thesis represents the supervised research component of the Doctor of Public Health, which comprises two thirds of the entire doctoral program and was carried out from 2004-2009. The underlying theme of the overall doctoral program is health promotion evaluation and consists of two projects described in this thesis as well as three independent doctoral research projects as described below. The framework for the doctoral program is based on Nutbeam’s Stages of Research and Evaluation Model which contains six stages of research that link together to inform the development and evaluation of health promotion interventions (Nutbeam, 1998). The stages are: problem definition, solution generation, innovation testing, intervention demonstration, intervention dissemination and program management. The Model is further described in

Chapter One.

Currently there is a wide spectrum of approaches to health promotion evaluation ranging from highly rigorous, methodological approaches to much less rigorous methods. This Doctor of Health Public Health program allowed a range of evaluation techniques to be tested, highlighting the strengths and weaknesses of such approaches as well as highlighting the complexity that one is faced with when planning best practice methodology for health promotion evaluation. To capture the breadth of the work undertaken in this Doctor of Public Health Program a brief summary of the three independent projects is also provided. The main doctoral projects described in this thesis and two of the independent projects undertaken, represent collaborative work between the candidate and external agencies and resulted in a number of industry based reports as well as papers published in peer review journals and conference presentations. The peer reviewed publications, reports and conference presentations that arose from all components of the Doctor of Public Health program are outlined below. The three independent project reports and the doctoral presentation report from the other one third of the overall doctoral program and these have been submitted for internal marking and successfully passed.

Main Thesis *(*the details of which will be provided within this thesis)

Publication

Devine, S., Buettner, P., Mummery, K. (2009). Correlates of adult physical activity participation in the tropics. *Journal of Rural Tropical Public Health. 8*. 30-37.

Industry reports

Devine, S. (2007). Report on the Thuringowa City Council 10,000 Steps Workplace Challenge. December, 2007. Report to City of Thuringowa Council.

Devine, S. (2007). "A study comparing physical activity between indoor and outdoor employees at the City of Thuringowa Council". July, 2007. Report to City of Thuringowa Council.

Devine, S. (2005). "Get Active Thuringowa: Report on the Physical Activity Observation Study of the Riverway Area". July, 2005. Report for City to Thuringowa Council.

Devine, S. (2005). "Get Active Thuringowa: Report on the Get Active Thuringowa Physical Activity Survey". July, 2005. Report for City to Thuringowa Council.

Devine, S. (2005). "Physical Activity Programs in the Workplace – Employee Perceptions. Report on a qualitative study examining Thuringowa City Council employee's perception of how to promote physical activity in the workplace". July, 2005. Report for City to Thuringowa Council.

Conference Presentations

Devine, S., Buttner, P., Mummery, K. (2007). Oral presentation at the National Parks and Leisure Australia Conference. Townsville, 17th-19th September. "Impact of the Riverway project in Thuringowa, North Queensland, on neighbourhood physical activity levels."

Devine, S., Buttner, P. (2007). Oral presentation at the Tropical Health & Cancer Research in Clinical Practice conference. Townsville, 19th-21st July. "Socio-environmental determinants of physical activity in the tropics."

Devine, S., Buttner, P., Mummery, K. (2007). Poster presentation at the 19th International Union for Health Promotion and Education Conference. Vancouver, Canada 10th-15th June. **"**Socio-Environmental Determinants of Physical Activity in the Tropics."

Devine, S., Buttner, P. (2007). Oral presentation at the 19th International Union for Health Promotion and Education Conference. Vancouver, Canada 10th-15th June. "A comparison of two methods for estimating who is sufficiently active for health."

Independent Projects

The three Independent Projects which count towards the Doctorate of Public Health are not part of the main thesis and are briefly described below.

<u>Independent Project One:</u> **Assessing and Responding to Employee Perceived Occupational Health and Safety Concerns at a Fly-in/Fly-out Mine in Northwest Queensland**

This study ran from 2001 – 2006 and was the qualitative component of a broader study on Workplace Environment and Health which aimed to assess, monitor and improve occupational health and safety. The qualitative component of the study comprised baseline and ongoing qualitative exploration of staff perceptions of occupational health and safety issues. Focus groups and interviews with mine site employees and managers were used to assist in problem definition and solution generation as well as being the basis for strategy development and testing, and evaluation (innovation testing, intervention demonstration and dissemination).

Publication

Devine, S, Muller R, Carter T. (2008). Using the framework for health promotion action to address staff perceptions of occupational health and safety at a fly-in/fly-out mine in northwest Queensland. *Health Promotion Journal of Australia, 19*(3), 196-202.

Conference Presentation

Devine, S, Muller R, Carter T (2009). Oral presentation at the 18^{th} Australian Health Promotion Association Conference. Perth, 17^{th} – 20^{th} May. *"Applying the Framework for Health Promotion Action to Address Occupational Concerns in a Mining Setting."*

Industry Reports

Devine, S., Carter, T., Muller R. (2006). Staff Perceptions of Occupational Health and Safety at the Century Mine and Karumba Port Operations. Report to Zinifex Pty Ltd.

Devine S., Carter, T., Muller R. (2005). Staff Perceptions of Occupational Health and Safety at the Phosphate Hill Site. Report to Western Mining Corporation Fertilisers Pty Ltd.

Devine S., Carter, T., Muller R. **(**2004). Report on Qualitative Research Findings to Western Mining Corporation Fertilisers Pty Ltd. Follow Up of Employee Perceived Occupational Health and Safety Concerns at Phosphate Hill Fertiliser Plant.

Devine S., Carter, T., Muller R**.** (2003). Report on Qualitative Research Findings to Western Mining Corporation Fertilisers Pty Ltd. Follow Up of Employee Perceived Occupational Health and Safety Concerns at Phosphate Hill Fertiliser Plant.

Devine S., Woolley, T., Muller R. **(**2002). Report on Qualitative Research Findings to Western Mining Corporation Fertilisers Pty Ltd. Employee Perceived Occupational Health and Safety Concerns at Phosphate Hill Fertiliser Plant.

<u>Independent Project Two:</u> **Building Capacity of Maternity Staff to Discourage the Use of Sunlight Therapy in the post-Partum Period and Infancy.**

Project Two involved the development, piloting and evaluation of an educational intervention to change the beliefs and practices of nurses and parents regarding therapeutic sun exposure in the post-partum period and infancy. The project had a quasi-experimental design with an intervention hospital and two control hospitals. The intervention was multifaceted and involved parental education, staff education and capacity building, educational resource development and policy initiatives. Previous research defined the problem (Harrison, Buettner, & Nowak, 1999; Harrison, Büttner, & Nowak, 2005) and collaborative processes were used for solution generation. These formed the basis for innovation testing and intervention demonstration and dissemination.

Publication

Devine, S, Harrison S, Buttner P. (2008). Building capacity of maternity staff to discourage the use of sunlight therapy in the post-partum period and infancy. *Women and Birth*, *21*(3): 107-112.

Conference Presentations

Devine, S., Harrison, S., Buttner, P. (2007). Oral presentation at the 19th International Union for Health Promotion and Education Conference. Vancouver, Canada 10th-15th June. "The development and implementation of an educational intervention to address inappropriate beliefs about therapeutic sun exposure held by nurses and post-partum women in North Queensland, Australia."

Devine, S., Harrison, S., Saunders, V., Woosnam, J., Morrison, M. (2004). Oral presentation at the 4th Annual Queensland Health and Medical Scientific meeting. 30 Nov and 1 Dec, 2004. Brisbane QLD. "An interevention to change "risky" beliefs about sun exposure held by nurses and post-partum women in northern Queensland".

Devine, S., Saunders, V., Harrison, S. (2004). Poster presentation at the 18th World Conference on Health Promotion and Health Education. Melbourne, 26-30 April. "An intervention to change risky beliefs about sun exposure held by nurses and post-partum women in North Queensland: The Process".

<u>Independent Project Three</u>: Health Promotion Workforce Capacity Building Project

Project Three was an impact evaluation of a capacity building educational intervention aimed at improving the health promotion knowledge, skill and practices of health professionals across north Queensland. A pre–post, single group study design was used. This study reflects the innovation testing and intervention demonstration and dissemination stages of Nutbeam's model.

Publication

Devine, S., Llewellyn-Jones, L., Lloyd, J. (2009). Impact of a five-day short course on integration of health promotion into practice in north Queensland. *Health Promotion Journal of Australia, 20*(1) 69-71.

Industry Reports

Devine, S. (2009). Report on the Impact Evaluation of the 2008 Five-Day Short Courses on Health Promotion. Report to the Tropical Population Health Network.

Devine, S. (2008). Report on the Impact Evaluation of the Five-Day Short Course on Health Promotion. Report to the Tropical Population Health Network.

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Harrison, S., Buettner, P., & Nowack, M. (1999). Why do mothers still sun their infants? *Journal of Paediatrics and Child Health, 35*(3), 296-299.

Harrison, S., Büttner, P., & Nowak, M. (2005). Maternal beliefs about the reputed therapeutic uses of sun exposure in infancy and the postpartum period. *Australian Midwifery, 18*(2), 22-28.

Nutbeam, D. (1998). Evaluating health promotion – progress, problems and solutions. *Health Promotion International, 13*(1), 27-43.

Chapter 1. Introduction and Context of the Thesis

The local government workplace and community based initiatives that are relevant to the research in this thesis commenced in November 2004 and were conducted through until July 2007. The research examined the impact of local government initiatives in promoting active lifestyles and increasing physical activity both at a community neighbourhood level and at a workplace level. The introductory chapter aims to set the scene by clearly defining some of the key terms that are important in undertaking research of this nature. It also describes the important health benefits of physical activity, the burden of disease and costs in relation to physical inactivity and population physical activity participation data in Australia up to the year 2004 when this body of research commenced. The importance of taking multispectral and multistrategic approaches to address the problem of physical inactivity is introduced and the role that local government can play in this area both as a provider of community based infrastructure and services and as an employer is described. A brief description of the research, the aims of the thesis and a short overview of the components of the thesis will be outlined.

1.1. Defining physical activity and related terms

In 1996 the US Surgeon General released a landmark report "Physical Activity and Health" which recommended 30 minutes of moderate activity on most days of the week (United States Department of Health and Human Services[USDHHS], 1996). This led to the development of guidelines for physical activity including The National Physical Activity Guidelines for Australia in 1999 which outline the minimum levels of physical activity that are needed to gain a health benefit. The guidelines advocate thirty minutes of moderate intensity physical activity on most days of the week to achieve health benefits (Commonwealth Department of Health and Aged Care [CDHAC], 1999). This equates to the accumulation of 150 minutes of at least moderate intensity physical activity per week, which can be accumulated in sessions of at least 10 minutes and undertaken ideally, over five separate occasions (CDHAC, 1999).

Understanding the terms in these guidelines is important, particularly in relation to undertaking research that assesses physical activity participation by groups and populations. Definitions of key terms are provided below:

Physical activity is "any bodily movement produced by skeletal muscle that results in a substantial increase over the resting energy expenditure" (Bouchard & Shephard, 1994). The term should not be confused with exercise which is a subset of physical activity and is defined as "planned, structured and repetitive bodily movement done to improve or maintain one or more components of physical fitness" (Armstrong, Bauman & Davies, 2000). Physical activity is described in terms of the frequency, duration, intensity and context in which it is undertaken (e.g. leisure time, occupational related, domestic including household chores and gardening and yard work, and active transport) (Bouchard & Shephard, 1994; Bauman, Bellew, Vita, Brown & Owen, 2002).

Frequency is the number of times a person participates in physical activity, within a reporting period (Armstrong et al., 2000).

Duration is the length of time spent participating in physical activity (Armstrong et al., 2000).

Intensity is the effort at which a person participated in physical activity and is usually reported in terms of light, moderate or vigorous activity (Bauman et al., 2002). Intensity is often measured as ***METs (metabolic equivalents of task)***. A MET is a unit used to estimate the metabolic cost (oxygen consumption) of physical activity. One MET is defined as the energy expenditure for sitting quietly, which for the average adult is one kilocalorie per body weight in kg^{-1} per hr^{-1} or 3.5 ml of oxygen per body weight in kg^{-1} per min^{-1}. METs are used as an index of the intensity of activities (Armstrong et al., 2000).

Sedentary denotes people who are physically inactive, and report no participation in walking, moderate-intensity or vigorous-intensity activity, resulting in an estimated energy expenditure of less than 50 kilocalories per week (Armstrong et al., 2000). Although this was an accepted definition at the time the research reported on in this thesis commenced it is acknowledged that definitions have changed. A more contemporary definition of sedentary behaviour is *"activities that do not increase energy expenditure sunstantially above the resting level and includes activities such as sleeping, sitting, lying down, and watching television, and other forms of screen based entertainment.... i.e activities that involve energy expenditure at the level of 1.0-1.5*

METs" (Pate, O'Neill and Lobelo, 2008). The term **inactive** will be used in the thesis rather than sedentary.

Light-intensity physical activity is defined as 1–2.9 METs and includes reading, dishwashing and walking at an ambling pace (National Public Health Partnership, 2003).

Moderate-intensity physical activity is physical activity requiring 3–4 times as much energy as at rest or intensity of 3–5.9 METs, e.g. brisk walking (National Public Health Partnership, 2003).

Vigorous-intensity physical activity is physical activity requiring 7–9 times as much energy as at rest or intensity of 7–9 METs, e.g. running, squash, vigorous cycling (National Public Health Partnership, 2003).

Type is the specific physical activity included in the following domains:
Leisure time physical activity - refers to sport and recreational physical activity, including:
a range of activities conducted specifically for enjoyment, social, competitive or fitness purposes, performed in leisure or discretionary time (Armstrong et al., 2000);
Domestic and gardening activity – this is activity undertaken as part of domestic, parenting and other carer duties. Moderate levels of this type of activity include window cleaning, vacuuming, pushing a pram, and digging in the garden;
Work related physical activity – physical activity undertaken as part of paid or unpaid work, excluding travelling to and from work (National Public Health Partnership, 2003).
Active transport related physical activity – undertaken for the purposes of travel to and from places (National Public Health Partnership, 2003).

The current recommendations regarding the activity required for health benefit focus on 'leisure time' activity.

Understanding the above terms is important when considering the measurement of physical activity and there are a range of measurement methods that can be used in research. These include self-reported surveys, motion sensors such as pedometers and accelerometers, diaries and logs, behavioural observation techniques, use of doubly-labelled water, and measures of fitness and indirect physiological measures such as lipids, heart rate and body composition (Bauman et al., 2002). Methods used in the studies undertaken in this research are outlined in subsequent chapters.

1.2. Physical activity as an issue

Over the last 30 years there has been strong, consistent epidemiological evidence that defines a range of health and social benefits for participation in regular moderate intensity physical activity (USDHHS, 1996; CDHAC, 1998). Participation in the recommended levels of moderate intensity physical activity provides an overall risk reduction in all-cause mortality of approximately 30% (Lee & Skerrett, 2001). In particular the greatest benefits on all-cause mortality are gained when shifting those who are most inactive towards becoming moderately active (USDHHS, 1996; Lee & Skerrett, 2001). Participation in physical activity also impacts on a number of specific diseases, in particular a reduction in cardiovascular risk factors and prevention of cardiovascular disease, non-insulin dependent diabetes and some cancers (CDHAC, 1998).

The relationship between physical activity and cardiovascular disease is well established and, as with all-cause mortality, the population risk reduction is greatest for those who are moved from being inactive to meeting the recommended levels of moderate intensity physical activity (Bull, Bauman, Bellew & Brown, 2004). Wannamethee and Shaper (2001) reviewed the epidemiological evidence regarding physical activity and cardiovascular disease and concluded that leisure time physical activity is clearly associated with reduced risk of coronary heart disease and cardiovascular mortality in both men and women and in middle-aged and older individuals, as well as being associated with reduced risk of stroke. They highlighted that physical activity does not have to be vigorous to achieve a reduction in the risk of cardiovascular disease and that the existing evidence supported regular moderate physical activity.

Early cross-sectional studies showed that decreased physical activity was an important risk factor for the incidence of type 2 diabetes and in more recent years stronger evidence from randomized controlled trials has supported these findings (Bull et al., 2004). A study that examined the risk of prolonged television watching on type 2 diabetes, found that increasing physical activity was associated with a significant reduction in risk for diabetes and that prolonged television watching was directly related to increased risk of type 2 diabetes (Hu, Leitzmann, Stampfer, Colditz, Willett, and Rimm 2001).

The increasing trends in global obesity, mainly in developed countries, in recent decades are of concern (Australian Institute of Health and Welfare [AIHW], 2003) and although the association between overweight and obesity and an increased risk of ill health is well established (World Health Organisation [WHO], 2000), the role of physical activity in this relationship is unclear. Erlichman, Kerbey and James (2002) undertook an analysis to examine the evidence for physical activity in preventing unhealthy weight gain and obesity and concluded that the amount of physical activity required to prevent population weight gain or to induce or maintain weight loss in those populations that are already overweight or obese is more than the current recommendations for physical activity.

There has been research examining the link between levels of physical activity and specific cancers since the 1980s and it has been suggested that regular physical activity is associated with a reduction in all-cancer morbidity and mortality (Bull et al., 2004). However the strongest relationships appear to be between two of the most common cancers – breast cancer and colon cancer – and the broader association is likely to be due to the effect of physical activity on these two cancers (Bull et al., 2004). Bauman, Habibullah and Holford (2003) undertook a systematic review of physical activity and cancer in 2002–2003 for the New South Wales Cancer Council and concluded that the strongest evidence for the protective effect of physical activity was in relation to colon cancer with moderate to good evidence regarding protective effects for breast cancer development. There was a lack of evidence in relation to other cancer sites (Bauman et al., 2003). There is also evidence that physical activity can provide psychosocial and quality of life benefits for those people with cancer (Courneya, 2001) and that physical activity before, during and after treatment consistently shows a positive association with cancer outcomes (Courneya, 2003).

Participation in physical activity can also have an impact on mental health and injury although the evidence is less convincing than for the previously discussed health outcomes. In relation to injury it appears that being physically active could have benefits for the prevention of osteoporosis and reducing the risks and consequences of arthritis but it is unclear what sort of activity contributes the greatest benefits - i.e.

strength training, balance, or gait training (Bull et al., 2004). As with injury, there are suggestions regarding the benefits of physical activity on mental health outcomes but there is a lack of evidence to convincingly demonstrate these benefits (Bull et al., 2004).

The above evidence demonstrates the protective benefits of being physically active on health outcomes and reaffirms that the National Physical Activity Guidelines for Australia which advocate for thirty minutes of moderate intensity physical activity on most days of the week, does provide population health benefits (CDHAC, 1999). Promoting regular, moderate intensity physical activity participation is clearly a public health priority (Bauman et al., 2002; USDHHS, 1996).

1.3. Physical activity participation rates globally and in Australia

Despite the existence of clear physical activity guidelines which recommend 30 minutes of moderate activity on most days of the week (USDHHS 1996; CDHAC, 1999) levels of overweight and obesity, and physical inactivity are increasing in many parts of the western world including Australia.

Physical inactivity is a global problem. In 1997 to 1998 a survey conducted in the United States of America showed that 70% of adults failed to participate in 30 minutes of light to moderate physical activity at least five times a week or 20 minutes of vigorous exercise three times a week (Schoenborn & Barnes, 2002). Broader data from 24 countries in the region of the Americas showed that more than 50% of the population were not performing the minimum recommended 30 minutes of moderate-intensity activity on at least five days of the week (Jacoby, Bull & Neiman, 2003). European data varies widely with a 2002 study showing the prevalence of inactive leisure time behaviour in the European Union varied from less than 10% in Finland to almost 60% in Portugal (Vainio & Bianchini, 2002). Closer to home, data from New Zealand showed that 61% of adults did not achieve the recommended 30 minutes of moderate activity a day on five or more days a week (Sport and Recreation New Zealand, 2003).

In 2001, Bauman, Ford & Armstrong released a report describing trends in population levels of self-reported physical activity in Australia between 1997, 1999 and 2000. The data used in this report were collected as part of Active Australia and National Physical Activity Surveys (the 1997 Survey was funded by the Australian Sports Commission and the CDHAC, the 1999 Survey was funded by the CDHAC and the Australian Institute of Health and Welfare [AIHW], with support from the New South Wales [NSW] State Health Department and the 2000 Survey was funded by the Australian Sports Commission with support from Australian Capital Territory [ACT] Health and NSW Health). The surveys used the same measures and the questions related to self reported participation in physical activity. The questions that were used have been shown to be appropriate and reliable for population surveys (Bauman, et al., 2001). Each survey was conducted at the same time of the year, (the last two weeks of November), and were undertaken at a similar time to the surveys conducted as part of the research in this thesis.

The major findings from this report demonstrated that the percentage of adult Australians achieving sufficient time being physically active for health benefits (defined as at least 150 minutes of walking, moderate and/or vigorous activity per week) declined from 62.2% in 1997 to 56.6% in 1999 and remained stable at 56.8% in 2000 (Table 1.1). Levels of physical inactivity increased from 13.4% in 1997 to 14.6% in 1999, with an additional increase again in 2000 to 15.3% (Bauman, et al., 2001). A clear gradient was seen in relation to educational attainment with those having less than 12 years of schooling being less likely to be sufficiently active (Bauman, et al., 2001).

Table 1:1: Percentage of People achieving sufficient activity time in Australia* (95% confidence intervals)

	1997 N=4824	1999 N=3842	2000 N=3590
Sex			
Men	63.4 (61.3, 65.4)	59.6 (57.3, 61.9)	57.6 (55.1, 60.0)
Women	61.1 (59.3, 62.9)	53.8 (51.7, 55.9)	56.0 (53.8, 58.2)
Total sample	62.2 (60.8, 63.6)	56.6 (54.0, 57.2)	56.8 (55.2, 58.4)
Age Group (years)			
18–29	74.0 (71.1, 76.8)	68.7 (65.0, 72.2)	68.5 (64.7, 72.0)
30–44	63.6 (61.3, 65.9)	53.5 (50.7, 56.2)	54.2 (51.4, 57.0)
45–59	53.8 (51.0, 56.6)	50.0 (47.0, 53.1)	49.7 (46.5, 52.9)
60–75	53.4 (50.2, 56.6)	54.1 (50.8, 57.5)	54.4 (50.7, 58.0)
Education Level			
Less than 12 years schooling	55.1 (52.9, 57.3)	49.6 (47.1, 52.1)	50.6 (47.9, 53.3)
Completed 12 years schooling	63.0 (60.7, 65.3)	59.7 (57.0, 62.3)	58.8 (56.1, 61.4)
Tertiary qualifications	71.9 (69.2, 74.5)	62.3 (59.0, 65.4)	62.3 (59.2, 65.4)

* 'Sufficient' activity time is defined as 150 minutes total activity including all walking and moderate minutes, and vigorous minutes of activity weighted by two (refer pages 16–18 of Armstrong *et al.*, 2000)

Adapted from: Bauman, Ford & Armstrong, 2001.

A telephone survey conducted in Queensland in 2001 showed that participation in leisure-time physical activity had declined since 1997. The average amount of time people spent each week in moderate leisure time physical activity declined from 66 minutes to 51 minutes between 1997 and 2001, and the average amount of time people spent each week in vigorous leisure-time physical activity also declined from 86 minutes to 68 minutes. The proportion of people achieving 'sufficient' levels of physical activity for a health benefit decreased from 49% to 45% with the decrease being greatest for women (50% to 41%), and was greatest among the 18 to 29 age group (61% to 51%) (Queensland Health, 2003).

1.4. The burden of disease from physical inactivity in Australia

Physical inactivity results in significant health care costs and burden of disease. In 1999, physical inactivity was seen to be responsible for approximately seven percent of the total burden of disease in Australia (Mathers, Vos & Stevenson, 1999). A study conducted by Stephenson, Bauman, Armstrong, Smith & Bellew (2000) looked at the costs of illness attributable to physical inactivity. They estimated that the amount of disease that could be prevented if the population were at least moderately active was 18% for Coronary Heart Disease, 16% for stroke, 13% for non-insulin dependent diabetes mellitus, 19% for colon cancer, 9% for breast cancer and 10% for depression symptoms.

In 2000, Stephenson and colleagues reported that there were approximately 8,000 preventable diseases each year in Australia associated with physical inactivity which makes it a large contribution to the overall burden of disease, ranking second only to tobacco as the most important issue in disease prevention. This represents an estimated 77,603 potential years of life lost because of inactivity. As a result, the economic cost of physical inactivity to Australia at that time was enormous; it was estimated that the direct health care cost attributable to physical inactivity was $400 million per year with indirect costs such as time off work and the social costs, resulting in a doubling of this amount (Stephenson *et al.*, 2000).

1.5. Potential interventions to address physical inactivity – the need for multistrategic, multisectoral approaches

There is no doubt that increasing physical activity in the population is a significant public health priority and has clear benefits at a physical, mental, social, environmental and economic level (Queensland Health, 2003). Despite much work that has already been done to address the problem of physical inactivity, the challenge to build the evidence base for effective best-practice interventions continues. Addressing physical inactivity requires a comprehensive approach that involves multiple strategies, multiple sectors and approaches that are delivered in multiple settings (Bauman et al., 2002). Such comprehensive approaches are consistent with the core health promotion philosophy. The Ottawa Charter for Health Promotion states that *"health is created and lived by people within the settings of their everyday life; where they learn, work, play and love"* and this document highlights the need for comprehensive approaches to health issues that use a combination of the five core principles for health promotion: build healthy public policy, create supportive environments, strengthen community action, develop personal skills and reorient health services (WHO, 1986). The Jakarta Declaration on Leading Health Promotion into the 21st Century goes on to emphasise that particular settings offer practical opportunities for the implementation of comprehensive strategies (WHO, 1997). Specifically, the Jakarta Declaration document mentions local communities and the workplace as key settings for health promotion action. In the Jakarta Declaration there is an emphasis on the importance of developing partnerships for health and social development, which would require collaboration between sectors at all levels of governance and society (WHO, 1997).

The need to develop effective interventions to increase physical activity is obvious but to do so it is necessary to identify what factors can be changed in order to have a measurable impact on participation in physical activity (Humpel, Owen and Leslie, 2002). Such factors have been classified within several domains including: demographic and biological, psychological, cognitive and emotional, behavioural, social and cultural and the physical environment (Sallis and Owen, 1999). Two areas that are of particular interest in relation to physical activity is the relationship between the physical environment and physical activity and the role of the workplace setting in physical activity. These two areas are the focus of the research in this thesis, with an emphasis on the role that local government can play in both these areas.

1.6. Introducing the environment, the workplace and local government roles

It has been recognised that changing behaviour at an individual level is challenging, while on the other hand there is evidence that changes to physical environments have the potential to influence the physical activity behaviours of significant numbers of people (McCormack, Giles-Corti, Lange, Smith, Martin & Pikora, 2004). Theories of health behaviour such as Bandura's Social Cognitive Theory describe the interaction between an individual, their behaviour and the environment and provide a basis for further understanding the relationship between physical activity and the physical environment (Bandura, 1986). Socio-ecological models, where the environment, people's behaviour and social and organizational influences are recognized, are also of importance when trying to develop further understanding in this area (Sallis, Bauman & Pratt, 1998; Sallis and Owen, 1997). Such models acknowledge the effects that interpersonal, intrapersonal, institutional, community and legislative factors have on the behaviour of individuals and populations (McCormack et al., 2004).

Research into the relationships between environment and physical activity is still evolving. From a public health perspective modification of environments has the potential to encourage increased physical activity at a population level (Sallis & Owen, 1999), and this is likely to be more effective and sustainable than just working at an individual level. In addition, creating supportive environments for physical activity can support some of the commonly used individual approaches (Merom, Bauman, Vita & Close, 2003). Current knowledge about the evidence for creating supportive physical environments for physical activity are described in detail in Chapter Two.

While traditionally the health focus of local government has been on the provision of environmental protection, especially against infectious diseases (Harris & Wills, 1997), more recently local government is recognised as a clear stakeholder in developing environments that support the health and wellbeing of local communities with a particular role in physical activity (Harris & Wills, 1997; King, Hawe & Corne, 1999).

In 2001 the NSW Department of Local Government released guidelines titled "Creating Active Communities: Physical Activity Guidelines for Local Councils" with the aim of assisting local councils to be involved in encouraging community level physical activity (NSW Department of Local Government, 2001). In this document numerous benefits are described for councils and their communities as a result of increasing participation in physical activity. These include: improved physical and psychological health of community members; stronger families and healthier communities; economic benefits (with a specific mention about the role of physical activity in improving work performance and productivity, decreasing absenteeism and staff turnover and reducing work accidents as well as creating employment opportunities in the area of sport and recreation provision, attracting tourism and new residents and economic benefits through holding sporting events); environmental benefits through protection of habitat and biodiversity and the provision of parks, open spaces and natural environments and providing infrastructure for cycling and walking; reduction in crime and antisocial behaviour; improved injury prevention; and enhanced profile for the council in the local community (NSW Department of Local Government, 2001). In particular, local government agencies were seen to have key responsibilities in providing a wide range of facilities and services that are relevant to encouraging physical activity participation such as facilitating the provision of sport and recreational facilities, providing infrastructure to support incidental activity, such as walkways and cycle ways and providing public open spaces such as parks (NSW Department of Local Government, 2001).

Not only do local governments play a role in community level activity, they can also play a role in promoting physical activity opportunities for their staff at a workplace level. A review of workplace physical activity programs conducted by Proper and colleagues (2002) showed some evidence of reduced absenteeism and less conclusive evidence for the effect of physical activity programs on job satisfaction, job stress and employee turnover (Proper, Staal, Hildebrandt, van der Beek & van Mechelen, 2002). The lack of well designed trials in this area was highlighted and there is a need for more research to be conducted in this field.

The focus of the research in this thesis is on the role of local governments in promoting physical activity both at a community neighbourhood level and at a workplace level. Further detail on the environment and workplaces as a key setting for physical activity programs are provided in Chapters Two and Five. The largest part of the presented research focuses on the evaluation of a local government environmental modification called the Riverway development.

1.7. Introducing Riverway

At the end of 2004, Thuringowa City Council commenced development of the Riverway project which is located in Townsville, North Queensland, on the Ross River. The Riverway Project is a multi faceted development that aims to make the river habitat accessible to residents and tourists while protecting and enhancing the natural beauty of the area. The development consists of multiple stages and when the entire development is complete it will stretch for 11 km along the reaches of the Ross River and be a dynamic combination of cultural, sports, leisure, residential and commercial activities. This is part of a 20 year plan for the area. Riverway was conceived by Thuringowa City Council and aims to provide a livable environment for the community while maintaining a standard of ecological sensitivity and river management. Along the proposed 11 km redevelopment there are four unique river precincts with nodes at Pioneer Park, Loam Island, Apex Park and the Ross River Dam. Stage one involved completion of the Pioneer Park and Loam Island nodes and it is these areas that are the focus of the research undertaken and described in this thesis. A detailed map of the entire study area is provided in Appendix 1.1.

Pioneer Park

Pioneer Park is the hub of Riverway and is where the local community, visitors and tourists can enjoy a range of activities. The development consists of:

- Two swimming lagoons covering 4,000 sqm
- A grassed outdoor amphitheatre
- A cultural centre including the Riverway Arts Centre and the Pinnacles Gallery
- River edge development including parklands, pathways, boardwalks, decks and bridges, picnic and barbeque facilities and playground equipment, all with river views
- A cafe and restaurant

Work commenced in the Pioneer Park area in September 2004 and the initial focus was on a 5 km section that involved civil and landscaping works. Construction of the newly developed Riverway area was due for completion in late 2005 but due to delays was not officially completed until July 2006. Before construction commenced there were rough paths along the river edge and a large open space with no development or infrastructure. Throughout construction of all areas, the public still had access to existing walking tracks along the river. The Riverway development has resulted in a unique integration of the built and natural environment. A map of this stage of the Riverway development is shown in Figure 1.1.

Figure 1:1: Riverway Map

1. BHP Billiton Yabulu Eco Active Centre
2. Riverway Arts Centre
3. Swimming Lagoons
4. Riverway Amphitheatre
5. Rivervillage
6. Carpark
7. Village Spine
8. Practice Oval
9. Tony Ireland Stadium
10. Riverwalk
11. Riverway Pontoon
12. Itara Residential
13. Skatepark

** Please note that the Tony Ireland Stadium and Itara residential area had not commenced when the 2006 follow up was completed.

Loam Island

Loam Island is 5 km west of the Pioneer Park development and is connected by a path along the River that was redeveloped as part of the overall project. Although called an island it is really a section of land alongside the river that is part of the mainland. Development commenced at Loam Island in October 2004 and included transforming the existing area into an environmental and nature recreational reserve and the construction of a multiuse community facility for use by local Scouts, Guides, the

Riverway Rowing Club and the Townsville Water Ski Club. The 5 km area between Riverway and Loam Island is referred to as the Riverway precinct in this thesis.

Future work in the Riverway area

Further development of the Loam Island area is planned including an upgrade to the savannah grassland in the area and expansion of the river edge that will comprise pools and interactive artwork that aims to stimulate children's interest and understanding of river ecology. Eventually this precinct will be an environmental wetland with boardwalks and information for visitors about the nature and diversity of marine wetland environments. Future development is also planned further along the river edge but is not part of the current research presented in this thesis.

Evaluation of the Riverway development provided an ideal opportunity to contribute to the knowledge of the relationship between the environment and physical activity, which is needed to support and lobby for environmentally focused public policy and interventions that will impact on physical activity.

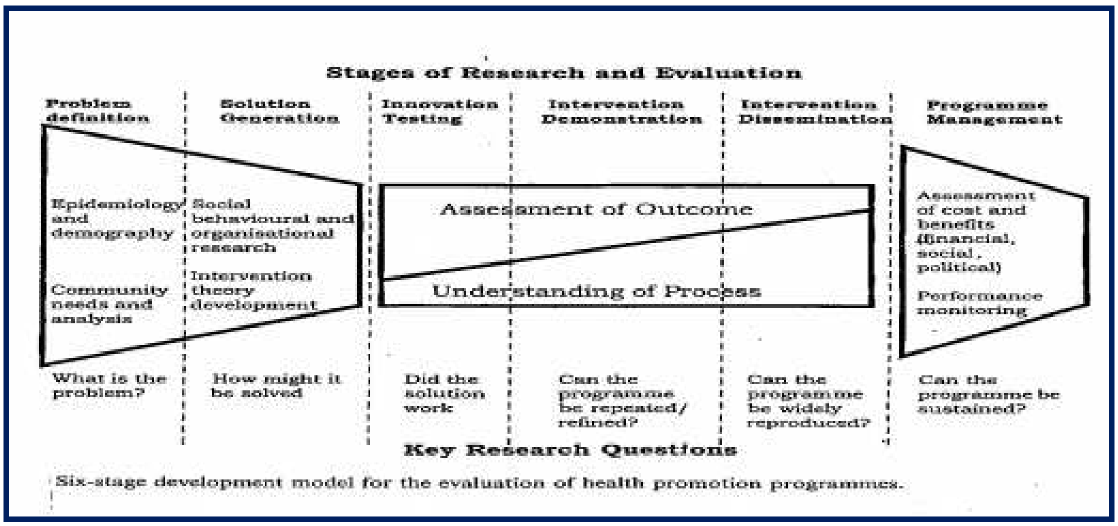
1.8. Thuringowa City Council Workplace Physical Activity Research

As a result of the doctoral candidate's involvement in the evaluation of the Riverway project, the Thuringowa City Council became interested in the topic of physical activity from a workplace perspective. A request was made by the council to undertake a qualitative research project to assess employees' views about workplace physical activity programs and, as a result of this research, further studies were conducted including a pedometer study to assess indoor and outdoor employee physical activity levels and the evaluation of a 10,000 steps workplace physical activity challenge. This additional research has been incorporated into the thesis. Plans to have ongoing involvement in workplace physical activity with the Thuringowa City Council were unable to proceed due to Queensland local government amalgamations in 2008, which resulted in the Thuringowa City Council being subsumed into the Townsville City Council.

1.9. Conceptual framework for the thesis

As mentioned earlier in this thesis, there is currently a wide spectrum of approaches to health promotion evaluation ranging from highly rigorous, methodological approaches to much less rigorous techniques (Nutbeam, 1998). The projects described in this thesis provided an opportunity to apply Nutbeam's Model of Research and Evaluation (Nutbeam, 1998), not only to these projects but also to the three independent projects which were part of the overall Doctor of Public Health Program (Figure 1.2). Nutbeam's model uses six stages of research, which go together to develop and evaluate health promotion interventions – problem definition, solution generation, innovation testing, intervention demonstration, intervention dissemination and programme management (Nutbeam 1998). Aspects of the model applied to the research conducted are discussed in subsequent chapters, and a brief overview is provided below.

Figure 1:2: Stages of Research and Evaluation Framework



Source: Reproduced with permission from Nutbeam, 1998 (pp33).

The problem definition stage of Nutbeam's Model investigates the causal basis and scope for preventive or health promotion interventions (Nutbeam, 1998). This might include an examination of existing demographic and epidemiological data as well as the collection of new information through needs assessment processes. Such data and information provides essential background information that allows definition of the major issues and their determinants, and identifies key target groups for future interventions (Nutbeam, 1998).

Solution generation uses social, behavioural and organisational research to allow a deeper understanding of the target audience so that appropriate interventions can be developed. In this stage intervention theory development may occur which helps in developing a more in-depth understanding of issues and the methods that can be used for achieving change (Nutbeam, 1998).

Innovation testing is assessing the success of an intervention. This stage often encompasses process evaluation where implementation is assessed, and impact and outcome evaluation where outcomes or effects are assessed (Nutbeam, 1998). Both aspects of evaluation are important to ensure that not only are outcomes identified but the reason for the outcomes being achieved is identified.

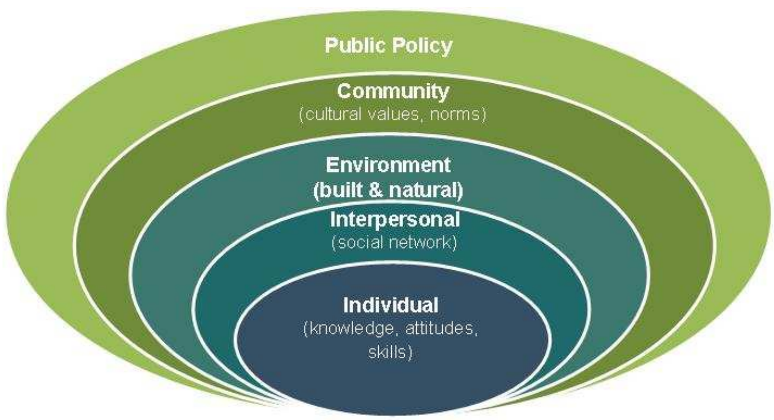
Intervention demonstration helps one understand if an intervention can be repeated or refined and adapted for use in a local situation. This is particularly important to ensure that research findings can be adapted for more practical application in a “real world” environment (Nutbeam, 1998).

Intervention dissemination is important, particularly if an intervention has been shown to be successful in achieving health outcomes. Such programs need wider dissemination and how to implement strategies at a local level needs to be understood. This includes ensuring that the contextual variables of health promotion practice are understood. Undertaking evaluation at this level is complex and it can be difficult to ensure that rigorous approaches are used by others when implementing interventions particularly at a community level (Nutbeam, 1998).

Programme management is the stage where evaluation tasks are directed towards supporting the ongoing management of a program and this might include ongoing monitoring of indicators of interest (for example, physical activity participation levels). Ongoing monitoring of the quality of a program delivery is also conducted (Nutbeam, 1998).

As well as using Nutbeam’s Model as the framework for the projects in this thesis, the research has been grounded within a socio-ecological model of health promotion that recognises the complex interactions between an individual, their behaviour and the broader social and physical environment (Sallis & Owen, 1997). The social-ecological model recognises that there are many influences on health behaviours, including intrapersonal factors, interpersonal factors, institutional factors, community influences and policy (Sallis & Owen, 1997). The socio-ecological model allows one to consider the complex area of physical activity and the effects of settings such as parks, leisure facilities and workplaces and the influence of intrapersonal factors related to self-efficacy and barriers; interpersonal factors related to social support; and organizational, environmental and community influences. By applying a socio-ecological framework the current research focuses attention on the environment and its influence on behaviour as well as considering intra and interpersonal factors. In the Riverway project the influence of the broader community and environment is considered in relation to neighbourhood level physical activity within a context of intrapersonal and interpersonal factors. The workplace project enables consideration of intrapersonal and interpersonal factors as well as organizational factors (workplace environmental supports and policy) and community factors. The socio-ecological model of Health Promotion is shown in Figure 1.3.

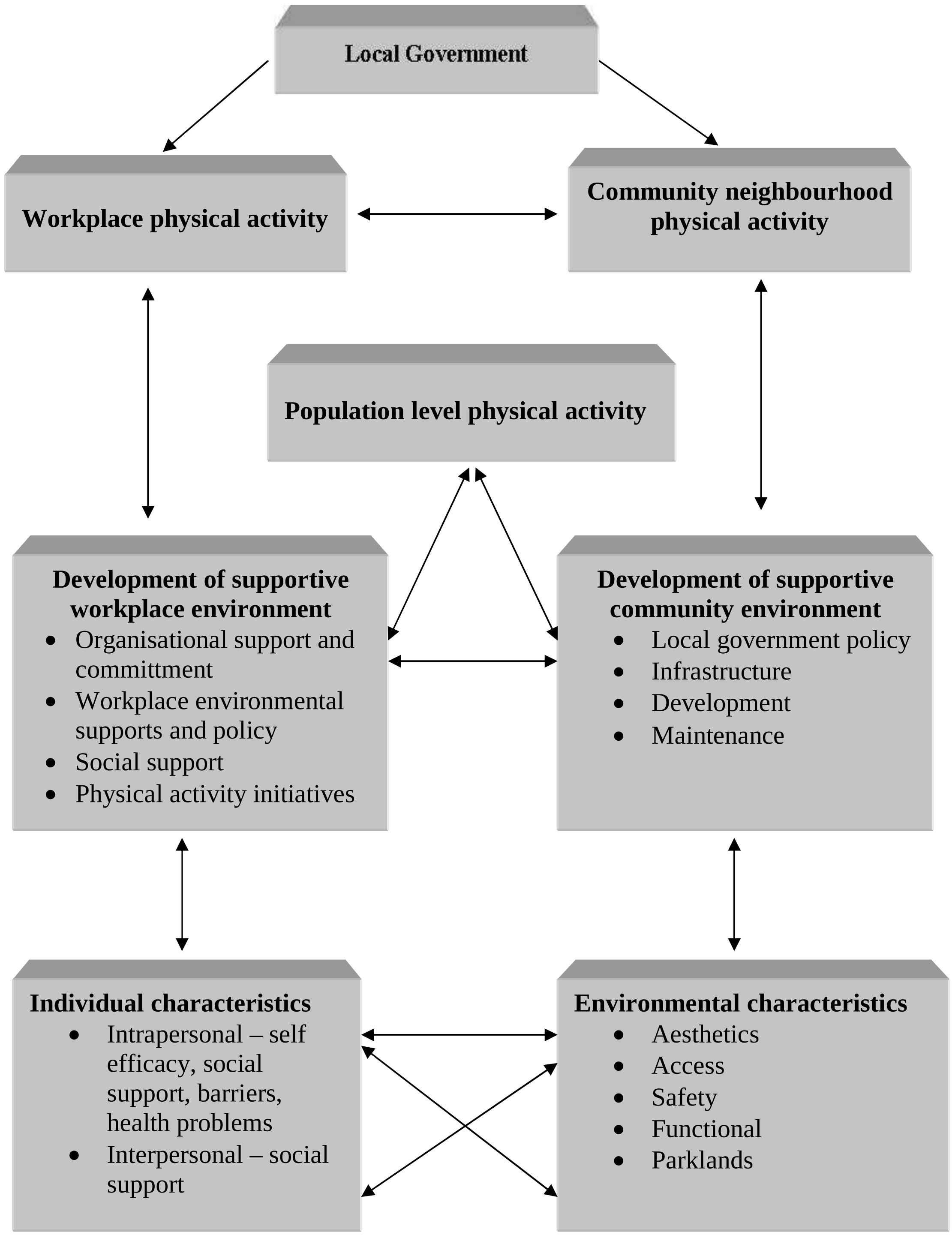
Figure 1:3: The Socio-ecological Model of Health Promotion



Source: Image modified from University of Victoria, Centre for Addictions Research of BC.

Based on the socio-ecological model, the doctoral candidate developed a conceptual framework to guide the research described this thesis, to help conceptualise the role that local governments play in creating supportive environments for physical activity. Although the research looks at local government roles both at a community and workplace level, the two cannot be seen in isolation as there is considerable overlap between the two environments. At both levels local government play a significant role in creating environmental supports and policy to achieve sustainable changes in behaviour. The framework is shown in Figure 1.4.

Figure 1:4: Conceptual Framework for Thesis



1.10. Research Aims

The research described in this thesis examined the impact of local government initiatives in promoting active lifestyles and increasing physical activity both at a community neighbourhood level and at a workplace level. The aims of the thesis in relation to the two main project areas were as follows:

1.10.1 The Riverway Project

The overall goal of the Riverway research was to evaluate the impact of recreational environmental modifications (The Riverway Project, Thuringowa) on the physical activity levels of neighbourhood residents. The study used the unique advantage of a real life intervention or "natural experiment." It examined the levels of physical activity amongst a group of Thuringowa residents who resided in suburbs adjacent to the Riverway development. Specifically the research aimed to investigate:

- Physical activity levels of Thuringowa residents who reside in suburbs adjacent to the proposed Riverway development before and after the Riverway development;
- The relationship between physical activity and proximity to environmental areas that are conducive of physical activity (i.e. the Riverway development);
- Thuringowa residents' perceptions of the impact of environmental modifications on physical activity in terms of aesthetics, facilities, safety, self efficacy and social connectivity; and
- Thuringowa residents'perceptions of the barriers to physical activity.

1.10.2 Thuringowa City Council Workplace Study

The workplace research had three separate components.

Study One: Qualitative Research project

The first component was a qualitative study that explored Thuringowa City Council employees' perceptions about the role of the workplace in promoting physical activity.

The specific objectives of this research were:

- To assess employees' perceptions regarding physical activity as an issue;
- To describe barriers to physical activity as perceived by employees; and
- To explore possible ways that the workplace could promote the physical activity of employees.

Study Two – Pedometer study

The aims of the pedometer study were to:

- Measure and describe self-reported occupational and leisure time physical activity levels of employees (indoor and outdoor);
- Measure and describe the occupational and leisure time physical activity levels using pedometer step counts of employees (indoor and outdoor); and
- Compare the number of steps accumulated by employees working in indoor and outdoor roles, with self-reported data on physical activity using the long version of the International Physical Activity Questionnaire (IPAQ) in terms of who achieved "sufficient" levels of physical activity.

Study Three – Evaluation of the 10,000 steps workplace challenge

The aim of the 10,000 steps workplace challenge evaluation was to:

- To measure and describe the physical activity levels of employees pre and post intervention (10,000 Steps Workplace Challenge) using pedometer step counts.

In line with the socio-ecological approach, further work was planned to be undertaken with the local Council to explore how the organisation could better encourage employee physical activity behaviours through environmental and policy supports within the workplace environment in addition to behavioural campaigns such as the 10,000 steps workplace challenge. Unfortunately this stage of the work was unable to continue due to the change to local government structures in Queensland and amalgamation of two local councils resulting in the demise of the Thuringowa City Council. Further information in relation to this is provided throughout the thesis.

1.11. Overview of thesis components

This thesis presents both components of the research undertaken, firstly the Riverway component, followed by the Thuringowa City Council Workplace Study. Each part is preceded by a literature review relevant to the area being researched. A short overview of the following chapters of this thesis is outlined below:

Chapter 2: Understanding Environmental Influences on Physical Activity

This chapter presents a literature review that describes the environmental factors that are associated with adult participation in physical activity. The literature review also describes what is known about envir onmental interventions and the impact they have on neighbourhood/population physical activity. The literature reviewed covers the time period 1994 – 2004 and was used to inform design of the Riverway project in 2004.

Chapter 3: Methodology for the Riverway study and baseline study findings

This chapter describes the baseline postal survey and observation study that was conducted prior to the commencement of the Riverway development.

Chapter 4: Evaluating an environmental modification: the impact of the Riverway construction on individual, social and physical environmental determinants of physical activity

This chapter compares data from the baseline 2004 cross-sectional survey completed before the Riverway development commenced with a follow up cross-sectional survey conducted in 2006, five months after the completion of Stage One of Riverway.

Chapter 5: The Role of Proximity in Physical Activity Participation

This chapter describes geographical information system data that was used to geocode the 2004 and 2006 survey respondents' homes to three locations (closest path along the river, the Riverway complex, the Riverway precinct) and assessed the relationship of proximity and physical activity.

Chapter 6: Understanding Workplace Influences on Physical Activity

This chapter presents a literature review describing the effectiveness of workplace physical activity initiatives on physical activity participation by workers. The literature reviewed covers the time period 1998 – 2005 and was used to design the Thuringowa City Council project in 2005.

Chapter 7: Physical activity programs in the workplace – employee perceptions

This chapter describes the findings of an exploratory descriptive study, using focus groups and interviews, conducted with Thuringowa City Council employees in March and April, 2005, to explore employees' perceptions about the role of the workplace in promoting physical activity.

Chapter 8: Findings of a pedometer study in a local government setting

This chapter describes the findings of the pedometer study that compared physical activity levels between indoor and outdoor employees in both leisure and work time, conducted at the Thuringowa City Council in August, 2006.

Chapter 9: Impact evaluation of a 10,000 steps workplace challenge in a local government setting

This chapter describes the findings of the 10,000 Steps Workplace Challenge conducted with Thuringowa City Council employees in October and November, 2006. The overall aim of the evaluation was to measure and describe the physical activity levels of employees at Thuringowa City Council pre and post intervention (i.e. 10,000 steps challenge) using pedometer step counts.

Chapter 10 – Overall Discussion, conclusions and recommendations

This chapter discusses the findings of the research in relation to other studies conducted in this area. The significance and implications of the research results is presented.

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Chapter 2. Understanding Environmental Influences on Physical Activity

2.1 Abstract

Objectives: This literature review identified existing reviews and studies that examined environmental factors associated with adult participation in physical activity and examined the impact of environmental interventions on neighbourhood/population physical activity.

Methods: A literature search for review papers published between 1995 and 2004 was conducted using electronic databases including Google Scholar, SPORT discus, Psychinfo, Medline, Pubmed and Cinahl in combination with hand searching of reference lists in identified studies and of personal journal libraries. A search of publications compiled by Active Living Research was also undertaken. In addition to these reviews, other significant studies were identified using the same databases and snowballing. The following search terms were used in combination: physical activity, physical inactivity, exercise, walking, bicycling, cycling, recreation, leisure, environment, physical environment, built environment, natural environment, neighbourhood, correlates, trails, footpaths, intervention.

Results: Twenty one papers (seven review studies and fourteen other studies) were reviewed. Overall consistent associations were identified between the following environmental variables and physical activity behaviour: existence of, access to and proximity of facilities for physical activity including walking and cycle paths; safety aspects of the physical environment; aesthetics of the environment; population density, connectivity, land use mix and overall urban/neighbourhood design features. However, many of the studies were limited by cross-sectional design, which prevented any convincing conclusions being made about causal evidence; the use of perceptual characteristics such as perceived safety, aesthetics and other neighborhood characteristics and accessibility; and self-report measures of physical activity and the lack of a sound theoretical framework.

Conclusions: Despite growing evidence that supports an association between environmental attributes and physical activity well designed prospective studies and

quasi-experimental intervention research is required to allow a clearer understanding of causal relationships. Local governments play a clear role in the development and maintenance of physical environments in which physical activity can occur.

2.2 Introduction

As discussed in Chapter One, addressing physical inactivity requires a comprehensive approach that involves multiple strategies and multiple sectors that are delivered in multiple settings (Bauman, Bellew, Vita, Brown & Owen, 2002). Traditionally, interventions to increase physical activity have been at an individual level and the challenge of achieving sustainable changes in individual behaviour is well recognised. For some time health promotion has endorsed the value of environmental and policy interventions (Sallis, Bauman & Pratt, 1998) and this view reflects two of the World Health Organisation’s Ottawa Charter for Health Promotion principles, creating supportive environments and building healthy public policy (World Health Organisation [WHO], 1986). Increasingly there is acknowledgement that interventions need to be expanded to the environments in which physical activity might occur including settings such as workplaces, schools, and neighbourhoods (McCormack, Giles-Corti, Lange, Smith, Martin & Pikora, 2004). The WHO (1998) proposes that an environment that does not support activity as part of daily life may contribute to the rises in obesity that is being seen in many parts of the world today (WHO, 1998). Creating supportive environments that are conducive to active living have the potential to influence the physical activity behaviours and health outcomes of significant numbers of people and can be more sustainable than individual approaches (Sallis & Owen, 1999; McCormack *et al.*, 2004).

Despite the growing recognition that environmental interventions to promote physical activity are useful, there is limited evidence to indicate which environmental factors are most likely to influence physical activity and what sort of environmental interventions are most likely to impact on population levels of physical activity (Humpel, Owen & Leslie, 2002). This is particularly important at a neighbourhood level where identification of the factors in the physical environment that are related to physical activity can be used to inform environmental interventions and policies. In particular, this evidence can be used by local governments who are ideally placed to contribute to the health and well-being of their communities through the provision and management of facilities and services that encourage neighbourhood level physical activity participation (New South Wales Department of Local Government, 2001). Examples of facilities that local government provide, which can potentially impact on the physical activity of community members both at a recreational level but also physical activity for a purpose, such as getting to a shop or other destination, include footpaths, walking and cycling tracks and trails, parks and other public open space, and sporting and recreational facilities.

The development of walking and bicycle paths and trails in particular, is an example of an environmental intervention that could contribute to neighbourhood level physical activity (Gordon, Zizzi & Pauline, 2004). Constructing walking paths and trails within close proximity to neighbourhood residents provides access to convenient places for physical activity (Wang, Macera, Scudder-Soucie, Schmid, Pratt & Buchner, 2004; Brownson, Housemann, Brown, Jackson-Thompson, King & Malone, 2000) and because they are permanent fixtures, they are likely to facilitate the maintenance of physically active lifestyles (Gordon et al., 2004). Although such developments have the potential to influence neighbourhood physical activity behaviour, they are at this point, not well studied (Gordon et al., 2004).

The development of new facilities and services in a community provide an opportunity for local government to evaluate how they impact on physical activity, thus contributing to the evidence base in this area. This is however, a complex area and one needs to be careful in making assumptions about cause and effect of environmental changes that a local government might make. There are other factors that can operate independently of the local government initiative that influence physical activity such as social marketing campaigns and locally based physical activity interventions and these need to be taken into account (New South Wales Department of Local Government, 2001).

Understanding the complex factors that impact on physical activity behaviour can be informed by a number of theories. Socio-ecological models of health promotion incorporate intrapersonal, interpersonal, physical environmental and socio-cultural factors that all interact to influence physical activity behaviour (Sallis & Owen, 1997; McLeroy, Bibeau, Steckler & Glanz, 1988). Socio-ecological models are based on social cognitive theory (Bandura, 1986), which explains how humans behave in relation to a reciprocal interaction between the characteristics of an individual, the behaviour (physical activity) and the broader environment in which the behaviour is performed. Understanding this interaction can provide insight into how physical activity behaviour can be modified through environmentally focused interventions.

King, Stokols, Talen, Glenn, Brassington and Killingsworth (2002) discuss additional theories which can influence physical activity at a neighbourhood level and help researchers understand the influence of factors such as heavy traffic, safety, threat of crime, poor environmental aesthetics, litter and graffiti which might decrease neighbourhood residents' inclination to be active within the neighbourhood. Studies conducted by Sallis et al., (1990); Troped, Saunders, Pate, Reininger, Ureda and Thompson, (2001); and Craig, Brownson, Cragg and Dunn, (2002), show that most people prefer to engage in activities in the local neighbourhood. Theories such as the theory of restorative environments can facilitate neighbourhood residents' inclination to be active within the neighbourhood due to factors such as the high prevalence of natural features, open spaces and other aesthetic attributes (King et al., 2002). Communities that incorporate restorative environmental features into their design are likely to encourage people to engage in recreational physical activity. This includes features such as pleasant and safe places to walk, well maintained footpaths, accessible spaces such as trails and parks and good lighting (Carnegie, Bauman, Marshall, Mohsin, Westerly-Wise & Booth, 2002).

Physical activity research is a complex area but understanding environmental attributes that influence physical activity can contribute to the overall body of knowledge in this area and can lead to sustainable environmental and policy changes. Environment can be defined in different ways and for the purposes of this literature review is defined in relation to health enhancing physical activity as *'any aspect of the physical (natural) environment or the urban or constructed (built) environment that subconsciously or consciously relates to an individual and their physical activity behaviour'* (Foster and Hillsdon, 2004).

Further to this definition, Handy, Boarnet, Ewing and Killingsworth (2002) define some other key terms in relation to the **"built environment,"** which they define as comprising "*urban design, land use, and the transportation system, and encompasses patterns of human activity within the physical environment*". **Urban design** "*refers to* *the design of the city and the physical elements within it, including both their arrangement and their appearance, and is concerned with the function and appeal of public spaces"* (Handy et al., 2002). **Land use** *"refers to the distribution of activities across space, including the location and density of different activities, where activities are grouped into relatively course categories, such as residential, commercial, office, industrial, and other activities"* (Handy *et al.*, 2002). The **transportation system** *"includes the physical infrastructure of roads, sidewalks, bike paths, railroad tracks, bridges."* (Handy et al., 2002).

The Riverway initiative introduced in Chapter One incorporates elements that are relevant to both the natural and built environment and its development creates an ideal opportunity to evaluate a local government initiated environmental modification that has the potential to influence neighbourhood physical activity. In order to inform the evaluation design of Riverway it is important to have a clear understanding of the current evidence about the aspects of the environment that are relevant to physical activity. Thus the objectives of this literature review are to:

1. Identify existing review studies that examine environmental factors associated with adult participation in physical activity;

2. Identify studies published since the reviews or not included in the reviews that examine environmental factors associated with adult participation in physical activity;

3. Identify studies that examine the impact of environmental interventions on neighbourhood/population physical activity; and

4. Provide direction for the design of the Riverway evaluation study.

2.3 Methods

2.3.1 Review Papers

A literature search for review papers published between 1995 and 2004 was conducted using computerised searches of Google Scholar, Medline, Pubmed and Cinahl in combination with hand searching of reference lists in identified studies. A search of publications compiled by Active Living Research was also undertaken. Active Living Research is a program of the Robert Wood Johnson Foundation and was established in

2001. It is administered by San Diego State University Research Foundation and supports research to identify environmental factors and policies that influence physical activity (About Active Living Research, n.d.). Further information on this organisation is available from their website - http://www.activelivingresearch.org/. The search time was limited to 2004 as this was when the research commenced.

The following search terms were used in combinations:

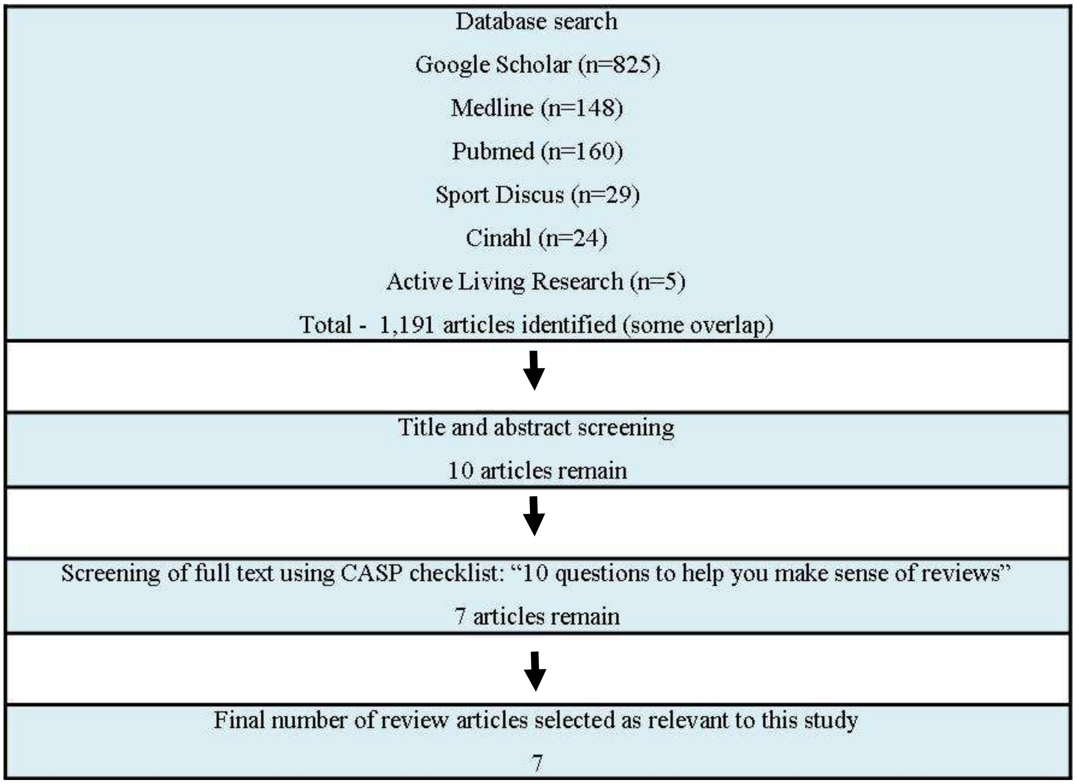
Physical activity, physical inactivity, exercise, walking, bicycling, cycling, recreation, leisure, environment, physical environment, built environment, natural environment, neighbourhood, correlates, determinants.

The inclusion criteria for the reviews included: publication between 1995 and 2004; a study population aged 18 or over; published in English; and studies that examined the relationship between any aspect of the built and natural environment and any form of physical activity including overall physical activity, walking or cycling. Reviews that reported on indoor environmental factors were excluded from this review (e.g. change facilities or stairs). Very few qualitative studies were identified and these were also excluded because they were not able to provide information on causal relationships.

All titles were independently reviewed and relevant abstracts extracted for further review. A full text of all articles assessed as being potentially relevant was obtained. A checklist identified from the Critical Appraisal Skills Programme (CASP) in the United Kingdom was used to assist in the review of each article. CASP was established in 1993 and aims to enable individuals to develop the skills to identify and make sense of research evidence, as well as assisting them to apply this knowledge into practice. The CASP checklist had “10 questions to help you make sense of reviews” and was adapted by CASP from Oxman, Cook and Guyat (1994). The checklist is included as Appendix 2.1.

Following the full text review, seven review articles were identified as being relevant. These articles were then examined in relation to their stated aims, type of review, search strategy, included studies, main findings and overall quality of the review. Each paper was appraised for its strengths and weaknesses (see Figure 2.1 for the search process for review articles included in this review).

Figure 2:1: Flow Chart Detailing Search Process for Review Articles



2.3.2 Other recent studies published since review papers or not included in reviews

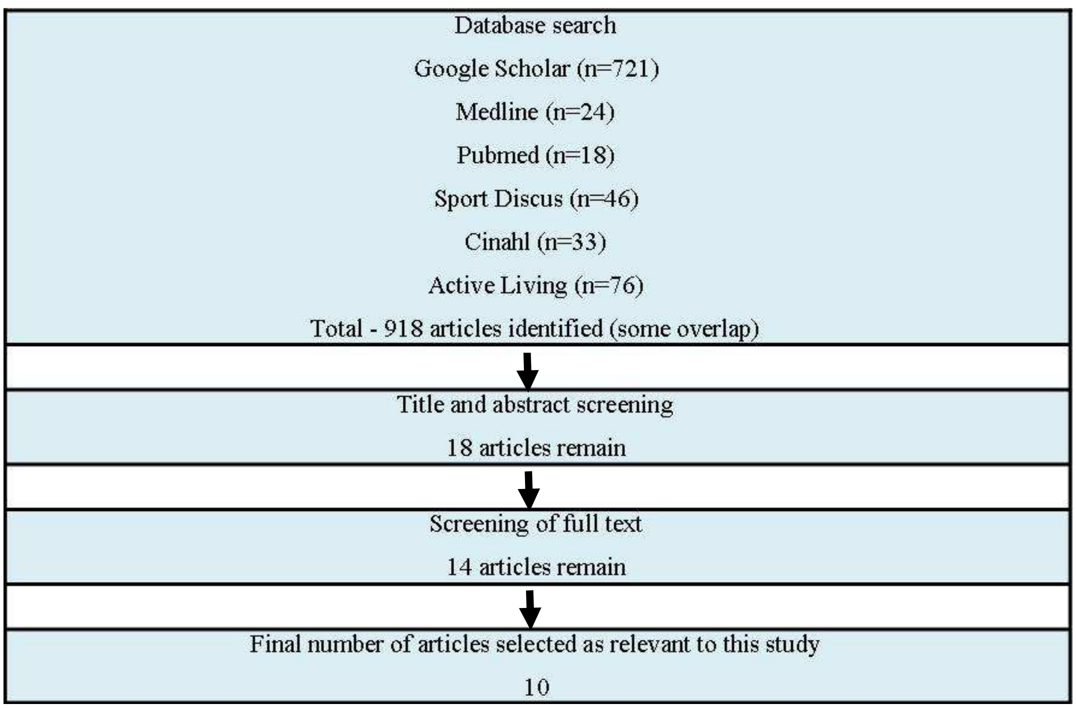
At the same time that the review articles were being searched, an additional search using the same databases and search terms was undertaken to identify other recent studies published since the review papers or not included in reviews. Hand searching of reference lists in identified studies and of personal journal libraries was also conducted as well as reviewing the publications compiled by Active Living Research.

The inclusion criteria for these papers were that they had been published since the reviews and/or were not included in the reviews – the search was limited to 2000-2004 to ensure that the most recent papers were identified; were published in the English language; and that the studies examined the relationship between any aspect of the built and natural environment and any form of physical activity including overall physical activity, walking or cycling. Four of the studies examined the association of the physical environment and physical activity related specifically to African-American women. These papers were included in the current review due to the higher proportion of Indigenous Australians that reside in neighbourhoods around the proposed Riverway area (Australian Bureau of Statistics [ABS], 2001) and it was thought that the findings might provide some insight relevant to this group. Qualitative studies were again excluded.

All titles were independently reviewed and relevant abstracts extracted for further review. A full text of all articles that were assessed as being potentially relevant was obtained.

Following a full text review of fourteen articles, four were excluded due to the weakness of the study methodology used, which left ten articles as relevant. These articles were then examined in relation to their stated aims, design, population, main findings and overall quality of the study. Each study was appraised for its strengths and weaknesses (see Figure 2.2 for the search process for the other recent studies published since review papers or not included in reviews).

Figure 2:2: Flow chart detailing search process for other studies included in this review



2.3.3 Studies that examine environmental interventions or modifications and physical activity

A literature search for papers published between 1995 and 2004 was conducted using computerised searches of Google Scholar, Medline, Pubmed and Cinahl in combination with hand searching of reference lists in identified studies. A search of publications compiled by Active Living Research was also undertaken.

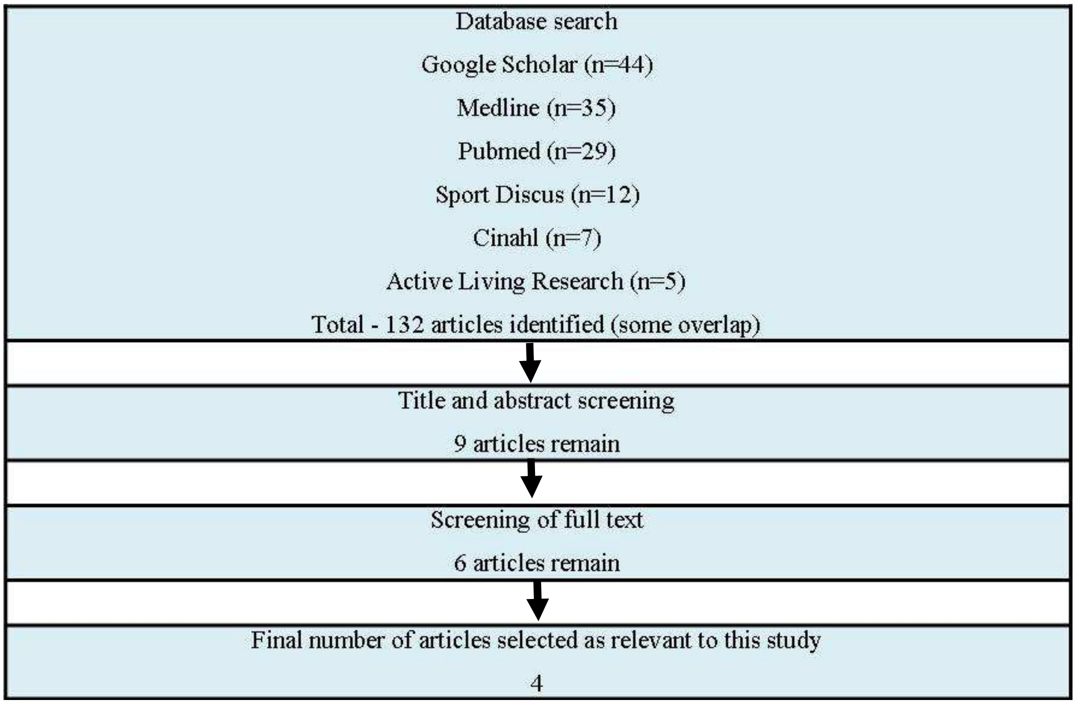
The following terms were used in combinations:

Physical activity, exercise, walking, bicycling, cycling, environment, physical environment, built environment, natural environment, trails, rail trails, footpaths, neighbourhood, intervention, modification.

The inclusion criteria for the intervention studies included: that they were published between 1995 and 2004; had a study population age of over 18; were published in English; and that the studies examined the relationship between any aspect of the built and natural environment that had been modified and any form of physical activity. Papers that reported on indoor environmental modifications were excluded from this review (e.g. modifying indoor workplace environments such as installing change facilities or stair interventions).

All titles were independently reviewed and relevant abstracts extracted for further review. Following the full text review, four articles were identified as being relevant. These articles were then examined in relation to their stated aims, type of intervention, design, population, main findings and overall quality of the study. Each study was appraised for its strengths and weaknesses (see Figure 2.3 for the search process for the other recent studies published since review papers or not included in reviews).

Figure 2:3: Flow chart detailing search process for studies that examine environmental interventions or modifications and physical activity



2.4 Results

The review of the evidence is presented in three categories. Firstly, findings from the review papers that summarise studies that explored what is known about physical environmental factors associated with adult physical activity participation are presented. Secondly, findings from other significant studies, not included in the review papers, are presented. Thirdly, what is known about interventions that use the environment to encourage physical activity is presented.

2.4.1 Review papers: Environmental factors associated with adult physical activity

Seven review articles, published between 2002 and 2004, summarising the relationship between the environment and physical activity were identified. The seven reviews examined 75 original papers published between 1991 and 2004 (see Table 2.1 for a full list of these articles).

Table 2:1: Studies included in review articles about the relationship between the physical environment and physical activity

Authors	Year	Journal	Humpel, Owen & Leslie 2002 AmJPrevMed	Trost, Owen, Bauman, Sallis, Brown 2002 Med&SciSports&Med	Saelens, Sallis, Frank 2003 AnnBehavMed	Sallis, Frank, Saelens, Kraft 2004 TranspnResPartA	Cunningham & Michael 2004 AmJHP	Owen, Humpel, Leslie, Bauman, Sallis 2004 AmJPrevMed	Lee & Moudon 2004 JPlanningLit	McCormack, Giles-Corti, Lange, Smith, Martin & Pikora 2004 JSciMedSport
Balfour & Kaplan	2002	AmJEpid					x			
Ball et al	2001	Prev Med	x				x	x	x	
Bauman et al	1999	AusNZLJPH	x	x					x	
Berrigan & Troiano	2002	AmJPrevMed					x	x	x	
Blommaert et al	1981					x				
Booth et al	2000	Prev Med	x	x			x		x	
Brown et al	1999	AustJRural Health		x						
Brownson et al	2000	AmJPrevMed		x		x		x	x	
Brownson et al	2000	AmJPH								
Brownson et al	2001	AmJPH					x			
Carnegi et al	2002	ResQExercSp						x		
Caughy et al	2001	HealthPlace					x			
CDC	1999	MorMortWklyRep	x	x					x	
CDC	1998	MorMortWklyRep							x	
Cervero	1996	TranspResA			x	x				

Authors	Year	Journal	Humpel, Owen & Leslie 2002 AmJPrevMed	Trost, Owen, Bauman, Sallis, Brown 2002 Med&SciSports&Med	Saelens, Sallis, Frank 2003 AnnBehavMed	Sallis, Frank, Saelens, Kraft 2004 TranspnResPartA	Cunningham & Michael 2004 AmJHP	Owen, Humpel, Leslie, Bauman, Sallis 2004 AmJPrevMed	Lee & Moudon 2004 JPlanningLit	McCormack, Giles-Corti, Lange, Smith, Martin & Pikora 2004 JSciMedSport
Cervero&Gorham	1995	JAmPlanning Ass			x	x				
Cervero& Kockelman	1997	TranspResD			x	x				
Cervero& Radisch	1996	Transport Policy			x	x				
Chapman & Beaudet	1981	JGerontology					x			
Corti et al	1996	HPJAust							x	
Craig et al	2002	AmJPrevMed					x	x	x	x
DeBourdeau-dhuij et al	2003	AmJHP						x		
Ewing et al	1994	TranspRes Record			x	x				
Ewing et al	2003	AmJHP						x		x
Eyler et al	1998	HealthEdu& beh							x	
Eyler et al	2003	MedSciSpEx						x		
Frank & Pivo	1994	TranspRes Record			x	x				
Friedman et al	1994	TranspRes Record			x	x				
Giles-Corti &Donovan	2002	PrevMed						x		x
Giles-Corti & Donovan	2002	SocSci Med	x			x			x	x

Authors	Year	Journal	Humpel, Owen & Leslie 2002 AmJPrevMed	Trost, Owen, Bauman, Sallis, Brown 2002 Med&SciSports&Med	Saelens, Sallis, Frank 2003 AnnBehavMed	Sallis, Frank, Saelens, Kraft 2004 TranspnResPartA	Cunningham & Michael 2004 AmJHP	Owen, Humpel, Leslie, Bauman, Sallis 2004 AmJPrevMed	Lee & Moudon 2004 JPlanningLit	McCormack, Giles-Corti, Lange, Smith, Martin & Pikora 2004 JSciMedSport
Giles-Corti &Donovan	2003	AmJPH						x		x
Greenwald & Boarnet	2001	TranspnRes Rec								x
Hahn & Craythorn	1994	HPJAust							x	
Handy	1992	Built Environment			x	x				
Handy	1996	TranspRes Record			x	x				
Handy and Clifton	2001	Transpn			x	x				x
Hanson & Schwab	1987	Environment and planning			x	x				
Hess et al	1999	TranspRes Record			x	x				
Hovell et al	1989	Prev Med	x				x	x		
Hovell et al	1992	ResQExerc Sp				x		x	x	
Humpel et al	2004	AmJPrevMed						x		
Humpel et al	2004	AmJHP						x		
Humpel et al	2004	AnnBehMed						x		
King et al	2000	Health Psychology	x	x			x		x	
King et al	2003	AmJHP						x		

Authors	Year	Journal	Humpel, Owen & Leslie 2002 AmJPrevMed	Trost, Owen, Bauman, Sallis, Brown 2002 Med&SciSports&Med	Saelens, Sallis, Frank 2003 AnnBehavMed	Sallis, Frank, Saelens, Kraft 2004 TranspnResPartA	Cunningham & Michael 2004 AmJHP	Owen, Humpel, Leslie, Bauman, Sallis 2004 AmJPrevMed	Lee & Moudon 2004 JPlanningLit	McCormack, Giles-Corti, Lange, Smith, Martin & Pikora 2004 JSciMedSport
Kitamura et al	1997	Transportation			x	X				
Klesges et al	1990	Health Psychology							x	
Kockelman	1997	TranspRes Record			x	X				
Lee et al	2000	AnnBehMed					x			
Leslie et al	1999	Prev Med	x							
MacDougall et al	1997	AustNZJPH	x	x		X				
McNally& Kulkarni	1997	TranspRes Record			x					
Newman & Kenworthy	1991	Transport Reviews			x					
Owens	1993	Landscape UrbanPlan					x			
Parsons et al	1993	Pedestrian Env (book)			x	x				
Pikora	2003	PD thesis								x
Rodriguez & Joo	2004	Transpn Res - D								x
Ross	2000	SocSc&Med		x						
Ross & Dunning	1997	Report			x	x				
Rutten et al	2001	JEpiComm Health							x	
Saelens et al	2003	AmJHP						x		x

Authors	Year	Journal	Humpel, Owen & Leslie 2002 AmJPrevMed	Trost, Owen, Bauman, Sallis, Brown 2002 Med&SciSports&Med	Saelens, Sallis, Frank 2003 AnnBehavMed	Sallis, Frank, Saelens, Kraft 2004 TranspnResPartA	Cunningham & Michael 2004 AmJHP	Owen, Humpel, Leslie, Bauman, Sallis 2004 AmJPrevMed	Lee & Moudon 2004 JPlanningLit	McCormack, Giles-Corti, Lange, Smith, Martin & Pikora 2004 JSciMedSport
Sallis et al	1989	Prev Med	x			x	x			
Sallis et al	1990	PHReport	x			x			x	
Sallis et al	1992	Prev Med	x							
Sallis et al	1992	AmJDiseases Children				x				
Sallis et al	1993	Health Psychology				x				
Sallis et al	1997	ResQExercSp	x				x	x	x	
Shaw et al	1991	JLeisureRes	x							
Stahl et al	2001	SocSciMed	x							
Sternfeld et al	1999	Prev Med	x							
Timperio et al	2004	Prev Med								
Troped et al	2001	Prev Med	x			x	x		x	x
Troped et al	2003	Prev Med								x
Turner et al	1998	report			x					
Wilcox et al	2000	JEpiComm Health	x	x			x		x	
Total no. of studies reviewed			**18**	**9**	**19**	**26**	**16**	**18**	**20**	**12**

This table has been adapted from one used by Gebel et al., (2005)

Summary of "review" findings

All of the reviews were narrative reviews. The reviews had similar findings in relation to aspects of the environment that influence physical activity and these are summarised in Table 2.2 (presented in the order of the year that the review was conducted). A brief summary of each review and a summary of the key points follows in the discussion.

The earliest review was conducted by Humpel, et al., (2002) who undertook a review that investigated environmental attributes associated with adult physical activity. Eighteen studies were included in the review. Positive associations were found in relation to: access to facilities including cycle paths, footpaths, local parks, health clubs and swimming pools; density of shop facilities; safety of footpaths; safety from neighbourhood crime; safe and friendly neighbourhoods; aesthetically pleasing areas and enjoyable scenery; and unattended dogs. Negative associations were found with busy streets; steep hills; lack of or inadequate facilities; and distance to cycle ways. A number of difficulties were experienced in this review. At times several environmental items were combined into an "overall" measure which made it impossible to determine which variable was significant. The outcome variables used in the studies reviewed used different physical activity measures. Some studies looked at aspects of the home environment which were not of interest to the current review. With the exception of one study, all the studies in this review presented cross-sectional associations of environmental features with physical activity. The authors highlight the need for prospective studies of environmental factors as predictors of physical activity change and the need for environmentally focused intervention studies to allow conclusions to be made regarding the possible causal nature of the environment-behaviour relationship.

The second review, conducted by Trost, Owen, Bauman, Sallis and Brown (2002), aimed to update the evidence relating to the personal, social and environmental factors associated with physical activity in adults. Nine of the studies had a particular environmental focus and although the strength and direction of the associations of environmental attributes with physical activity varied from study to study there was some limited evidence to suggest the following attributes as being relevant: access to and satisfaction with facilities; neighbourhood safety; enjoyable scenery/aesthetics; safe footpaths; access to a park; observing others being active. It was noted by the authors that the review was limited due to the number of studies that relied on self-report and not objective data. The studies all focused on leisure time activity and looked at multiple correlates in relation to physical activity – demographic and biological; psychological, cognitive and emotional; behavioural attributes and skills; social and cultural; not just the physical environment. All but one study was cross-sectional in design. These authors recommended the need for future longitudinal and intervention studies.

The third review, conducted by Saelens, Sallis and Frank, (2003), described the findings from transportation studies that have explored the relationship between neighbourhood environment and non-motorised transport. The focus of this review was on walking and cycling for transport. Most of the studies in this review showed an association between environmental variables (density, connectivity, land use mix and walking/cycling) and physical activity. High walkable neighbourhoods (characterised by high population density, good land use mix, high connectivity, provision of walking and cycling facilities) had higher rates of walking and cycling compared to low walkable neighbourhoods. The strengths of the associations varied but were mostly substantial. It was discussed that these factors possibly encourage walking and cycling for transportation but not for recreation.

The fourth review, conducted by Sallis, Frank, Saelens and Kraft, (2004), summarised literature on the relationship between the physical environment and leisure time physical activity that have relevance for transportation research. The authors concluded that active transport is higher in walkable neighbourhoods but only related to walking for destinations not for leisure. Positive associations were found with mixed land use, density, footpaths and lighting and active transport. The availability of recreational facilities close to home, convenient facilities, and presence and characteristics of trails were related to recreational physical activity. The authors of this review hypothesised that placing facilities within walking or cycling distance of homes could reduce driving to recreational areas.

The fifth review, conducted by Owen, Humpel, Leslie, Bauman and Sallis, (2004), aimed to identify the relationship of perceived and objectively assessed environmental attributes with the walking behaviour of adults (walking for exercise or recreation and destinations). Eighteen studies were included in the review of which 16 studies were cross-sectional and two were prospective. Thirteen studies used perceived measures and twelve had at least one objective measure. The conclusions from the review were that there are promising but limited patterns of positive findings in relation to walking and the following environmental attributes: convenience of facilities for walking (footpaths, trails); aesthetic nature of the environment; accessibility of places to walk; and level of traffic on roads. The limitation of cross-sectional designs was discussed as was the limitations of using perceived ratings of environmental attributes. The authors recommended that self-reported environmental attributes be objectively verified and that multi-level studies should be conducted that look at individual and social influences as well as environmental influences. The use of prospective study designs were recommended in order to demonstrate which environmental attributes have a causal role in physical activity behaviour. The point was also made that although the studies only accounted for a small proportion of variance in physical activity, it must be acknowledged that at a population level, these changes could be substantial.

The sixth review, conducted by Lee and Moudon (2004), investigated the environmental characteristics that support or hinder physical activity. Twenty studies that used both objective and subjective measures of independent variables were included. The physical activity outcomes included, but were not limited to, walking and biking. The review identified positive findings in relation to: access to and quality of walking paths/trails and cycleway; safe environments; pleasant aesthetic features and enjoyable scenery; mixed land use and connectivity. Lee and Moudon (2004) concluded by recommending the need for application of socio-ecological models in the research on the environment to allow a thorough understanding of the multi-level influences on physical activity behaviour.

The seventh and final review, conducted by McCormack, et al., (2004), updated the evidence on the association between the physical environment and physical activity behaviour with a focus on research published between 2000–2004. This review examined context-specific physical activity behaviour and examined the environmental attributes that influenced walking for recreation and transport; non-walking moderate and vigorous-intensity physical activity; and overall levels of physical activity. Studies in the review included those that used self-report measures or objectively measured (pedometer or accelerometer) physical activity and self-reported or objectively measured environment data (such as Geographical Information Systems [GIS], observer collected, and audit data). The review identified that vigorous intensity activity is associated with convenience and proximity of facilities, perceived attractiveness, presence of sidewalks and safety. Walking is associated with perceived access and convenience of facilities, attractiveness, safety and interest of the neighbourhood, aesthetics, and access to footpaths, access to beaches and public open spaces, path and street designs. The studies used in this review were mostly cross-sectional so lacked the ability to demonstrate causal evidence. There was also an overall lack of objectively measured data. The authors highlighted the need for prospective study designs and quasi-experimental intervention research using objective data.

Table 2:2: Summary of review articles examining the relationship between the physical environment and physical activity

Authors/Journal/year	Purpose of review	Search strategy	Years	Inclusion	No of studies included	Main findings	Comments/weaknesses
Humpel, Owen and Leslie **American Journal of Preventive Medicine** **2002**	Provide an overview of the measures that have been used to assess environmental attributes and to review environment-physical activity associations.	Searched three databases – Psychinfo, Medline, Cinahl	1989–2001	Studies that measured environment-al variables that could be related to individuals and directly to measured physical activity variables.	18 studies	Positive associations with: • Access to facilities - a cycle path, footpaths, local park, health clubs, swimming pools. • Density of shop facilities • Safe footpaths • Unattended dogs • Safety from neighbourhood crime • Safe and friendly neighbourhoods • Aesthetically pleasing area • Enjoyable scenery Negative associations with • Busy streets, steep hills , lack of or inadequate facilities, distance to cycle way	Didn't discuss limitations of the review. Promising interventions include: • Cycle ways • Local parks • Access to and provision of facilities • Safe and aesthetically pleasing neighbourhoods Recommends future prospective studies of environmental factors as predictors of physical activity change and environmentally focused intervention studies.
Trost, Owen, Bauman, Sallis & Brown **Medicine and Science in Sports and Exercise** **2002**	Review and update the evidence relating to the personal, social and environmental factors associated with physical activity in adults.	Searched four databases – Medline, Pyschlit, social science index, sports discus and did manual searches of reference lists.	1997–2000	Adults 18 and over. Dependent variable – physical activity, exercise. 1998–2000. Quantitative studies	38 studies but only nine with environmental relevance.	Limited evidence suggests: • Access to and satisfaction with facilities. • Neighbourhood safety. • Enjoyable scenery/aesthetics. • Safe footpaths • Access to a park • Observing others being active While the above factors are associated with pa, the associations are weak.	No studies reviewed used objective measures, just self-report. All studies were observational. Most studies focused on leisure time activity. Looked at multiple correlates – demographic and biological; psychological, cognitive and emotional; behavioural attributes and skills; social and cultural; physical environment; physical activity characteristics. Recommends longitudinal and intervention studies.

Authors/Journal/year	Purpose of review	Search strategy	Years	Inclusion	No of studies included	Main findings	Comments/weaknesses
Saelens, Sallis & Frank **Annals of Behavioural Medicine** **2003**	Provide a brief review of findings from transportation studies that have explored the relation between neighbourhood environment and non-motorised transport (i.e. cycling and walking)	Searched one database – TRANSPORT and did manual searches of reference lists	1991–2002	Measure-ment of walking or cycling as an outcome variable	19 studies	Most studies reviewed showed an association between environmental variables (density, connectivity, land use mix) and walking/cycling. High walkable neighbourhoods (high population density, good land use mix, high connectivity, provision of walking and cycling facilities) had higher rates of walking and cycling compared to low walkable neighbourhoods. These possibly encourage walking and cycling for transportation but not for recreation.	Only one database used – TRANSPORT. Focus is on active transport not broader physical activity – for example related to leisure or recreation. Following features are promising: • High density • Good land use mix • High connectivity • Provision of walking and cycling facilities
Sallis, Frank, Saelens & Kraft **Transportation Research Part A** **2004**	Summarise transportation and planning studies on the relationship between community design and active transport and interpret them from a health perspective. Summarise literature on the relation between the physical environment and leisure time physical activity that have relevance for transportation research.	Searched one database – TRANSPORT and did manual searches of reference lists	1991–2002	Not mentioned	26 studies	Active transport is higher in walkable neighbourhoods but only related to destinations not leisure (as described above). Mixed land use, density, footpaths and lighting were associated with active transport. Availability of recreational facilities close to home, convenient facilities, presence and characteristics of trails related to recreational physical activity. Hypothesise that placing facilities within walking or cycling distance of homes could reduce driving to recreational areas.	Same data as Saelens, Sallis and Frank (2003). Additional studies related to leisure time physical activity have been added here. Search terms not described in this paper.

Authors/Journal/year	Purpose of review	Search strategy	Years	Inclusion	No of studies included	Main findings	Comments/weaknesses
Owen, Humpel, Leslie, Bauman & Sallis **American Journal of Preventive Medicine** **2004**	Identify the relationship of perceived and objectively assessed environmental attributes with the walking behaviour of adults (walking for exercise or recreation and destinations).	Searched three data bases – Psychinfo, Cinahl, Medline.	1989–2004	Any type of walking as the main outcome variable. Independent variable included environmental attributes – measured objectively or by self-report.	18 studies	Promising but limited patterns of positive findings in relation to: • Convenience of facilities for walking (footpaths, trails) • Aesthetic nature of the environment • Accessibility of places to walk • Level of traffic on roads • Composition of environmental attributes	Review looked at walking only. 16 studies were cross-sectional. 2 studies were prospective. 13 used perceived measures. 12 had at least one objective measure.
Lee & Moudon **Journal of Planning Lieterature** **2004**	Examine environmental characteristics that support or hinder physical activity.	Searched three databases – Medline, Psychinfo, Web of Science and publication searches from government agencies.	1990-2002	Outdoor environments	20 studies	Positive findings in relation to: • Access to and quality of walking paths/trails and cycle ways • Safe environment • Pleasant aesthetic features and enjoyable scenery • Mixed land use and connectivity	This review looked at 20 studies that used both objective and subjective measures of independent variables.
McCormack, Giles-Corti, Lange, Smith, Martin & Pikora **Journal of Sciencee and Medicine in Sport** **2004**	Update the evidence on the association between the physical environment and physical activity.	Searched four databases – Medline ISI Current Contents, SPORT Discus and TRIS Online	2000-2004	Quantitative studies published since 2000. Any measure of physical activity behaviour as an outcome, correlate or predictor variable. Self-report or objectively measured environment data.	12 studies	Vigorous intensity activity is associated with convenience and proximity of facilities, perceived attractiveness, presence of sidewalks and safety. Walking is associated with perceived access and convenience of facilities, attractiveness, safety and interest of the neighbourhood, aesthetics, access to footpaths, access to beaches and public open spaces, path and street designs.	Studies are mainly cross-sectional so no causal evidence, lack of objectively measured data, need for prospective study designs and quasi-experimental intervention research.

2.4.2 Original studies examining physical environmental factors associated with adult physical activity participation published between 2003 and 2004

Table 2.3 contains a summary of the ten studies that examined the influence of environmental factors on physical activity that were published since the reviews or not included in the reviews. The studies are listed alphabetically by author surname. As with the reviews, a range of environmental factors are identified as having an influence on physical activity and the findings are presented under the main environmental areas that were identified as having an influence. These are: safety; proximity and access to destinations; and urban design and land use; and other.

Safety

Six studies (Addy, Wilson, Kirtland, Aisworth, Sharpe & Kimsey, 2004; Ainsworth, Wilcox, Thompson, Richter & Henderson, 2003; Foster, Hillsdon & Thorogood, 2004; Huston, Evenson, Bors & Gizlice, 2003; Sharpe, Granner, Hutto, & Ainsworth, 2004; Wilbur, Chandler, Dancy & Lee, 2003) reported on aspects of safety in the environment that were related to physical activity. These were safety of the neighbourhood, street lighting, traffic, and access and maintenance of sidewalks and footpaths. All but Foster et al., (2004) used the Behavioral Risk Factor Surveillance System (BRFSS), to measure physical activity as the outcome variable. Addy et al., (2004) and Huston et al. (2003) found that better lighting in the neighbourhood was associated with increased physical activity. Sharpe et al., (2004) reported that well maintained sidewalks were associated with being sufficiently active. The existence of foot paths or sidewalks was also reported by Addy et al., (2004) and Ainsworth et al., (2003), although they reported it in relation to having access to paths rather than the safety aspects of the footpath or sidewalk. Foster et al., (2004) found that women who reported feeling safe in their neighbourhood during the day were more likely to walk compared to women who did not feel safe. Women in the Wilbur et al., (2003) study were also more likely to be sufficiently active if they reported feeling safe in their neighbourhood. Busy traffic was reported by Ainsworth et al., (2003) as being a significant aspect of the environment that deterred physical activity.

Access and proximity to destinations

Six studies reported that proximity and access to destinations in the neighbourhood had a positive influence on physical activity (Cervero & Duncan, 2003; Foster et al., 2004;

Addy et al., 2004; Huston et al., 2003; Powell, Martin & Chowdhury, 2003; Sharpe et al., 2004). Destinations included those that were used for leisure and those that were used for utilitarian purposes. A number of studies showed that access to areas such as parks, playgrounds, sporting fields and walking/cycling paths or trails were associated with increased physical activity. Foster et al., (2004) found that walking increased in men who had access to a park and Huston et al. (2003), Powell et al., (2003) and Sharpe et al., (2004) found that access to trails and other areas for walking and jogging increased physical activity. Addy et al., (2004) showed that access to leisure destinations such as parks, playgrounds and sporting fields positively influenced physical activity and also found that access to schools and worship facilities impacted positively on physical activity. Cervero and Duncan (2003) and Foster et al., (2004) reported that access to destinations such as shops was associated with increased walking. A number of studies looked at actual distance. Addy et al., (2004) found that defining the neighbourhood as a 0.5 miles (800 m) radius was a stronger predictor for physical activity than a broader community variable that was set at a 10 mile, (16 km) radius. Cervero and Duncan (2003) compared participants in relation to a one mile (1.6 km) and five mile (8 km) radius of origins and destinations and found that the likelihood of walking eroded steadily with the length of the trip and that having retail and service activities within a one mile (1.6 km) radius encouraged participant cycling. Although Powell et al., (2003) didn't specify distance they did examine what impact there was on walking in relation to the time that it took to get to a place suitable for walking. They found that participants who reported having access to a place to walk in less than 10 minutes from their origin were significantly more likely to meet the recommended levels of physical activity. The most commonly reported places for walking were neighbourhood streets, footpaths and public paths (Powell et al., (2003).

Urban design and land use

Cervero and Duncan (2003) found that urban design and land-use diversity factors influenced bicycling and walking. Land-use diversity in and around a person's neighbourhood (for example having neighbourhood retail facilities) was the strongest predictor on walking whereas bicycling was equally influenced by density, diversity and design especially at the person's origin (i.e. residence) of a trip. Their study found that the built environment had a stronger influence on walking and bicycling in relation to where the person lived more than where they intended to go to (i.e. the destination).

Despite this finding however, the built environment factors that they examined had a weaker influence on walking and bicycling compared to the influence of other variables such as topography, darkness, rainfall and demographics. Presence and quality of footpaths, sidewalks, trails and public paths were found to influence physical activity (Cervero and Duncan, 2003; Ainsworth et al., 2003; Addy et al., 2004; Huston et al., 2003; Sharpe et al., 2004). The existance of parks and having places in the neighbourhood for walking and jogging also had a positive impact (Cervero and Duncan, 2003; Powell et al., 2003; Addy et al., 2004; Sharpe et al., 2004).

Other

Although not directly related to the physical environment it is worth noting that a number of studies identifed the impact of the social environment and self-efficacy on physical activity. A perception of having active neighbours increased the likelihood of participants being physically active (Addy et al., 2004; Ainsworth et al., 2003; Sanderson, et al., 2003) and if participants knew people who exercised, they were more likley to be physically active themselves (Wilbur et al., 2003; Sanderson et al., 2003;; and Rohm Young and Voorhees, 2003). Participants who had social pressures and expectaions were less likley to be physically active (Rohm Young and Voorhees, 2003; Ainsworth et al., 2003) while Ainsworth et al., (2003) found that participants with greater self efficacy were more likley to be sufficiently active.

Table 2:3: Summary of original articles examining the relationship between the physical environment and Physical activity

Author/Year/Journal	Research objective	Design	Study Population	Outcome measures	Results	Comments
Addy, Wilson, Kirtland, Ainsworth, Sharpe, Kimsey **American Journal of Public Health** **2004**	To evaluate perceived social and environmental supports for physical activity and walking.	Cross-sectional telephone survey	1,194 adults over 18 years. Rural south eastern USA county	Dependent variable - physical activity measured by BRFSS. Neighbourhood defined as 0.5 mile radius, community defined as a 10 mile radius. 13 items addressed perceived supports and barriers of physical activity in the neighbourhood and 13 related to the same supports and barriers in the community. Neighbourhood supports were sidewalks, public recreation facilities, street lighting, pleasant neighbourhood for walking and physically active neighbours and barriers included traffic volume, unattended dogs, crime, perception of neighbours being untrustworthy. Community supports were walking/cycle trails, swimming pools, recreation facilities, parks, playgrounds, sports fields, schools, malls, places of worship and waterways and barriers included crime and safety concerns associated with recreation facilities.	Perceptions of social and physical environment supports were positively associated with physical activity and walking behaviour, especially at a neighbourhood level. Better street lighting, trust of neighbours, use of private recreation facilities, parks, playgrounds, sports fields, schools, worship facilities, were associated with physical activity. Availability of sidewalks and using a mall for walking were associated with increased walking.	Cross-sectional so no causal inferences can be made. Only self-report measures of perceptions, physical activity and walking were used. Neighbourhood variables (0.5 mile radius) were a stronger predictor for physical activity and walking than community variable (10 mile radius).
Ainsworth, Wilcox, Thompson , Richter & Henderson **Am Journal of Preventive Medicine** **2003**	To assess the relationship of personal, social, cultural, environmental and policy variables with physical activity among women in ethnic minority groups.	Cross-sectional telephone survey	917 African-American women living in two counties in South Carolina, USA	*** Dependent variable - physical activity measured by BRFSS Physical environment variables included traffic, sidewalks, street lighting, unattended dogs, safety from crime, places within walking distance, places to exercise.	34.1% were sufficiently active, 49.4% were insufficiently active and 16.5% were inactive. The presence of sidwalks was realted to meeting recommended levels of physical activity. Seeing people exercising in the neighbourhood, being more self-confident in ability to exercise, having better health and higher educational attainment were all associated with being more physically active.	Cross-sectional so no causal inferences can be made. Only self-report measures of perceptions and physical activity were used. Women only in the sample. Participants were solely African-American so not necessarily representative of all people in South Carolina.

Author/Year/Journal	Research objective	Design	Study Population	Outcome measures	Results	Comments
Cervero & Duncan **American Journal of Public Health** **2003**	To examine the influence of urban design, land-use diversity and density patterns on the choice to walk or bicycle.	Cross-sectional Telephone survey	Adults in San Francisco Bay area, USA 15,066 households. Used the 2000 Bay Area Travel Survey (BATS)	Dependent variable - self-report walking and bicycling Subjective measures of street connectivity, land use mix, pedestrian/bike friendly design, employment, accessibility,– measured around trip origin and trip destination. For each recorded trip a 1 mile and a 5 mile radii of origin and destinations was used using GIS data.	Land use diversity in and around a person's neighbourhood was the strongest predictor of walking. Bicycling was influenced by diversity and design especially at the origin. The built environment exerts a bigger impact on walking and bicycling in and around a person's residential neighbourhood than do destinations. Topography and weather had stronger associations.	Didn't examine other aspects of the environment such as landscaping, aesthetics, etc. Evidence of the influence of built environment attributes such as street connectivity, mixed land use and proximity to shops in associated with active transport but is more "suggestive" than "compelling". Did use GIS to measure distances.
Foster, Hillsdon & Thorogood **Journal of Epidemiology and Community Health.** **2004**	To examine the relationship between adults' perceptions of the social and physical environment and their self-reported walking behaviour.	Cross-sectional. Face to face interviews at home.	England Population-based sample of 4,265 adults aged 16–74 years.	Dependent variable – frequency, duration, intensity and type of physical activity performed in past 4 weeks. Walking included any occaision of walking for at least 15 mins. Perceptions of physical environment covered attractiveness of local area for walking, access to shops, leisure centres, parks, cycle paths, and traffic density	In women, perceived safety of walking during the day and no shop within walking distance were associated with reported walking occaisions. Perceptions of environment were not associated with walking ≥150 mins/week. In men, having a park within walking distance was associated with walking ≥150 mins/week.	Cross-sectional so no causal inferences can be made. Self-selection bias of participants. Self-reported measures of walking and physical activity.
Huston, Evenson, Bors & Gizlice, **American Journal Of Health Promotion** **2003**	To examine associations between perceived neighborhood characteristics, access to places for activity, and leisure-time physical activity.	Cross-sectional telephone survey.	Cabarrus, Henderson, Pitt, Robeson, Surry, and Wake counties in North Carolina, USA. Subjects. Population-based sample of 1796 adults at least 18 years of age residing in the six counties.	Dependent variable - physical activity measured by BRFSS Perceptions of neighborhood characteristics (sidewalks, trails, heavy traffic, streetlights, unattended dogs, and safety from crime) and general access to places for physical activity.	Trails, streetlights, and access to places were positively associated with engaging in any leisure activity. Trails and access to places were positively associated with engaging in the recommended amount of Leisure activity. In multivariable logistic regression modeling including environmental factors and demographics, access to places was associated with any activity, and trails were associated with recommended activity. Certain neighborhood characteristics, particularly trails, and access to places for physical activity may be associated with leisure activity levels.	Cross-sectional so no causal inferences can be made Self-report measures. Only assessed leisure activity. Can't generalise to all populations.

Author/Year/Journal	Research objective	Design	Study Population	Outcome measures	Results	Comments
					In this study, perceived neighborhood environmental factors and access to places for physical activity were strongly associated with race, education, and income.	
Powell, Martin & Chowdhury **American Journal of Public Health** **2003**	To examine whether adult Georgians were (1) aware of safe and convenient places for walking, (2) what places they most commonly envisioned, and (3) whether the proximity of those places was associated with self-reported physical activity behaviours.	Cross-sectional telephone survey.	4532 adults in Georgia, USA	Dependent variable - physical activity measured by BRFSS Categorised as meeting recommendations or activity or not. Added questions about safe and convenient places to walk and proximity.	People reporting a place to walk in less than 10 minutes were significantly more likely to meet recommended levels of physical activity. There was a direct relation between the convenience of the walking place and ability to meet recommended levels of physical activity. The most commonly reported safe and convenient places for walking were neighbourhood streets, footpaths and public paths.	Cross-sectional so no causal inferences can be made Self-report measures. .
Rohm Young, & Voorhees **American Journal of Preventive Medicine** **2003**	To determine associations among personal, social environmental, and physical environmental factors with physical activity level in urban African-American women.	Cross-sectional face to face interviews	234 African-American women living in Baltimore, USA.	*** Dependent variable - physical activity measured by BRFSS Physical environment variables included traffic, sidewalks, street lighting, unattended dogs, safety from crime, places within walking distance, places to exercise. Women were divided into three groups: meeting current recommendations for moderate or vigorous physical activity, insufficiently active, and inactive. Comparisons were made between the group of women that met recommendations versus women who did not, and women who reported any activity versus women who were inactive.	21% were sufficiently active, 61% were insufficiently active and 18% were inactive. Women who had a partner or who had no children were less likely to engage in some physical activity. Inactive women were more likely than women who participated in some physical activity to know people who exercised. Women who belonged to community groups were more likely to be inactive. Women with fewer social roles were more likely to meet current recommendations. Physical environment factors were not associated with physical activity level.	Cross-sectional so no causal inferences can be made. Only self-report measures of perceptions and physical activity were used. Women only in the sample. Participants were solely African-American so not necessarily representative of all people in Baltimore.

Author/Year/Journal	Research objective	Design	Study Population	Outcome measures	Results	Comments
Sanderson, Foushee, Bittner, Cornell, Stalker, Shelton, Pulley. **American Journal of Preventive Medicine** **2003**	To explore personal, social, and physical environmental factors associated with activity to help plan interventions	Cross-sectional telepone surveys	567 African-American women residing in three rural counties in the USA.	*** Dependent variable - physical activity measured by BRFSS Physical environment variables included traffic, sidewalks, street lighting, unattended dogs, safety from crime, places within walking distance, places to exercise. Women were divided into three groups: meeting current recommendations for moderate or vigorous physical activity, insufficiently active, and inactive. Comparisons were made between the group of women that met recommendations versus women who did not, and women who reported any activity versus women who were inactive.	39% were sufficiently active, 46% were insufficiently active and 15% were inactive. In the adjusted model, the social environmental factors associated with women meeting the recommendations (versus inactive) were attending religious services and seeing people exercise in the neighborhood. Attending religious services, knowing people who exercise, and a higher social issue score were associated with women who reported any activity (versus inactive). No physical environmental factors were associated with the more active groups.	Cross-sectional so no causal inferences can be made. Only self-report measures of perceptions and physical activity were used. Women only in the sample. Participants were solely African-American so not necessarily representative of all African-American women.
Sharpe, Granner, Hutto, &Ainsworth. **American Journal of Health Promotion.** **2004**	To examine associations between environment and policy factors and physical activity	Cross-sectional telephone survey.	Two South Carolina Counties in the USA 1,936 adults	Dependent variable - physical activity measured by BRFSS Self-report items assessed knowledge, presence and use of recreational facilities, presence of environmental and worksite supports, perceived safety, condition of sidewalks and quality of street lighting.	More likely to be sufficiently active if there were well maintained sidewalks, access to safe areas for jogging/walking, near where safe areas for walking/jogging were, if they often used the tracks, trails and pathways.	Cross-sectional so no causal inferences can be made. Only self-report measures of perceptions, physical activity and walking were used.

Author/Year/Journal	Research objective	Design	Study Population	Outcome measures	Results	Comments
Wilbur, Chandler, Dancy & Lee. **American Journal of Preventive Medicine** **2003**	To identify personal, social environmental and physical environmental correlates of physical activity of urban dwelling, Midwestern, African-American women and to obtain their recommendations for increasing exercise in their communities.	Cross-sectional face to face interviews	399 African-American women aged 20–50 years living in Chicago.	*** Dependent variable - physical activity measured by BRFSS Physical environment variables included traffic, sidewalks, street lighting, unattended dogs, safety from crime, places within walking distance, places to exercise. Women were divided into three groups: meeting current recommendations for moderate or vigorous physical activity, insufficiently active, and inactive. Comparisons were made between the group of women that met recommendations versus women who did not, and women who reported any activity versus women who were inactive.	42% were sufficiently active, 48% were insufficiently active and 9% were inactive. Women who viewed the neighbourhood as safe and women who knew people who exercised were more likely to be sufficiently active.	Cross-sectional so no causal inferences can be made. Only self-report measures of perceptions and physical activity were used. Women only in the sample. Participants were solely African-American so not necessarily representative of all people in Chicago

*** All four studies that had African-Americans as subjects used the same survey questions.

2.4.3 Summary of the findings of other studies that examined modified environments that use the environment to encourage physical activity

Very few studies examined the use of environmental modifications and most of these were not relevant to this review (e.g. modifying infrastructure at work or stair interventions). Table 2.4 contains a summary of the four studies that assessed the effect of environmental change on physical activity behaviour. Each study investigated the use of existing walking/cycling trails but did not evaluate the before and after impact of an environmental modification. They did however provide information about bikeway and trail use that was of interest in relation to the Riverway study and are thus included in this review. Due to the lack of studies in this area and the difficulties of drawing conclusions, each study is described separately rather than looking for commonalities across all studies.

Brownson et al., (2000) conducted a cross-sectional study that aimed to assess the physical activity patterns and correlates of walking in the community, the availability of places to walk and perform other physical activities, and to describe attitudes towards the trails and their uses that may serve as barriers or enablers. This study was done in the context of the development of walking trails in Missouri, United States of America within the last 6 months to five years. Trails existed in 31 communities and the majority were located in residential park areas within city limits. The trails varied in length from 0.13 miles (200 m) to 2.38 miles (3.8 km) (mean 0.68 miles, approximately 1 km). The study assessed walking behaviour in the past month, access to and use of trails and whether exercise behaviour had changed due to walking trail use. Aspects of trails that were most liked were also assessed. Results showed that 38.8% of people who had access to the trails reported using them. Women, persons with more education and higher income earners were more likely to use trails. Although there was a 55.2% self-reported increase in the amount of walking among trail users since using the trail, the results were limited by the study design. Only self-report measures were used and the cross-sectional design means that no causal relationships can be inferred. There was also no baseline assessment of physical activity prior to trail development and the questions used were retrospective. Some trails had been in existence for five years so this left the responses very open to recall bias. However despite these limitations there is some suggestion that construction of walking trails may be a viable intervention strategy to increase physical activity.

Troped et al., (2001) conducted a study that aimed to examine the associations between self-reported and objective physical environmental variables and use of the Minuteman Bikeway (Arlington, USA). The Minuteman Bikeway is a 10.5 mile (16.8 km) long asphalt-paved rail-trail. Rail-trails are multi-use paths constructed on abandoned railway beds and can be used for recreational and transportation-related physical activity. Global Information System [GIS] data was used to geocode survey respondents' homes and distance to the bikeway, a steep hill barrier and a busy street barrier. Results showed that increases in self-reported and GIS distance were associated with decreased bike use. Absence of self-reported busy street and GIS steep hill barriers were also associated with bikeway use. The findings from this study do suggest that proximity is important with respondents being two-thirds more likely to use the bikeway for every self-reported 400 m increase. As with the previous study the cross-sectional design of the study limits the ability to define causal relationships. The use of GIS data to support the self-reported distance from the trail data is a strength of this study.

Merom, Bauman, Vita and Close (2003) conducted a study to evaluate the impact of a local campaign promoting a newly constructed rail trail cycleway that was completed in December 2000 by the New South Wales [NSW] Road Traffic Authority in Australia. The 3 month promotional campaign targeted residents living within 5 km of the trail. The campaign aimed to increase awareness of the trail and promote the recreational and health benefits of using it. Promotional materials included local media advertisements, trail maps, local radio promotion, onsite promotion at railway stations, and brochures distributed to workplaces, high schools, motor registries and railway stations. The study used a pre and post intervention study design using telephone surveys. The pre-campaign survey was conducted before the commencement of the promotional campaign (November/December 2000) and the follow up survey was conducted three months later (March 2001). Objective measures of daily bike counts were also used. Results were compared for people living 1.5 km from trail (inner residents) and 1.5–5 km from the trail (outer). Awareness of the trail increased post-campaign (3-fold for inner residents and 2-fold for outer residents). Post-campaign awareness of the trail was still low –34%. Trail usage was higher amongst bike owners than those without a bike (8.9% *vs* 3.3%) and proximity to the trail influenced usage – 20.5% of inner-area bike owners used the trail compared to 3.8% of outer bike owners. Pre/post-walking was the same for inner and outer residents. Immediately post-campaign daily bike counts increased significantly and at follow up inner cyclists increased mean cycling by 0.19 hours. Trail use was significantly higher at weekends. The authors concluded that the campaign had a significant influence on cyclists living up to 1.5 km from the trail but not for others, including pedestrians. This study was strengthened by its pre- and post-experimental design and population based sampling.

Gordon, et al., (2004) undertook a study to evaluate the physical activity patterns and trail use among new and habitually active exercisers. A cross-sectional design was used and on-site interceptor-based interview surveys were conducted over a four week period. The trail comprised 12 miles (19.2 km) of level and paved surfaces that ran parallel to adjacent water sheds, businesses and neighbourhoods. The construction of the trail was completed in 2001. Results showed that 22.5% of trail users were new exercisers and 77.5% habitual exercisers. Habitual exercisers reported significantly greater frequency of physical activity compared to new exercisers. New exercisers reported that trail use was their only form of exercise whereas habitual exercisers also did other exercise. Ninety eight percent of new exercisers said that exercise amounts had increased since using the trail, however only 52% of habitual exercisers reported an increase. Approximately 25% of trail users became regular exercisers as a result of the trail development. New exercisers travelled shorter distances to access the trail suggesting that residential proximity played a role. The authors concluded that convenient, safe and proximal community walking trails could provide an incentive for community residents to engage in regular physical activity. However the absence of baseline physical activity data prior to trail development, reliance on retrospective questions and the sole use of self-report data, limit the findings. The interviews were conducted with actual trail users and as a result the findings may represent a biased view of the impact of the trail on the whole community.

Table 2:4: Summary of original articles examining the impact of environmental interventions or modifications on physical activity

Author/Year/Journal	Research objective	Design	Study Population	Intervention	Outcome measures	Results	Comments
Brownson, Housemann, Brown, Jackson-Thompson, King, Malone & Sallis 2000 American Journal of Preventive Medicine	To assess physical activity patterns and correlates of walking in the community, to assess availability of places to walk and perform other physical activities and to describe attitudes towards the trails and their uses that may serve as barriers or enablers. This study was done in the context of the development of walking trails in Missouri.	Cross- sectional design Self-report phone surveys. 17 communities surveyed and 8 were chosen specifically because they had a walking trail in the local area. N=1269.	Adults aged >18 years in 12 rural communities in Missouri (USA).	Trails exist in 31 communities. Majority located in residential park areas within city limits. Trails vary in length from 0.13 miles to 2.38 miles (mean – 0.68 miles). Trails had been in existence from 6 months to 5 years.	Walking behaviour in past month. Access to trails Use of trails Whether exercise behaviour had changed due to walking trail use. Aspects of trails most liked.	38.8% of people having access to trails reported using them. Women, persons with more education and higher income earners are more likely to have used trails. Among trail users 55.2% reported an increase in amount of walking since using the trail.	Not really an intervention study but existence of trails considered as an intervention. Self-report measures only. Cross-sectional data so causal relationships cannot be inferred. No baseline assessment of physical activity prior to trail development – retrospective questions asked. Some trails had been in existence for 5 years so very open to recall bias. Construction of walking trails may be a viable intervention strategy.
Troped, Saunders, Pate, Reininger, Ureda & Thompson 2001 Preventive Medicine	To examine associations between self-reported and objective physical environmental variables and use of the Minuteman Bikeway (Arlington, USA)	Cross-sectional design Self-report mail surveys. N=413	Adults residing in Arlington, Massachusetts .	Minuteman Bikeway is a 10.5 mile long asphalt-paved rail-trail (rail-trails are multiuse paths constructed on abandoned railway beds and can be used for recreational and transportation-related physical activity.	GIS data used to geocode survey respondents homes and distance to bikeway; steep hill barrier, busy street barrier. Participation in physical activity Perceptions of neighbourhood. Self-reported distance to bikeway, presence of hill and busy road. Use or non-use of bikeway was the primary physical activity measure (dependent variable).	Increases in self-reported and GIS distance associated with decreased bike use. Absence of self-reported busy street and GIS steep hill barriers associated with Bikeway use.	Not really an intervention study but existence of trails considered as an intervention. Findings suggest that proximity is important – respondents were two-thirds as likely to use the bikeway for every self-reported 400m increase. Cross-sectional data so causal relationships cannot be inferred. Strength that GIS used to support self-report data.

Author/Year/Journal	Research objective	Design	Study Population	Intervention	Outcome measures	Results	Comments
Merom, Bauman, Vita and Close 2003 Preventive Medicine	To evaluate the impact of a local promotional campaign around a newly constructed rail trail	Cohort study Pre and post intervention using telephone surveys N=450 Objective measures of daily bike counts Evaluation over a 3 month period	Adults 18–55 in Western Sydney	A 16.5 km rail Trail cycleway was completed in December 2000 by the NSW Road Traffic Authority. A 3 month promotional campaign was conducted targeting residents living within 5km of the trail. The campaign aimed to increase awareness of the trail and promote the recreational and health benefits of using it. Promotional materials included local media ads, trail maps, local radio promotion, onsite promotion at railway stations, brochures distributed to workplaces, high schools, motor registries and railway stations.	Campaign reach. Awareness changes. Trail usage for walking and cycling – self-reported. Total time spent walking or cycling (for recreation, transport or exercise in the previous week) Results were compared for people living 1.5km from trail (inner residents) and 1.5-5km from the trail (outer). Objective measures of cycle traffic on trail (bike counters)	Increase of 2.9% in unprompted awareness of trail (p<0.01). Awareness of trail increased post campaign (3-fold for inner residents and 2 fold for outer residents). Post campaign awareness was still low – only 34%. Trail usage was higher amongst bike owners than those without a bike (8.9%vs3.3%) and proximity to the trail influenced usage – 20.5% of inner-area bike owners used the trail compared to 3.8% of outer bike owners. Pre/post walking was the same for inner and outer residents. Immediately post-campaign daily bike counts increased significantly. At follow up inner cyclists increased mean cycling by 0.19 hours. Weekends significantly increased trail use.	The campaign had a significant influence on cyclists living up to 1.5km from the trail but not for others including pedestrians. Methodological strengths of this study were the cohort design and objective measures of trail usage and the population based sampling. Weakness is that the sample might not be representative of actual/potential users (people over 55 years were excluded). Increase in cyclists may not mean new behaviour in the cyclist – they might have changed to this as an alternative route that is more convenient or safer.

Author/Year/Journal	Research objective	Design	Study Population	Intervention	Outcome measures	Results	Comments
Gordon, Zizzi & Pauline 2004 Preventing Chronic Disease	To evaluate physical activity patterns and trail use among new and habitually active exercisers.	Cross-sectional design N= 414 On-site interceptor-based interview survey over a four week period.	Adults using two new rail trails within the City of Morgantown USA.	Trail comprises 12 miles of level and paved surface that run parallel to adjacent water sheds, businesses and neighbourhoods. Construction of trails completed in 2001.	Frequency and duration of activity. Distance travelled on trail Point of access for each type of activity. Method and distance travelled to get to trail. Actual access distance measured using an odometer wheel. No sign difference between self-report and actual distance travelled so actual distance travelled is reported in the study. Retrospective question about exercise before they started using the trail.	22.5% of trail users were new exercisers and 77.5% habitual exerciser. Habitual exercisers reported sign more frequency of physical activity compared to new exercisers. New exercisers reported that trail use was only form of exercise where habitual exercisers also did other exercise. 98% of new exercisers said that exercise amounts had increased since using the trail. Only 52% of habitual exercisers reported an increase. Approx 25% of trail users became regular exercisers as a result of the trail development. New exercisers travelled shorter distances to access the trail suggesting residential proximity as playing a role. Convenient, safe and proximal community walking trails could provide an incentive for community residents to engage in regular physical activity.	Limited by cross-sectional design. No baseline assessment of physical activity prior to trail development – retrospective questions asked. Self-report data Not a true reflection of the impact of the trail on the whole community. Conclusions – trails show promise in promoting active lifestyles – provide access for community residents. Proximal and safe access from the residential area to the trail is likely to be important and safety on the trail is important.

2.5 Discussion

This review was undertaken to provide direction for the design of the Riverway evaluation study by identify existing review studies as well as other studies published since the reviews or not included in the reviews, that examine the environmental factors that are associated with adult participation in physical activity. This review also identified studies that examined the impact of environmental modifications on neighbourhood/population physical activity.

As introduced in Chapter One, part of the focus of the research in this thesis is on the role of local governments in promoting physical activity at a community neighbourhood level. Given the role that local government has in enhancing the health and well being of the community by modifying the physical environment and providing facilities and infrastructure that provide opportunities for physical activity, it is important to identify the elements in the environment that could be modified to support physical activity and the evidence that supports such actions.

Although the literature examining the influence of the physical environment on physical activity was still at an early stage (Ball, Bauman, Leslie & Owen, 2001) at the time that this literature review was conducted, there was some evidence emerging in relation to what factors in the physical environment are likely to influence health enhancing physical activity. The seven review papers that were identified, examined 75 original source papers published between 1991 and 2004 although interestingly there was not a lot of overlap in the studies examined. This could be due to the diversity of countries that the authors were from, the types of databases that they accessed and the overall purpose of the review (i.e. some looked at overall physical activity as an outcome whereas other looked at leisure time physical activity, walking or active transport). The strength of this however, is a wide range of papers identified similar aspects of the physical environment that impact on a range of physical activity behaviours and that can be used to inform environmental and policy interventions in the future as well as future research in the area.

The review and additional papers identified consistent associations between a number of environmental variables, particularly at a neighbourhood level, that influence physical activity behaviour, all of which have relevance to local governments.

These environmental variables can be grouped under the following headings:

1. Existence of, access to and proximity of facilities for physical activity including walking and cycle paths
2. Safety aspects of the physical environment
3. Aesthetics of the environment
4. Population density, connectivity, land use mix and overall urban/neighbourhood design features.

All the review studies found that having access to and provision of facilities for physical activity were associated with higher levels of physical activity (either in terms of achieving sufficient levels of overall physical activity, increased leisure time physical activity or increased walking (Humpel et al., 2002; Trost et al., 2002; Saelens et al., 2003; Sallis et al., 2004; Owen et al., 2004; Lee and Moudon, 2004; McCormack et al., 2004). These findings were also supported by Huston et al., (2003); Powell et al., (2003) and Sharpe et al., (2004). The studies conducted by Brownson et al., (2000); Troped et al., (2001); Merom et al., (2003); and Gordon et al., (2004) also showed that using trails increases physical activity behaviour. Given that local government play a key role in the development and maintenance of such facilities (NSW Department of Local Government, 2001), these findings provide support for such developments within local neighbourhoods. Promoting the availability of such facilities also shows promise in increasing usage (Merom et al., 2003).

The importance of having recreational facilities within close proximity of peoples' homes was supported by five studies. The reviews conducted by Sallis et al., (2004) and McCormack et al., (2004) concluded that having the availability of recreational facilities close to home was related to recreational physical activity although no mention of distance was made. McCormack et al., (2004) also found that proximity and distance to destinations such as shops were positively associated with walking for transport near home. Powell et al., (2003) reported that people who had somewhere to walk that was less than 10 minutes from their home were more likely to meet the recommended levels of physical activity. Troped et al., (2001) found that self-reported distance was inversely related to the use of the bikeway, with survey participants being 0.65 times less likely to use the bikeway for every 0.25 mile (400 m) further from the bikeway. Increases in both self-report and GIS measured distance was associated with decreased bike use. Merom et al., (2003) found that proximity to a trail influenced bike usage. They divided their respondents into two groups (inner residents lived 1.5 km or less from the trail and outer residents lived 1.5–5 km from the trail). Twenty point five percent of inner-area bike owners used the trail compared to 3.8% of outer-area bike owners and mean cycling hours increased after the campaign that promoted the trail. Research by Handy et al., (2002) suggests that walking is more likely if trips are less than one mile (1.6 km). These findings offer further support for local government to develop facilities within a reasonable walking distance of residents' homes. Although the exact recommended distance remains unclear it appears that having facilities within 1.5 km increases physical activity.

It is important for local governments to provide a safe community environment to enhance physical activity (Humpel et al., 2002; Trost et al., 2002; McCormack et al., 2004; Sallis et al., 2004; Lee and Moudon, 2004), including street lighting (Addy et al., 2004; Ainsworth et al., 2003; Foster et al., 2004; Huston et al., 2003; Sharpe et al., 2004; and Wilbur et al., 2004) and provision of good quality footpaths and sidewalks (Addy et al., 2004; Ainsworth et al., 2003 and Sharpe et al., 2004). This also includes a role in animal control as unattended dogs in the neighbourhood have been shown to be a barrier for physical activity (King, Castro, Wilcox, Eyler, Sallis & Brownson, 2000).

While the research highlights the importance of provision of accessible and safe places for physical activity within close proximity to residents' home, there is also evidence that the aesthetics of an area influences physical activity behaviour. Humpel et al., (2002), Trost et al., (2002), Lee and Moudon, (2004), Owen et al., (2004), and McCormack et al., (2004) all describe the impact of neighbourhood environmental aesthetics which have an impact on physical activity participation including attributes such as presence of trees, and having a variety of views and enjoyable scenery around the home and local area, as well as in the area where exercise is carried out (McCormack et al., 2004). Local governments have a key opportunity to influence physical activity by providing and maintaining aesthetically pleasing physical environments through landscaping and gardening services.

Population density, connectivity, land use mix and overall urban/neighbourhood design are also important aspects of the physical environment that influence physical activity particularly in relation to making neighbourhoods more walkable (Saelens et al., 2003; Sallis et al., 2004; Lee and Moudon, 2004: Cervero & Duncan, 2003). While local government contributes to some aspects of these areas there is a wider responsibility across other sectors in making neighbourhoods more conducive for active living.

The studies identified in this review highlight that physical activity is a complex behaviour and that it is not enough to consider the impact of the physical environment in isolation from other individual and social influences which clearly also have an impact. This review identified that observing others being physically active in the neighbourhood can influence the likelihood of people engaging in physical activity themselves (Trost et al., 2002; Ainsworth et al., 2003; Sanderson et al., 2003). Social support was an important element in motivating people to be active (Giles-Corti & Donovan, 2002; Leslie, Owen, Salmon, Bauman, Sallis & Lo, 1999; Sallis & Owen, 1999; Stahl, et al., 2001) as were individual factors such as self-efficacy – i.e. individuals confidence to be physically active on a regular basis (Booth, Owen, Bauman, Clavisi & Leslie, 2000; Trost et al., 2002). Two of the studies that examined aspects of the environment in relation to African American women showed that there were no physical environment factors associated with physical activity (Sanderson et al., 2003; Rohm Young & Voorhees, 2003) suggesting that for some groups other individual and social constraints are more relevant.

The literature included in this review highlight a number of methodological issues that should be considered by those undertaking further research in the area of the physical environment and physical activity. Most of the studies that examined environmental influences on physical activity use cross-sectional designs which prevented any convincing conclusions being made about causal evidence (Humpel et al., 2002; McCormack et al., 2004; Owen et al., 2004). Many studies used perceptual characteristics such as perceived safety, aesthetics and other neighborhood characteristics, and accessibility, and self-report measures of physical activity. This reliance on self-report data is a significant limitation and there is a need for more objective measures of both physical activity and environmental variables (Humpel et al., 2002; Lee and Moudon, 2004; McCormack et al., 2004; Owen et al., 2004). Many of the studies also lack a sound theoretical framework and the importance of theory in guiding research and hypothesis development as well as helping interpret results was highlighted (Owen et al., 2004). The review articles reported that significant variations in methodology existed making comparisons between results difficult.

While most studies controlled for confounding factors such as age, sex, education and income there seemed to be a lack of comprehensive reporting on their relationship to physical activity. Of particular interest and relevance to the Riverway study is the impact of income and education as a confounding factor given the lower socio-economic status of the five suburbs that are in the study area (to be described in Chapter Three) (Australian Bureau of Statistics, 2001). The relationship between physical activity and education was highlighted in Table 1.1 in Chapter 1.

As with most reviews, this current review was limited in its ability to identify all relevant published literature related to this topic which could lead to publication bias. However the review identified consistency with regard to the environmental factors that influence physical activity and methodological limitations of previous studies.

2.6 Conclusion

Although this review showed that there was growing evidence regarding the environmental attributes that can support physical activity, the need to move beyond the description of cross-sectional associations was clear. In particular there was limited published evidence to support the effectiveness of environmental interventions on influencing physical activity. The findings outlined above in relation to overall access and proximity to facilities for physical activity support the development of such facilities as promising environmental interventions to enhance physical activity participation. This includes availability and access to walking and cycle paths and trails, footpaths/sidewalks, parks, other public open space, and facilities such as health clubs and swimming pools, for leisure related physical activity.

Local governments play an important role in the development and maintenance of community physical environments and thereby have an exceptional opportunity to incorporate facilitators of physical activity when planning new developments. Given the paucity of evidence to support such interventions there was clearly a need for well designed prospective studies and quasi-experimental intervention research to allow a clearer understanding of causal relationships (Humpel et al., 2002; McCormack et al., 2004; Owen et al., 2004).

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Chapter 3. Methodology for the Riverway Study and Baseline Study Findings

3.1 Abstract

Objective: Understanding socio-environmental correlates of physical activity is important for future planning of health promotion actions to address physical inactivity however there are limited studies that specifically focus on populations living in a tropical environment. There are also limited well designed studies that have been conducted to evaluate the impact of environmentally focused interventions on physical activity. This chapter describes the overall methodology that was used for the evaluation of the Riverway study and specifically, for the baseline study. Results from the baseline study are presented.

Methods: The Riverway study uses a quasi-experimental design with a pre- and post-intervention group (participants who reside within 1.5 km of the Riverway development) and an independent concurrent comparison group (participants who reside beyond 1.5 km of the Riverway development). This design allows the Riverway development to be evaluated by measuring factors attained from a baseline survey conducted before the Riverway Project commenced and after completion. For the baseline study a cross- sectional study was conducted using a mailed questionnaire for both the intervention and the comparison areas. The questionnaire assessed self-report measures of physical activity, barriers, perception of the physical and social environment, self efficacy and social support. It was administered to 1,930 neighbourhood residents (response rate 22%) in November/December 2004. An observation study was also conducted.

Results: At baseline, almost 67% (95% confidence interval = [62.3, 71.3]) of respondents were sufficiently active for health. Respondents who were sufficiently active for health were more likely to score high on the self-efficacy ($p<0.001$) and on the social support ($p=0.002$) scores. Respondents who were sufficiently active for health were more likely to be self-motivated ($p=0.010$), could be active even when tired ($p<0.001$), have family support to be active ($p=0.003$), and perceive their neighbourhood as safe for walking ($p=0.031$). Despite the current existence of paths along the river and the fact that 50.6% of survey respondents report current use of the

paths, the observation study showed little usage of the paths both in the mornings and late afternoons, particularly for recreational purposes.

Conclusion: The findings from the baseline study show that socio-environmental correlates of adult physical activity participation in the study area are no different to those experienced in other locations and social variables were more strongly associated with physical activity behaviour than physical environmental variables.

3.2 Introduction

As described in Chapter Two there is growing evidence regarding environmental attributes that support physical activity particularly at a neighbourhood level. The seven reviews in Chapter Two provided support for the following environmental features: the existence of, access to and proximity of facilities for physical activity including walking and cycle paths, parks and other public open space (Humpel, Owen & Leslie, 2002; Trost, Owen, Bauman, Sallis & Brown, 2002; Saelens, Sallis & Frank, 2003; Sallis, Frank, Saelens & Kraft, 2004; Owen, Humpel, Leslie, Bauman & Sallis, 2004; Lee & Moudon, 2004; McCormack, Giles-Corti, Lange, Smith, Martin & Pikora, 2004); safety aspects of the physical environment (Humpel et al., 2002; Trost et al., 2002; Owen et al., 2002, Lee & Moudon, 2004; McCormack et al., 2004); aesthetics of the environment (Humpel et al., 2002; Trost et al., 2002; Owen et al., 2002, Lee & Moudon, 2004; Sallis et al., 2004: McCormack et al., 2004); and population density, connectivity, land use mix and overall urban/neighbourhood design features (Saelens et al., 2003; Lee & Moudon, 2004; Sallis et al., 2004).

Despite these environmental features showing promise in regards to their influence on physical activity, the findings must be viewed with caution due to the mostly cross-sectional design of the studies, which do not allow for causal associations to be defined. The authors of the reviews emphasised the need for well designed prospective studies and quasi-experimental intervention research to allow a clearer understanding of causal relationships (Humpel et al., 2002; McCormack et al., 2004; Owen et al., 2004). A quasi-experimental design is a variation of the classical experimental design (Neuman, 2000). While true experimental designs are the gold standard (Thomas and Nelson, 1990), not all research can be conducted using this design and the application of quasi-experimental designs helps researchers test for causal associations in a variety of situations where true experimental design is difficult or inappropriate (Neuman, 2000). A "natural experiment" such as Riverway where the physical environment is being modified is ideally suited for research applying a quasi-experimental approach. Quasi-experimental studies do not fulfil all of the internal validity requirements that true experimental designs have, however, in environmental research, such as the Riverway study, it is not possible to randomly assign participants to a control group that has no exposure to the intervention. It is possible, however, to design the study using a comparison group which, as Bryman (2004) discusses, still allows for compelling results because of strong ecological validity.

Prior to the development of the Riverway study, the literature was examined to try and identify whether any studies had been conducted that evaluated an environmental modification similar to Riverway. No studies were identified that were the same as Riverway, however, two prospective evaluation studies were identified that were conducted to assess different interventions on trail usage and physical activity. The study conducted in Australia by Merom, Bauman, Vita & Close (2003) used a quasi-experimental non-control pre- and post-design and examined the impact of a campaign that promoted a newly constructed 16.5 km rail trail. Results from this study showed no increase in self-reported mean walking or cycling time, however, counts of trail use collected at the trail did indicate a significant increase in cycling (Merom et al., 2003). The study by Brownson, et al., (2000) used a quasi-experimental, pre- and post-design, with a comparison group and examined the impact of multifaceted interventions on trail use and walking behaviour in a rural area of the United States of America (Missouri). That study showed an increase in trail use but no difference in walking. As described in Chapter Two, other cross-sectional studies have been conducted that look at the influence of existing rail trails/bikeways/trails on physical activity: the findings from these studies support that if such facilities exist, they will be used and will influence how many people are physically active, particularly at a neighbourhood level (Brownson, et al., 2000; Troped, Saunders, Pate, Reininger, Ureda & Thompson, 2001; Gordon, Zizzi & Pauline, 2004).

While the studies above provide information about bikeway and trail use that is of interest in relation to the Riverway study, they also highlight that further evaluation of such initiatives continues to be needed and are important. As discussed in Chapter One, the Riverway study provides a "natural experiment" and is an ideal research opportunity to evaluate a multi-level local government environmental modification, using a quasi experimental design. The Riverway study is different to the studies conducted by Merom et al., (2003) and Brownson et al., (2000) in that it solely evaluates the impact of a modified environment on physical activity without using any health promotion or other interventions that promote its use. The findings from the Riverway study have the potential to contribute to the body of knowledge regarding causal relationships between the physical environment and physical activity behaviour and can be used as evidence to support and advocate for the development of local government community initiatives.

This Chapter describes the overall methodology for the evaluation of the Riverway study and presents the findings of the baseline study that was conducted as the first part of the evaluation in the study. The baseline study consisted of a postal survey and an observation study and the methodology for these two components is described. The evaluation of the Riverway project relates to "Innovation Testing", "Intervention Demonstration", and "Intervention Dissemination" components from Nutbeam's "Stages of Research and Evaluation Model" (Nutbeam, 1998), where the intervention (Riverway) is evaluated to assess the impact on neighbourhood physical activity behaviour and to assess aspects of intervention that influence this.

The baseline postal survey and observation study was conducted in November and December, 2004 to assess:

- Current self-reported physical activity levels of Thuringowa residents who reside in suburbs adjacent to the proposed Riverway development.
- The individual, social and environmental factors that correlated with whether or not people were sufficiently active for health
- Thuringowa residents' perceptions of the impact of environmental modifications on physical activity in terms of aesthetics, facilities, safety and social connectivity.
- Thuringowa residents' perceptions of the barriers to physical activity
- The current amount and type of usage of the existing Riverway pathways before the environmental changes were made.

3.3 Methodology

3.3.1 Overall Riverway Study Design

In considering the design for the Riverway study two questions identified by Nutbeam (1998) were deemed relevant:

- Can change be observed in the object of interest; and
- Can the observed change be attributable to the intervention (i.e. in this case the Riverway development)?

There were a number of methodological issues in relation to these questions that needed to be considered when designing the pre- and post- evaluation of the Riverway project including overall design, sample size and selection, data collection methods, response rates and analysis. The difficulty in establishing a clear temporal relationship between an intervention and an outcome is a relevant issue and while the most rigorous designs are randomised controlled trials it is not always possible to evaluate a health promotion intervention using such a design. Riverway is a locally based environmental modification or a "natural experiment" and it is impossible to randomise participants into intervention and control groups. In this situation the most rigorous design that can be used is a quasi-experimental design. The main difference between an experimental design and a quasi-experimental design is that a quasi-experimental design lacks the element of randomisation that is a core part of randomised controlled trials (Gribbons & Herman, 1997). In an intervention such as Riverway, random assignment of subjects is not possible or practical so it makes a quasi-experimental design the most appropriate and rigorous design possible.

In the Riverway study the quasi-experimental design used a pre- and post-intervention group and an independent comparison group. The term "comparison" is chosen rather than "control" because the comparison group was formed through a non-random process. In addition, the comparison group was chosen somewhat arbitrarily – as living further away from the Riverway than the intervention group. In selecting this design, it was acknowledged that definitive causal inferences could not be made due to the absence of random assignment of participants which resulted in a loss of internal validity (Thomas and Nelson, 1990); Bryman, 2004). The study was also open to outside influences that could impact on the results such as exposure of study participants to media campaigns promoting physical activity or other community based physical activity interventions. However, it was the most appropriate and rigorous design available given the situation.

3.3.2 Sample population and study area for the Riverway study

The participants in the Riverway study were residents from five suburbs in Thuringowa which is located in tropical north Queensland (19°13'S). At the time of the study there were two separate local government areas in Townsville – Townsville City Council and Thuringowa City Council. The five suburbs in the study were part of the Thuringowa City Council (which later merged in 2008 with the Townsville City Council forming a regional city of approximately 190,000 people). Townsville has a dry tropical climate with distinct wet and dry seasons. In November/December, when the baseline surveys were distributed, average mean minimum temperatures were 22.9°C and the average mean maximum temperatures were 30.8°C, with average humidity levels of 63% at 9.00 a.m. and 58% at 3.00 p.m. (Bureau of Meterology, 2004). Adults over the age of 18 years were invited to participate in the study and, due to the quasi-experimental design being used, were located in five suburbs that are within close proximity to the proposed Riverway modification area. The participants in the intervention group resided within 1.5 km of the proposed Stage One Riverway development, which on completion would stretch for 5 km along the banks of the Ross River. Geographical Information System maps from the Thuringowa City Council were used to select participants and generate addresses (see Appendix 3.1). The 1.5 km radius was chosen on the assumption that a typical walking gait in a healthy adult is approximately 6 km per hour. This means that it would take approximately 15 minutes to walk 1.5 km which is seen as a reasonable time and distance to get to a destination (Allan, 2001). Studies conducted by Merom *et al.,* (2003), Troped *et al.,* (2001), and Gordon *et al.,* (2004) also highlight the importance of distance. Participants in the comparison group lived in adjoining neighbourhoods but reside more than 1.5 km from the proposed 5 km Riverway intervention area.

Sample Size

Previous studies showed that the impact of environmental changes might be quite small. Thus it was initially considered that the study would show a difference of 10% in physical activity levels between the intervention and control group. Group sample sizes of 395 and 395 would achieve 80% power to detect a difference of 0.10, in being sufficiently active for health, between the null hypothesis that both group proportions are 0.55 and the alternative hypothesis that the proportion in group 2 is 0.65 (significance level of 0.05). This is based on the national physical activity data that shows approximately 56% of the population are sufficiently active for health (Bauman, Ford and Armstrong, 2001). The sample size was inflated (to 1200 and 900) as an attempt to counteract low response rates previously reported for postal surveys (Armstrong, White & Saracci, 1995). Non-response is important as it presents potential biases that could threaten the validity of survey results and limit the ability to generalise the findings (Kristal, et al., 1993). Assuming only a 20% response rate (240 versus 180 participants) the power would only be in excess of 80% for comparing 0.55 with 0.69, for detecting a 14% difference (significance level 0.05).

3.3.3 Data collection methods for baseline study

Two methods of data collection were used for the baseline study – a cross-sectional postal survey and an observation study.

Baseline postal survey

Initially 2,100 surveys were posted (1,200 to residents in the intervention area and 900 to residents in the comparison area). One hundred and seventy were returned due to addresses being unoccupied leaving 1,930 distributed surveys. It was requested that respondents must be an adult of 18 years or over. As an incentive to return the survey, respondents were offered the opportunity to go into a random draw to win gift vouchers at a sports store. Two mail-outs were completed two weeks apart.

Baseline postal survey instrument

The postal survey instrument was developed with support from members of a project team which was established at the commencement of the study. The team included representatives from the Tropical Public Health Unit in Townsville, The Thuringowa City Council, James Cook University and Central Queensland University. Where possible, questions from previous surveys were incorporated. Active Australia questions were used to assess physical activity participation (Australian Institute of Health and Welfare [AIHW], 2003) and questions from a survey used in the

Rockhampton 10,000 Steps Program (Duncan & Mummery, 2005). These were selected due to the potential to compare results in the future as Townsville and Rockhampton are both large coastal, regional centres in Queensland. The survey questionnaire is attached as Appendix 3.2.

The self-reported data collected, and the management of the data are presented below:

- ***Physical activity participation*** Questions 1–21) - self reported activity undertaken during the previous week was assessed using The Active Australia Physical Activity Questionnaire (AIHW, 2003). This instrument asks respondents to recall the amount of time spent in activity for purposes of recreational walking, walking for transport reasons, and moderate to vigorous activity for periods of at least 10 minutes during the last seven days. Respondents were asked to report the duration in hours and minutes and the frequency of recreational and transport related walking, gardening, vigorous activity and moderate intensity activity. Participation in “sufficient activity” was defined as a total of 150 minutes of activity per week in any combination of the above activities excluding gardening and is derived from the National Physical Activity Guidelines (AIHW, 2003). The Active Australia questions were chosen as they have demonstrated moderate to very good test/retest reliabilities (Bull, Milligan, Rosenberg & MacGowan, 2000). In a reliability study that was conducted on the final version of the questionnaire, all items were found to have excellent reliability with intraclass correlation coefficients from 0.71 to 0.86 and Spearman’s Rho from 0.54 to 0.77 (Bull et al., 2000).
- ***Beliefs about physical activity and health*** (Question 22) - self reported opinions regarding physical activity and health were assessed using The Active Australia Physical Activity Questionnaire (AIHW, 2003). For each statement there were five categories ranging from strongly agree to strongly disagree. These five categories were then grouped into two: one for those who agree or strongly agree and one for those who disagree or strongly disagree or have no opinion.
- ***Intent to be active*** (Question 23) – self reported intention of physical activity in the future was asked using The Active Australia Physical Activity Questionnaire (AIHW, 2003).

- ***Barriers to physical activity*** (Questions 24–25) – respondents were asked to assess the degree to which certain barriers impacted on their participation in physical activity. The barrier items were derived from those used in other studies and related to personal, family and environmental barriers (Salmon, Owen, Crawford, Bauman & Sallis, 2003; Booth, Bauman, Owen & Gore, 1997). A five point scale was used with the categories coded 1-5, with 1 = never, 2 = rarely, 3 = sometimes, 4 = often, 5 = very often. These five categories were then grouped into two: one for those who say that the item is never, or rarely an issue and one for those who say that the item is sometimes, often or very often an issue. This was done to reduce the possibility of misclassification and for ease of statistical analysis and interpretation of results. Results were examined to look at the overall percentage of people experiencing the barriers as well as looking at the differences in perceived barriers between Riverway and non-Riverway users. The relationship between people who were and were not sufficiently active, and perceived barriers was also examined.
- ***Riverway questions*** (Questions 26–29) – respondents were asked whether or not they currently used the existing paths along the Ross River. If they did, they were asked to state the purpose/s of that use and how they had reached the paths.
- ***Impact of Riverway development on own and others physical activity*** (Questions 30–31) – respondents' opinion on what impact the Riverway development would have on their own and on neighbourhood residents' physical activity levels was asked using a five point scale with categories coded 1-5, with 1 = no increase, 2 = slight increase, 3 = moderate increase, 4 = significant increase, 5 = very significant increase. These five categories were then grouped into three – one for those who said that there would be a significant to very significant increase on the physical activity levels; one for those who said it would have a moderate increase; and one for those who had said that it would have a slight or no increase on the physical activity levels.
- ***Self efficacy*** (Questions 32–37) – six items were used to assess self-efficacy. A five point scale was used with categories coded 1-5, with 1 = not at all confident, 2 = slightly confident, 3 = somewhat confident, 4 = confident, 5 = very confident. Items were summed to form a single item for self efficacy and dichotomised into high and low self efficacy using a mean split as described by

Duncan and Mummery (2005). The relationship between people who were and were not sufficiently active and levels of self efficacy was also examined. *Perceived physical environment and safety* (Questions 38–52) –15 items from the Rockhampton 10,000 Steps Program were used to assess perceived physical environment and safety (Duncan & Mummery, 2005). A five point Likert scale was used and coded from 1 to 5, with 1 = strongly disagree, 2 = disagree, 3 = unsure, 4 = agree, 5 = strongly agree. The five categories were then grouped into two: one for those who strongly agree or agree with the statement and one for those who are unsure, disagree, or strongly disagree with the statement. Results were statistically examined to assess difference in perceived physical environment and safety between Riverway and non-Riverway users. The relationship between people who were and were not sufficiently active and perception of the physical environment and safety was also examined.

- ***Social environment*** (Questions 53–56) – four items were used to assess the perceived social environment in terms of the impact that family, friends and colleagues had on physical activity. A five point scale was used coded from 1 to 5, with 1 = never disagree, 2 = rarely, 3 = sometimes, 4 = often, 5 = very often. Items were summed to form a single item for perceived social environment and dichotomised into high and low levels of social support using a mean split as described by Duncan and Mummery (2005). The relationship between people who were and were not sufficiently active and perceived level of social support was also examined.

- ***Perception of neighbourhood physical activity levels*** (Question 57) – respondents were asked to rate their perception of neighbourhood physical activity using a four point scale coded 1-4, with 1 = very physically active, 2 = somewhat physically active, 3 = not very physically active, 4 = not at all physically active.

- ***Demographics*** (Questions 58–73 and Question 83) – the postal survey used standard Australian population survey items including age, gender, income, educational achievement, place of birth, time in Australia and the tropics, occupational status and family status.

- ***Dog ownership*** (Questions 74–75) – respondents were asked whether or not they had a dog and, if so, did it get walked regularly (defined as least 30 minutes five or more times a week).

- ***Health related questions*** (Questions 76–82) – respondents were asked whether or not they had any chronic or long-term health problems and, if so, what they were. They were also asked questions about current and past smoking behaviour, weight and height. If they answered 'yes' to smoking they were then asked how many cigarettes were smoked per day. If they answered yes to smoking in the past, they were asked how long ago they quit. Body mass index was calculated for each respondent (defined as the individual's body weight divided by the square of his or her height).

Statistical analysis for baseline survey

Categorical variables were described as percentages. Depending on the distribution, numerical data was summarised using mean and standard deviation (SD) or median and inter-quartile range (IQR). Standard bivariate statistical tests such as t-tests for approximately normally distributed data, Chi-square tests for categorical data, and non-parametric Wilcoxon tests for numerical data not normally distributed, were utilized to compare respondents who were sufficiently active for health with respondents who were not. Responses to the 20 barrier questions, to the 6 perceived self-efficacy questions, to the 15 physical environment and safety questions, and to the 4 social support questions were added up to create four new numerical scores. Multivariable logistic regression analyses were used to identify independent correlates for being "sufficiently active for health": (1) one model used the added up scores of barriers, perceived self efficacy, physical environment and safety, and social support treating these issues conceptually; (2) the second model treated all items of barriers, perceived self-efficacy, physical environment and safety, and social support as independent factors. Backward and forward stepwise procedures were used to identify the two multivariable models. All remaining demographic and health related characteristics were considered as potential confounders. The models were adjusted for potential confounding if the estimate had changed by more than 5%. All possible two-way interactions were considered. Results of multivariate logistic regression analyses were presented as prevalence odds-ratios and 95%-confidence intervals (95%-CI).

Statistical analysis was conducted using SPSS, release 12 for Windows and STATA, release 8. A significance level of 0.05 was assumed throughout the analysis.

Observation study

Direct observation of three sites along the Riverway area was undertaken to record the amount and types of use of the Riverway areas (refer to Appendix 3.1 for the site locations). Each site was approximately 2.5 km apart. Each site had different environmental modifications carried out as part of the Riverway development project.

Site One: Western end of Pioneer Park

Site One was adjacent to a proposed swimming lagoon, cultural centre and a new River Walk, all part of the Riverway development. Before modifications began a pathway ran along the river and led to an open parkland area at the eastern end. The path was quite narrow and in some degree of disrepair with rough edges and cracks in the surface (Figure 3.1 and 3.2). There was no landscaping along this section. As part of the Riverway project, the existing pathway was to be upgraded and landscaping done to beautify the area.

Figure 3:1: Photo of western end of Pioneer Park close to observation Site One.

Figure 3:2: Photo of western end of Pioneer Park close to observation Site One.

Site Two: Loam Island

Observation Site Two was located in the Loam Island area itself, not on the path along the river as in the other two sites. Loam Island consists of large public open space areas that extend from the pathway to the river edge. Despite being called an island it is attached to the mainland. No major modifications were planned for this site but it was close to a proposed multi-use community facility designated to become the headquarters for local scouts, guides, water-ski and rowing clubs and it was anticipated that this might impact on usage of the park areas near the Loam Island car park. No work was being done around the actual car park areas although work had commenced on building the club house at the western end of Loam Island at the time of observation. No traffic relevant to the construction site passed through the observation area. Loam Island is the site where the Booroona Walking Tail commences. This is a dirt walking track that extends along the river from Loam Island to Apex Park. The observer could easily view all people who entered the adjacent park areas on either side of the car park. The paths along the river above the Loam Island area were to be upgraded as part of the Riverway project and it was thought that this might increase the number of people using both the paths and the Loam Island park areas (Figures 3.3, 3.4 and 3.5).

Figure 3:3: Current path along the river above the road that leads down to Loam Island.

Figure 3:4: Road into Loam Island

Figure 3:5: Starting of walking trail, Loam Island end

Site Three: Apex Park

Site Three was the pathway that was immediately above Apex Park. This site was chosen as it was at the western end of the proposed 5 km Riverway development and the path had to be used to gain access to Apex Park. The existing path in this area was narrow and in a similar condition to the path in the Pioneer Park area with rough edges, some cracks and no landscaping along the pathway (Figures 3.6, 3.7, and 3.8). This site was to be upgraded as part of the Riverway project.

Figure 3:6: Path heading west near Apex Park

Figure 3:7: Existing path along the river leading to the Apex Park area

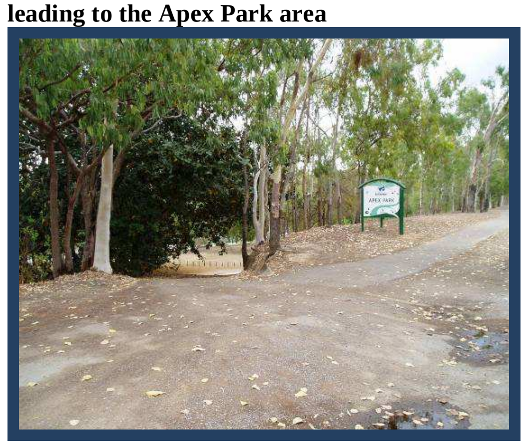

Figure 3:8: Path between Western end of Pioneer Park and Loam Island

As established from Australian Bureau of Statistics [ABS] data, all study sites were adjacent to neighbourhoods that had similar socio-demographic characteristics and geographical features (ABS, 2001). All sites required residents to cross a busy major road to enable access to the Riverway paths. All had similar vegetation and tree cover and views of the river. A map of the overall study area is included as Appendix 3.1.

Observation times

Observation was undertaken twice a day from 0600-0730, and 1630-1800 on a Tuesday, Thursday and Sunday over a two-week period from November 9 to 21, 2004. The observation periods were chosen as they were considered to be times when people were more likely to use the Riverway area for recreational purposes due to cooler temperatures and daylight hours.

Observers and observation data collected

Over the two week period four observers carried out the data collection: two university students, a research assistant and myself. The observers were required to sit at a specified point that allowed maximum visibility of the Riverway area of interest. Each observer had an observation data sheet on which to record all people using the Riverway area. The information recorded was:

- Observation site
- Day and time period
- Weather conditions
- Time that person was observed using the Riverway area
- Gender of person
- Estimated age of user using pre-specified categories (0-4, 5-12, 13-19, 20-39, 40-59 and 60+ years)
- Type of activity being undertaken using pre-specified categories (walking, jogging, cycling, or other)
- Whether activity was alone or in the company of another person/s (adult or child)
- Whether activity was with a dog either on or off a leash.

The data recording form is included as Appendix 3.3.

Prior to data collection all observers attended a training session during which the observation procedure and recording forms were explained. Each observer received an observation pack, which included data recording sheets and a map showing where they were to be located. All observers had the contact phone number of the project coordinator should any problems arise during the observation periods.

3.3.4 Ethical considerations

Participation in the Riverway study was completely voluntary and informed consent was implied on completion of the survey. Ethics approval was gained from the James Cook University Human Ethics Subcommittee – Number H1911 (Appendix 3.4) and following National Health & Medical Research Council guidelines, the data will be stored securely for at least five years.

3.4 Results

3.4.1 Survey

Participants and demographics:

A total of 420 residents responded to the questionnaire: 236 respondents (56.2%) were in the intervention group and 184 (43.8%) in the comparison group. The overall response rate to the survey was 22% (21% in the intervention group and 23% in the comparison group) as a proportion of the surveys mailed out.

The majority (73.0%) of respondents were female and their mean age was 44 years (SD ±13.6; range 18 to 83). About 3.4% of respondents were of Indigenous descent. The majority of respondents (87%) were born in Australia and had lived a median time of 23.5 years (IQR = [10.0, 38.0]) in the tropics.

Health and health related factors:

Of the respondents, 32.7% reported having a chronic or long-term health problem. The problems reported were: diabetes (5%), heart disease (2.9%), high blood pressure (10.1%), a stroke (0.5%), thrombosis (0.5%), arthritis (10.1%), emphysema (0.7%), osteoporosis (2.9%), breast cancer (1.2%), colon cancer (0.2%), skin cancer (2.2 %), some other form of cancer (1.0%), depression (6.7%), an anxiety or nervous disorder (3.6%), and other (11.1%). Nearly half (49.3%) stated that their health limited their physical activity (from "a little" to "all the time"). Eighteen per cent were current smokers with the median number of cigarettes smoked per day being 20. The mean BMI of participants was 27.1 kg/m^2 (SD ± 5.6) which is above the normal range of 18.5 to 24.9 kg/m^2. The BMI of respondents who were sufficiently active (mean BMI = 27.0, SD = ± 5.8) was not significantly different to those who were not sufficiently active (mean BMI = 27.5, SD = ± 5.3; P = 0.492).

Physical activity:

The median minutes of physical activity achieved by the participants during the week previous to undertaking the survey was 270 minutes (IQR = (90, 600), range = 0 – 4800). A total of 10.7% (95%-CI = [7.7, 13.7]) of respondents were completely inactive (physical activity of zero) during the previous week, while 66.8% (95%-CI = [62.3, 71.3]) of the respondents were sufficiently active for health. The median physical activity time of respondents not sufficiently active for health was 50 minutes (IQR = [0, 90]) and the median physical activity time of respondents sufficiently active was 400 minutes (IQR = [263, 780]). Of respondents who were not sufficiently active for health 57.6% said their health limited their physical activity compared to 45.0% of people who were sufficiently active (p=0.003).

The demographic, health related factors and self-reported physical activity levels are presented in Table 3.1 and are stratified between respondents who were sufficiently active for health and those who were not sufficiently active for health. Median minutes spent in walking, in moderate physical activity, and in vigorous physical activity is also presented. There were no statistically significant differences between respondents who were sufficiently active for health and those who were not with respect to demographic characteristics (Table 3.1).

Table 3:1: Demographic and health related factors in the strata of sufficiently active and not sufficiently active for health. Results were based on data collected from 419 residents# of Townsville, North Queensland, Australia in 2004.

	Sufficiently active (n=280)	Not sufficiently active (n=139)	p value
Demographic factors			
Mean age (SD)* [years]	43.7 (13.5)	43.9 (13.8)	0.873
% Female	71.0%	76.8%	0.206
% Born in Australia	84.9%	90.6%	0.110
Median time lived in the tropics (IQR)** [years]	23 (13,36)	24 (9, 40.25)	0.644
% Indigenous Australian	3.2%	2.2%	0.758##
% Finished year 12 at school	54.7%	47.8%	0.178###
% With trade qualification	58.8%	54.7%	0.427
% Currently employed	69.2%	68.1%	0.826
Median number of dependent children (IQR)	1 (0,2)	1 (0, 2)	0.087
% Living with child	56.4%	63.5%	0.168
% Dog owner	64.3%	64.5%	0.967
Health related factors			
% People with chronic health problems	30.3%	37.0%	0.174
% People whose health limits physical activity (from “a little” to “all the time”)	45.0%	57.6%	0.003
Smoking status % Current smokers % Ex-smokers Median number of cigarettes smoked per day (IQR), range	 16.8% 29.9% 0 [0, 0], 0 - 50	 21.2% 27.9% 0 [0, 0], 0 - 40	 0.276 0.677 0.238
Mean body mass index (SD) kg/m^2 (n = 382)	27.0 (± 5.8)	27.5 (± 5.3)	0.423
Physical activity during previous week			
Median minutes of overall physical activity	400 (263, 780)	50 (0,90)	
Median minutes spent walking (IQR)	210 (113, 300)	20 (0,70)	
Median minutes spent with moderate activity (IQR)	30 (0, 120)	0 (0, 0)	
Median minutes spent with vigorous activity (IQR)	180 (90, 360)	60 (0, 150)	

* SD = Standard deviation
** IQR = Inter-quartile range
# One person did not answer the questions relating to physical activity
Fisher’s exact test
Chi-square test for trend.

Beliefs about Physical Activity

Using the Active Australia questions people were asked the following questions as a way of assessing whether they remember physical activity messages:

Message 1: Taking the stairs at work or generally being more active for at least 30 minutes each day is enough to improve your health.

Message 2: Half an hour of brisk walking on most days is enough to improve your health.

Message 3: To improve your health it is essential for you to do vigorous exercise for at least 20 minutes each time, 3 times a week.

Message 4: Exercise doesn't have to be done all at one time—blocks of 10 minutes are okay.

Message 5: Moderate exercise that increases your heart rate slightly can improve your health.

The findings from the survey are detailed in Table 3.2.

Table 3:2: Percentage of people who agreed or strongly agreed with knowledge statements in a sample of residents of Townsville, North Queensland, Australia in 2004, n=419.

	Message 1	Message 2	Message 3	Message 4	Message 5
Respondents	88.3	91.9	63.8	65.8	87.1

Future Physical Activity intentions

The Active Australia Physical Activity Questionnaire (AIHW, 2003) asks respondents to report their intention to be active in the future as a way of considering intention as a precursor to trialling active behaviours. Table 3.3 details the findings from the survey.

Table 3:3: Future intention of physically activity in a sample of residents of Townsville, North Queensland, Australia in 2004.

	Less active in the future	Same level of activity	More active in the next month	More active in the next six months
Respondents	1.4%	39%	40.2%	19.3%

Barriers to physical activity:

The barriers are described in three ways:

- Overall percentage of people experiencing the barriers to physical activity.
- Relationship between users and non-users of the existing river paths and perceived barriers
- Relationship between people who are and are not sufficiently active and perceived barriers

Overall percentage of people experiencing the barriers.

Over 75% of the respondents reported that lack of self-discipline, lack of time, lack of energy/too tired, and weather "too hot or humid" prevented regular participation in physical activity. Over 50% of the participants reported that a lack of interest in exercise or physical activity, lack of company, and/or lack of motivation to be physically active prevented regular participation in physical activity. In relation to the physical environment, barriers to physical activity indicated by participants were a lack of a pleasant environment in which to be active (39.2%), and lack of a safe place in which to be active (38.8%).

The overall percentage of barriers expressed by respondents are presented in Table 3.4.

Table 3:4: Overall perceived barriers to regular physical activity in a sample of 420# residents of Townsville, North Queensland, Australia in 2004.

Perceived Barriers	% Sometimes, often, or very often
"Self conscious about my looks when I exercise"	30.2
"Lack of interest in exercise or physical activity"	56.6
"Lack of self-discipline"	75.3
"Lack of time"	79.8
"Lack of energy/too tired"	82.5
"Lack of company"	56.1
"Lack of enjoyment from exercise or physical activity"	43.4
"Being discouraged (from past attempts)"	25.5
"Lack of equipment"	31.8
"Weather too hot or humid"	79.5
"Weather too cold"	14.3
"Lack of skills"	22.8
"Lack of facilities"	36.9
"Lack of knowledge on how to exercise"	24.9
"Lack of good health"	39.2
"Fear of injury"	19.4
"Lack of pleasant environment to be active in"	39.2
"Lack of safe place to be physically active"	38.8
"Lack of motivation to be physically active"	67.3
"No child care assistance"	24.8

the number of respondents who did not provide information on a barrier question varied between 14 and 25

Relationship between perceived barriers to regular physical activity and users and non-users of the river paths

In both the river path users and non-users the most common barriers to regular physical activity were general lack of interest in exercise or physical activity, lack of self discipline, lack of time, lack of energy, hot and humid weather, lack of enjoyment from exercise or physical activity and general lack of motivation. Non-river path users were significantly more likely to report lack of motivation to be physically active ($p<0.001$) and lack self-discipline ($p<0.001$) to be physically active than river path users. There was borderline significance in relation to general lack of interest in exercise or physical activity ($p=0.012$) and lack of enjoyment from exercise or physical activity ($p=0.024$) with non-users identifying it as a bigger issue. Barriers in relation to river path users and non-users are presented in Table 3.5.

Table 3:5: Perceived barriers to regular physical activity in the strata of users and non-users of the Riverway paths in a sample of 417[#] residents of Townsville, North Queensland, Australia in 2004.

Perceived Barriers	River path users (n = 211)	Non-users (n = 206)	p value
	% Sometimes, often, or very often	% Sometimes, often, or very often	
"Self conscious about my looks when I exercise"	28.4%	32.0%	0.435
"Lack of interest in exercise or physical activity"	50.5%	62.9%	**0.012**
"Lack of self-discipline"	68.5%	82.2%	**<0.001**
"Lack of time"	77.9%	81.6%	0.361
"Lack of energy/too tired"	79.7%	85.4%	0.137
"Lack of company"	45.5%	47.5%	0.832
"Lack of enjoyment from exercise or physical activity"	37.8%	49.0%	**0.024**
"Being discouraged (from past attempts)"	24.4%	26.8%	0.584
"Lack of equipment"	31.2%	32.5%	0.773
"Weather too hot or humid"	76.8%	82.3%	0.176
"Weather too cold"	17.5%	11.2%	0.072
"Lack of skills"	22.1%	23.4%	0.769
"Lack of facilities"	40.4%	33.0%	0.125
"Lack of knowledge on how to exercise"	24.4%	25.5%	0.794
"Lack of good health"	36.5%	41.4%	0.308
"Fear of injury"	18.3%	20.1%	0.650
"Lack of pleasant environment to be active in"	40.6%	37.7%	0.551
"Lack of safe place to be physically active"	39.6%	37.9%	0.723
"Lack of motivation to be physically active"	59.7%	74.9%	**<0.001**
"No child care assistance"	24.9%	25.6%	0.704

[#] Two people did not answer the questions relating to river path usage and the number of respondents who did not provide information on a barrier question varied between 14 and 25.

Relationship between people who were and were not sufficiently active and perceived barriers

Compared to the participants who were sufficiently active for health, respondents who were not sufficiently active were significantly more likely to respond that they were sometimes, often or very often lacking an interest in exercise or physical activity ($p<0.001$), lacking self discipline ($p=0.007$), lacking energy or were too tired ($p=0.002$), received no enjoyment from exercise or physical activity (p=0.002), felt an overall lack of motivation (p<0.001), and found the weather to be too hot or humid (p=0.032) (Table 3.6). The mean of the total score of all barriers was 49.0 for the people who were not sufficiently active for health and 44.6 for the people who were sufficiently active (p<0.001). Perceived barriers to regular physical activity in the strata of being sufficiently active for health or not is presented in Table 3.6.

Table 3:6: Perceived barriers to regular physical activity in the strata of being sufficiently active for health or not in a sample of 419[#] residents of Townsville, North Queensland, Australia in 2004.

	Sufficiently active (n=280)	Not sufficiently active (n=139)	p value
% Respondents who sometimes, often or very often			
… were self conscious about their looks	29.0%	32.6%	0.468
… lack interest in exercise or physical activity	50.4%	69.5%	**<0.001**
… lack self discipline	71.3%	83.6%	**0.007**
… lack time	77.5%	84.3%	0.107
… lack energy or are too tired	78.3%	91.0%	**0.002**
… lack company to be active with	46.3%	48.5%	0.676
… receive no enjoyment from exercise or physical activity	37.9%	54.5%	**0.002**
… are discouraged to be physically active due to failed past attempts	25.7%	25.4%	0.954
… lack the necessary equipment to be physically active	31%	33.6%	0.598
… find the weather to be too hot or humid to be physically active	76.6%	85.7%	0.032
… find the weather to be too cold to be physically active	14.3%	14.5%	0.954
… feel they lack the skills to be physically active	21.5%	25.2%	0.411
… feel there is a lack facilities to be physically active	37.2%	36.4%	0.874
… feel they lack the knowledge on how to exercise	23.7%	27.5%	0.411
… feel they have a lack of good health	35.1%	47.3%	0.018
… fear injury	16.3%	25.8%	0.024
… feel that there is a lack of a pleasant environment in which to be active	36.8%	43.9%	0.169
… feel that there is a lack of a safe place to be physically active	36.1%	44.3%	0.113
… feel an overall lack of motivation	60.1%	81.8%	**<0.001**
… have no child care	21.7%	31.1%	0.042
Total mean score of barriers (range 20 to 82) (SD)	44.6 (12.1)	49.0 (12.4)	**<0.001**

[#]One person did not answer the questions relating to physical activity and the number of respondents who did not provide information on a barrier question varied between 14 and 25.

Riverway questions

Of all respondents, 50.6% (n=211) used the pathways along the river. Of these, the majority (36.2%) walked to the paths; 11.3% drove themselves to the paths, 1.0% had someone else driving them to the paths, 16.1% cycled to the paths, 0.7% took the bus to the paths and 1.2% used other means to get to the paths.

The main purpose for using the paths was to walk (41.7%) compared to using the paths for running or jogging (7.4%), cycling (18.9%) or for other purposes (2.4%). A small percentage of respondents also used the river area for other reasons, primarily to access activities on the water. These purposes included canoeing (3.8%), kayaking (1.4%), rowing (1%), water skiing (4.1%) and other purposes (11.7%).

People using the river paths were significantly more active compared to the non-users of the pathway (median minutes of physical active per week: users 360 (IQR = 140 to 660) versus non-users 205 (IQR = 60 to 452.5); $p < 0.001$). Of the current river path users 74.9% were sufficiently active for health compared to 59.2% of the non-users ($p = 0.001$).

Impact of Riverway on own and others resident's physical activity

Of all respondents, 39.1% thought the Riverway development would have a significant to very significant increase on the physical activity levels of residents living in close proximity to the development, however, only 23.4% of respondents thought the Riverway development would have a significant to very significant increase on their own physical activity levels. In addition, 33.2% thought it would have a moderate increase on the physical activity levels of residents living in close proximity to the development, however, only 23.2% of respondents thought the Riverway development would have a moderate increase on their own physical activity levels. Twenty nine point four percent of respondents thought that the Riverway development would have no impact on other residents' physical activity and 63.5% percent thought that it would have no impact on their own physical activity.

Self efficacy and social support

Compared to the participants who were not sufficiently active for health, respondents who were sufficiently active were more likely to feel confident or very confident to be active even when it was hot outside, when they didn't have someone to exercise with, when they didn't have money, when they were tired, when they were too busy with other commitments, and even when the activity took a lot of effort (Table 3.7). Those who were sufficiently active for health had a significantly higher mean self efficacy score compared to those who were not sufficiently active (p<0.001).

Compared to respondents who were not sufficiently active for health, participants who were sufficiently active were significantly more likely to be encouraged by family, friends or colleagues to be active (p<0.003), have family, friends or colleagues do something to help them to be physically active (p<0.001) and have family, friends or colleagues offer to do physical activity with them in the last three months (p=0.007). Those who were sufficiently active for health had a significantly higher mean social support score than those not sufficiently active (p<0.001) (Table 3.7).

Table 3:7: Confidence to participate in physical activity and social support in the strata of being sufficiently active for health or not of a sample of 419# residents of Townsville, North Queensland, Australia in 2004.

	Sufficiently active (n=280)	Not sufficiently active (n=139)	p value
% Respondents feeling "confident or very confident" to be active even …			
… when it is hot outside	40.6%	29.5%	**<0.001**
… when I don't have someone to exercise with	60.4%	47.8%	**0.030**
… when I don't have any money	59.6%	45.5%	**0.021**
… when I am tired	19.1%	5.1%	**<0.001**
… when I am too busy with work and/or family commitments	17.8%	5.9%	**<0.001**
… when the activity takes a lot of effort	31.4%	15.6%	**<0.001**
Total mean score of self-efficacy questions (range 6 to 30) (SD)	18.0 (5.3)	14.7 (4.8)	**<0.001**
% Respondents who had been "often or very often" …			
… encouraged by family, friends or colleagues to be physically active in the last three months	31.9%	18.0%	**0.003**
… had family, friends or colleagues do something to help them to be physically active in the last three months	24.7%	11.5%	**<0.001**
… had family, friends or colleagues who made it difficult for them to be physically active in the last three months	12.6%	20.2%	0.089
… had family, friends or colleagues offer to do physical activity with them in the last three months	22.9%	12.2%	**0.007**
Total mean score of social support questions (range 4 to 20) (SD)	11.8 (3.3)	10.3 (3.2)	**<0.001**

#One person did not answer the questions relating to physical activity, between two and 11 respondents did not answer the confidence questions, and between one and two respondents did not answer the social support questions.

Perceived physical environment and safety

River path users were significantly more likely to perceive that "crime was higher in their neighbourhood" ($p=0.022$), that "there were pleasant walks to do in the neighbourhood" ($p<0.001$), that "shops and services were within walking distance in the neighbourhood" ($p<0.001$), and that "there are bicycle or walking paths/trails within walking distance of my home" ($p<0.001$). River path users were significantly less likely to perceive that "the neighbourhood is kept clean and tidy" ($p<0.001$). Perceived physical environment and safety issues are presented in Table 3.8.

Table 3:8: Perceived physical environment and safety in the strata of users and non-users of the Riverway paths in a sample of 417# residents of Townsville, North Queensland, in 2004.

Issue	River path users (n = 211)	Non-users (n = 206)	p value
	% Strongly agree or agree	% Strongly agree or agree	
"It is safe to walk in your neighbourhood"	64.0%	61.2%	0.471
"Dogs frighten people who walk in your neighbourhood"	46.4%	47.6%	0.972
"The neighbourhood is friendly"	65.4%	69.3%	0.689
"Crime is high in the neighbourhood"	23.7%	14.1%	**0.022**
"There are pleasant walks to do in your neighbourhood"	69.5%	50.5%	**< 0.001**
"Shops and services are in walking distance in your neighbourhood"	79.6%	68.0%	**<0.001**
"You often see people out on walks in your neighbourhood"	88.6%	89.8%	0.730
"Your neighbourhood is kept clean and tidy"	63.6%	77.2%	**0.010**
"There are busy streets to cross when out on walks"	66.8%	56.8%	0.064
"The footpaths are in good condition"	53.1%	51.7%	0.722
"There is heavy traffic"	57.8%	54.9%	0.382
"It is safe to cycle in your neighbourhood"	68.7%	62.4%	0.196
"The streets are well lit"	42.2%	36.9%	0.115
"There are open spaces (such as parks, ovals) for people to walk in or around my neighbourhood"	74.4%	66.5%	0.208
"There are bicycle or walking paths/trails within walking distance of my home"	88.6%	69.8%	**< 0.001**

#Two people did not answer the questions relating to path use and between one and seven respondents did not answer the environment and safety questions.

Relationship between people who were and were not sufficiently active and perception of the physical environment and safety

Respondents who were sufficiently active for health were more likely to agree or strongly agree that it was safe in their neighbourhood to walk ($p=0.003$) or to cycle ($p=0.016$) compared to people who were not sufficiently active (Table 3.9). The mean of the added up score of all environmental questions was 48.6 for the people who were not sufficiently active for health and 50.8 for the people who were sufficiently active (p=0.003).

Table 3:9: Perceived physical environment and safety in the strata of being sufficiently active for health or not of a sample of 419# residents of Townsville, North Queensland, in 2004.

% Respondents "agreeing or strongly agreeing" that …	Sufficiently active (n=280)	Not sufficiently active (n=139)	p value
"It is safe to walk in your neighbourhood"	67.1%	52.9%	**0.003**
"Dogs frighten people who walk in your neighbourhood"	43.6%	53.6%	0.117
"The neighbourhood is friendly"	70.3%	60.9%	0.107
"Crime is high in the neighbourhood"	19.3%	18.2%	0.295
"There are pleasant walks to do in your neighbourhood"	62.0%	56.5%	0.405
"Shops and services are in walking distance in your neighbourhood"	73.9%	73.9%	0.345
"You often see people out on walks in your neighbourhood"	89.6%	87.6%	0.700
"Your neighbourhood is kept clean and tidy"	68.8%	73.2%	0.579
"There are busy streets to cross when out on walks"	61.4%	63.0%	0.641
"The footpaths are in good condition"	55.8%	44.9%	0.098
"There is heavy traffic"	54.6%	60.1%	0.556
"It is safe to cycle in your neighbourhood"	69.5%	57.6%	**0.016**
"The streets are well lit"	41.1%	37.4%	p=0.453
"There are open spaces (such as parks, ovals) for people to walk in or around my neighbourhood"	72.1%	66.9%	p=0.251
"There are bicycle or walking paths/trails within walking distance of my home"	81.4%	73.9%	p=0.128
Total mean score of environmental questions (range 29 to 70) (SD)	50.8 (6.8)	48.6(7.0)	**p=0.003**

#One person did not answer the questions relating to physical activity and between one and seven respondents did not answer the environment and safety questions.

Dog ownership, walking and physical activity

Sixty four point four percent of participants owned a dog but only 23.4% took the dog for regular walks (defined as being for at least 30 minutes, 5 or more times a week). In general, people who owned a dog were no more likely to be sufficiently active than those who did not (66.9%, 67.1% respectively p=0.967). However, people who actively walked their dog were more likely to be sufficiently active than those who did not (88.8%, 60.5% respectively, p<0.001)

Multivariable results

The first logistic regression analysis showed that the summed self-efficacy (p<0.001) and social support scores (p=0.002) were correlated with being sufficiently active for health. The second multi-variable analysis showed that independent significant correlates to being sufficiently active were the barrier "I lack the general motivation for being physically active" (p=0.010), the self-efficacy statement "Even when I am tired I feel that I could be physically active" (p=0.001), the social environment statement "In the last 3 months family, friends and colleagues have encouraged me to perform physical activity" (p=0.003), and the physical environment issue "I believe it is safe to walk in my neighbourhood" (p=0.031)(Table 3.10).

Table 3:10: Results of multivariate logistic regression analysis of socio-environmental correlates of being sufficiently active for health of a sample of residents of Townsville, North Queensland, Australia.

	Sufficiently active	Not sufficiently active	POR [95%-CI]#	p value
Model 1*				
Total self-efficacy score	Continuous		1.1 [1.1, 1.2]	**<0.001**
Total social support score	Continuous		1.1 [1.0, 1.2]	**0.002**
Model 2*				
"I lack the general motivation for being physically active"				
Sometimes, often, or very often	155	103	1	
Never or rarely	100	120	2.2 [1.2, 4.1]	**0.010**
"Even when I am tired I feel that I could be physically active"				
Not at all confident	53	58	1	
Slightly confident to very confident	202	65	2.5 [1.5, 4.2]	**<0.001**
"In the last 3 months family, friends and colleagues have encouraged me to perform physical activity"				
Never or rarely	89	69	1	
Sometimes, often, or very often	166	54	2.1 [1.3, 3.4]	**0.003**
"I believe it is safe to walk in my neighbourhood"				
Strongly disagree, disagree, or unsure	87	54	1	
Agree	115	59	0.8 [0.5, 1.4]	0.397
Strongly agree	53	10	2.5 [1.1, 5.7]	**0.031**

* The model was adjusted for the confounding effects of perceived severity of limitation of physical activity due to health issues. There were no significant two-way interactions in the model. The model was able to predict 69.2% of the activity levels correctly. There were 30 data records with incomplete information.

**The model was adjusted for the confounding effects of perceived severity of limitation of physical activity due to health issues and the total time the respondent had lived in Australia. There were no significant two-way interactions in the model. The model was able to predict 72.0% of the activity levels correctly. There were 42 data records with incomplete information.

#POR [95%-CI] = Prevalence odds-ratio with 95%-confidence interval.

3.4.2 Results of Observation Study

Weather conditions during observation

Over the two week period of the observation study, there were 36 direct observation shifts which is equal to 54 hours of observation. Findings are reported under the headings of the three sites observed and are divided into morning and afternoon use. Total and mean number of people observed at each site are reported as are the total and mean number of dog walkers observed for each location per shift.

The weather was quite consistent during all observation periods except for one day during which there was light to heavy rain for a one hour period. This was on a Sunday afternoon and all sites were very quiet for the entire observation period while the rain was falling. All other observation days were fine with sunny conditions or light cloud cover. 0900 temperature observations were between 28.5 and 29.4°C and 1500 temperature observations were between 28.9 and 30°C and it can be assumed that the temperatures were slightly cooler at the time of the observations. Lowest minimum temperatures in November were 21.7°C and maximum temperatures were 32.8°C.

Overall usage per individual site

Table 3.11 shows the total and mean number of people observed at each site for each morning and afternoon shift. The site adjacent to the Pioneer Park development was the busiest site followed by the pathway above Apex Park. Loam Island was the quietest area observed.

Table 3:11: Overall usage by people per individual site

Observation site	Total number of people observed over all shifts	Mean number of users per 1.5 hour shift
Loam Island – am	89	15
Loam Island – pm	102	17
Apex Park – am	176	29.5
Apex Park – pm	144	24
Pioneer Park – am	277	46
Pioneer Park – pm	272	45.5

Dog use per individual site

The number of dogs being walked was generally quite low. The greatest number of dogs were walked in the Loam Island area where there was open park land. There was little difference observed between Apex Park and Pioneer Park areas.

Table 3:12: Dog usage per individual site

Observation site	Total number of dog walkers observed over all shift	Mean number of dog walkers per 1.5 hour shift
Loam Island – am	42	7
Loam Island – pm	36	6
Apex Park – am	26	4.5
Apex Park – pm	11	2
Pioneer Park – am	28	4.5
Pioneer Park – pm	14	2.5

Activities engaged in while being in observation area

The activity of people using the observation areas was recorded. All users were either walking, jogging or cycling and no other activity was observed except for one skater on roller blades. Walking was the most common activity in Loam Island for both males and females whereas cycling was more popular for males at the Apex Park and Pioneer Park areas. It would appear that most of the cycling at these sites was for active transportation purposes (i.e. going to and from work or school) but this can not be conclusively stated as people were not asked the purpose of their journey. Generally more females than males were observed to be walking in both the morning and afternoon shifts and walking appeared to be the activity of choice for females. Very few people were observed jogging at any site.

Site One: Western end of Pioneer Park

Table 3:13: Activity type – Pioneer Park

	Activity engaged in during observation site visit - Pioneer Park			
Gender - time	**Sample Size**	**% Walking**	**% Jogging**	**%Cycling**
Male – am	207	21	2	77
Female – am	70	73	5.5	21.5
Male – pm	218	14	4	82
Female – pm	54	57.5	2	40.5

Site Two: Loam Island car park

Table 3:14: Activity type – Loam Island

	Activity engaged in during observation site visit - Loam Island			
Gender - time	**Sample Size**	**% Walking**	**% Jogging**	**%Cycling**
Male – am	35	94	0	6
Female – am	54	96	0	4
Male – pm	48	68.75	12.5	18.75
Female – pm	54	96	2	2

Site Three: Riverway path adjacent to Apex Park area

Table 3:15: Activity type – Apex Park

	Activity engaged in during observation site visit - Apex Park			
Gender - time	**Sample Size**	**% Walking**	**% Jogging**	**% Cycling**
Male – am	78	50	1	49
Female – am	98	80.5	0	19.5
Male – pm	103	18.5	4	77.5
Female – pm	41	68.5	2.5	29

Age groups of observation site users

The age of the observation site users was divided into four categories:

- Toddlers and children up to 12 years
- Teenagers (13-19 years)
- Young to middle aged adults (20-59 years)
- Older adults (60+ years).

These ages were approximated subjectively by the observers and may not be totally accurate. Some users did not have an age allocated to them so the total numbers are slightly less than those stated in the tables above. Babies in prams were not included in the analysis but only 12 prams were observed being pushed during the overall observation period. Adults aged 20–59 years were the most likely to be active in all of the observation areas except for Apex Park where similar numbers of teenagers and middle aged adults were observed. Generally children and older adults were least likely to be observed using the observation areas. Observations in the morning and afternoon by age group at the three locations are presented in Tables 3.16, 3.17 and 3.18.

Table 3:16: Age groups observed using Pioneer Park

Age	People observed am	People observed pm
Toddlers and children up to 12 years	39 (14.5%)	6 (2.5%)
Teenagers (19 and under)	52 (19.0%)	20 (8.0%)
Adults (20-59 years)	176 (64.5%)	207 (85%)
Older adults (60+ years)	5 (2.0%)	11 (4.5%)
Total	272	244

Table 3:17: Age groups observed using Loam Island – am

Age	**People observed am**	**People observed pm**
Toddlers and children up to 12 years	2 (2.5%)	9 (9.5)
Teenagers(19 and under)	0	16 (16.5%0
Adults (20-59 years)	64 (85.5%)	69 (71%)
Older adults (60+ years)	9 (12%)	3 (3%)
Total	75	97

Table 3:18: Age groups observed using Apex Park

Age	**People observed am**	**People observed pm**
Toddlers and children up to 12 years	1 (0.5%)	12 (8.5%)
Teenagers (19 and under)	17 (10%)	27 (19%)
Adults (20-59 years)	127 (63.5%)	99 (69%)
Older adults (60+ years)	28 (16%)	5 (3.5%)
Total	173	143

3.5 Discussion

This baseline study used a postal survey that aimed to assess current self-reported physical activity levels of residents in the study area as well assessing the relationship between physical activity, the physical and social environment, self efficacy, and barriers. An observation study was also conducted to assess the current amount and type of usage of the existing Riverway pathways before the environmental changes were made. It is one of the first to investigate individual, social and environmental correlates that impact on whether or not people are sufficiently active for health in a tropical environment.

This research identified that 66.8% of respondents were sufficiently active for health. This is higher than previous data from a National survey conducted in 2000 that demonstrated that 56.8% of adult Australians were sufficiently active for health benefits (Bauman, *et al.*, 2001) and a Queensland survey that demonstrated 45% of adult Queenslanders being sufficiently active for health benefits (Queensland Health, 2003).

Although both these surveys used the Active Australia questions, care should be taken when comparing this data as the 2001 Queensland Omnibus Survey (Queensland Health, 2003) was conducted at a different time of the year to the 2000 survey and could have seasonal differences.

Consistent with other studies, this research identified that social variables, including high levels of self-efficacy and social support, were more strongly associated with physical activity behaviour than physical environmental variables (Sallis & Owen, 1997; Giles-Corti & Donovan, 2002; Sallis & Owen, 1999; Salmon et al., 2003). The only environmental factors significantly related to physical was the perception that it was safe to walk and cycle in the neighbourhood. It is possible that people who were active in their neighbourhood perceived that it was safer due to the fact they only had a limited personal experience of their neighbourhood.

The most similar study previously reported in terms of tropical location was undertaken in Rockhampton, Queensland and this study also found self-reported perceptions of social support and self-efficacy to be important influences of physical activity (Duncan & Mummery, 2005). Similar to the findings in our study, Duncan and Mummery (2005) reported that safety was an important environmental issue although they additionally found that perceptions of environmental aesthetics to be relevant.

Similar to the findings in the National Survey on Physical Activity (Armstrong, Bauman & Davies, 2000), understanding of key physical activity messages appeared to be high, as was people's intention to become more physically active. In the Riverway study even more respondents indicated that they intended to be more active in the next month (40.2%, compared to 34.2% in the National survey) , although only 19.6% indicated an intention to be more active in the next six months compared to 28.5% in the national survey. Despite the self-reported intent, this does not appear to translate into higher levels of physical activity participation at a population level. Greater understanding is needed of the sort of interventions that are required to transform knowledge, motivation and intent into sustained behaviour change.

The mean BMI of 27.1 kg/m^2 (SD $\pm$ 5.6) is in line with the general profile of the Australian population. The mean BMI of Australian adults aged 25–64 years in 1995 was 27.2 kg/m^2 in males and 26.8 kg/m^2 in females (Cook, Rutishausen & Seeling, 2001).

Personal barriers such as lack of self-discipline, lack of motivation, lack of interest in physical activity and general lack of enjoyment in physical activity were the most commonly cited barriers in both those who did not participate in sufficient activity for health and those who did not use the Riverway pathways. This is consistent with other research in the area (Booth et al., 1997; Salmon et al., 2003; Canadian Fitness and Lifestyle Research Institute, 1996). Issues such as fear of injury, lack of child care and a lack of good health also impacted on whether or not people achieved sufficient levels of physical activity and must be considered when designing interventions. Some environmental issues including the hot and humid weather experienced in North Queensland were also reported to have a significant impact for people regardless of their level of activity. The relationship between weather and physical activity is not clearly understood and past studies in non tropical environments, have only shown weak relationships (Humpel et al., 2002). Of interest is whether the tropical location of the Riverway study impacted on correlates for physical activity, although while the hot and humid conditions were cited as a common barrier for both sufficiently active and insufficiently active respondents, it appears that socio-environmental correlates remain the same. Alternatively, respondents may have been more adapted to tropical conditions and therefore continued to engage in physical activity. What does appear important is the degree of self-efficacy individuals have in overcoming this barrier with the active respondents in this study stating that they felt they could be active even when it was hot and humid. This is consistent with Barnett and Spinks (2007) study of post-menopausal women in Townsville who found that weather was one of the main contributors to different perceptions towards exercise. In their study, women who did not regularly exercise did not feel confident that they could exercise if the weather was very hot or humid. Future studies comparing people living in tropical environments with people from temperate climates might be insightful in further defining the effect of climate on physical activity.

Consistent with the findings of Bauman, Russell, Furber and Dobson, (2001), the ownership of a dog had no impact on whether or not people achieved sufficient levels of physical activity. Only a low percentage of dog owners walked them, however, those who did walk their dogs were more likely to achieve sufficient levels of physical activity. There was no significant difference between respondents' perception of dogs frightening people who walked in the neighbourhood and whether or not they achieved sufficient levels of physical activity. The observation study supported the survey findings in relation to dogs being walked with very few dogs observed being walked both on the pathways and in the park land area at Loam Island.

Not surprisingly, users of the existing paths along the river were more likely to be active than non-users with a high percentage of users (74.9%) achieving sufficient levels of physical activity for health benefits. River path users also had a more positive perception of the aesthetics of the environment, access to services and access to walking and bicycle trails compared to non-users although they did perceive the environment to be less clean and tidy, possibly because they were out and about in the neighbourhood more than non-users. This is consistent with the findings of other research (Ball, Bauman, Leslie & Owen, 2001; Humpel et al., 2002; Humpel, Marshall, Leslie, Bauman and Owen, 2004; Duncan & Mummery, 2005). Interestingly, both insufficiently and sufficiently active people indicated a belief that there are bicycle or walking paths/trails within walking distance of their homes in their neighbourhood, however, this did not always translate into positive physical activity behaviours. This is inconsistent with the findings of Duncan and Mummery (2004) who found that having pathways that are located within walking distance of the home are positively associated with walking. This suggests that pathway access in this population was not enough to stimulate people to engage in physical activity and further investigation would be needed to clarify these findings. Issues such as road connectivity and having a very busy road to cross to gain access to the river pathways could be an issue. Respondents had a positive view of the potential impact of the Riverway modifications on the physical activity levels of neighbourhood residents, much more so than on their own perhaps because a significant proportion were already using the paths along the river.

Despite the current existence of paths along the river and the fact that 50.6% of survey respondents reported current use of the paths, the observation study showed that there appeared to be little usage of the paths both in the mornings and late afternoons particularly for recreational purposes. Subjective observation would indicate that the pathways were currently used mostly by cyclists getting to and from work or school and that the use of the paths for recreational purposes was quite low. The majority of cyclists were male with very few females observed cycling.

Walking was the most popular activity after cycling, with the majority of walkers being female and it would appear that most people were recreational walkers. Very few people were jogging and no other activities were observed other than the sole roller blader. Children were not big users of the pathway except if older and cycling to school. Very few adults were observed being active with their children and very few pram walkers were observed. The elderly were also less likely to use the paths with most pathway users being between approximately 20–59 years.

The fact that Riverway modifications had commenced at Pioneer Park and further along from Loam Island may have affected the usage of paths, however, anecdotal conversations with a number of the path users during the observation study indicated that their usage had not changed. Many of the people that the observers talked to informally had been walking along the paths for a long time and felt that usage was similar to the past.

This study had several limitations that need to be considered when interpreting results. The overall response rate of 22% was low and may not reflect the true characteristics of the study population. Also, due to this study being a baseline for an intervention, participants were not randomly selected from the overall population of Townsville, and instead resided in just five suburbs and may therefore not be representative of the broader population. A comparison of our sample with the census data of the overall Townsville population (Australian Bureau of Statistics [ABS], 2001) suggested that there was an over-representation of females and an older mean age by approximately 10 years. The bias towards female and older respondents has been observed in other mail survey research (Armstrong et al., 2000). In addition, self-reported data on physical activity participation may not be an accurate reflection of activity. Respondents in this survey appear to achieve a higher number of median minutes of physical activity than the general population, however, it is unlikely that true population participation in physical activity is any different in this location compared to Australia and Queensland overall. It is more likely to reflect that the people who chose to complete the survey were those who already had an interest in physical activity, possibly because they were already active and valued it as a personal priority. This is a likely issue in regards to both this study and other studies in that selection biases towards respondents generally being interested and motivated in the topic, may in fact lead to an over estimation of true physical activity levels in the overall population.

3.6 Conclusion

This research provides valuable baseline data on physical activity levels and the relationship between physical activity and perceptions in relation to barriers to physical activity, levels of self efficacy, impact of the physical environment and safety, and levels of social support of neighbourhood residents in the Riverway study area. This information will be used to assess the impact of environmental modifications (The Riverway Project) on neighbourhood level physical activity. Understanding the demographic, psychological, social and environmental influences on physical activity is important in order to design effective interventions to address the problem of physical inactivity. This study showed that socio-environmental correlates of adult physical activity participation in this tropical environment are no different to those experienced in other locations and social variables were more strongly associated with physical activity behaviour than physical environmental variables.

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Chapter 4. Evaluating an environmental modification – the impact of the Riverway construction on individual, social, and physical environmental determinants of physical activity

4.1. Abstract

Objective: Past research has shown some aspects of the physical environment that are likely to support physical activity however there is a paucity of intervention research to help more clearly understand the complex relationships between neighbourhood and community environmental factors on the one side and physical activity of individuals on the other. Prospective evaluations assessing the impact of environmental modifications on physical activity levels of residents who live within close proximity to modified area/s are needed. This chapter describes the findings of the Riverway evaluation study conducted in Townsville, North Queensland between 2004 and 2006.

Methods: The Riverway study used a quasi-experimental design with a pre- and post-intervention group (participants who reside within 1.5 km of the Riverway development) and an independent comparison group (participants who reside beyond 1.5 km of the Riverway development). Baseline surveys were conducted in November/December 2004. The Riverway project was completed in July 2006 and follow up surveys were conducted six months post-completion in November/December 2006. As with the baseline, the follow up questionnaire assessed self-report measures of physical activity, barriers, perception of the physical and social environment, self efficacy and social support. The follow up questionnaire was distributed to 2,373 neighbourhood residents (response rate 19.5%) in November/December 2006.

Results: Although there was an increase of 3.3% in the percentage of respondents who were sufficiently active for health in the intervention group compared to the comparison group in 2006 and a 2% increase in the percentage of respondents who were sufficiently active for health overall in 2006 compared to 2004, neither finding was statistically significant. There was no significant difference between the intervention and the comparison group in 2006 in relation to destination, recreation or overall walking nor were there significant differences between pre- and post-intervention. Participants were significantly less likely to state that there was a lack of a pleasant environment in which

to be active in 2006 compared to 2004 ($p=0.013$). There was a significant increase in path use by participants in the intervention group in 2006 compared to the comparison group ($p<0.001$) and significantly more participants from the intervention group walked to the paths ($p<0.001$) and used the paths for walking ($p<0.001$) compared to the comparison group. Participants who use the Riverway paths were significantly more likely to be sufficiently active for health ($p<0.001$).

Conclusion: Although this prospective study evaluating the impact of a modification to the physical environment failed to show a significant increase in the proportion of adults who were sufficiently active for health as a result of the Riverway intervention, the observed effects may have been attenuated as a result of the limitations including a selection bias and a lack of statistical power due to the low response rates. Further prospective studies are needed that rigorously evaluate modified environments similar to Riverway. The results of this study contribute to providing direction for future environmental intervention studies of a similar nature.

4.2. Introduction

Environmental attributes that can support physical activity, particularly at a neighbourhood level, have been identified and discussed in Chapters Two and Three. What has been highlighted in these two earlier chapters is that although there is some understanding of aspects of the physical environment that influence physical activity, there is a lack of well designed intervention studies that have prospectively evaluated the impact on environmental neighbourhood modifications (such as the Riverway project). A number of studies have been conducted that suggest interventions that improve access to facilities for physical activity, such as a trail or walking path in a local community, may increase the likelihood of neighbourhood residents engaging in regular physical activity and walking (Huston, Evenson, Bors & Gizlice, 2003; Powell, Martin & Chowdhury, 2003; Sharpe, Granner, Hutto & Ainsworth, 2004; Brownson et al., 2000; Troped, Saunders, Pate, Reininger, Ureda & Thompson 2001; Gordon, Zizzi & Pauline 2004; Merom, Bauman, Vita & Close, 2003; Brownson et al., 2004). Of these studies only two are prospective studies (Merom et al., 2003 and Brownson et al., 2004) and neither of these have been able to demonstrate a significant impact of a modified environment on physical activity and walking. There continues to be a need for intervention research to increase our understanding of the complex relationships between neighbourhood and community environmental factors and physical activity of the individual.

The Riverway study used a quasi experimental pre-/post- design with a comparison group and as described in Chapter Three, the baseline for the intervention was conducted in November/December 2004. The Riverway development was completed and officially opened in July, 2006. The follow up post-intervention study was conducted in November/December 2006. This chapter presents the findings from the 2006 study in comparison to the 2004 baseline study. To our knowledge, at the time this study was completed, there were no other studies that prospectively evaluated an environmental modification such as the Riverway development in Australia, thus providing an opportunity to study this "natural experiment" and to contribute to the limited body of evidence in regard to the impact of neighbourhood environmental modifications on adult physical activity.

As described in Chapter Three, the evaluation of the Riverway project relates to the "Innovation Testing", "Intervention Demonstration", and "Intervention Dissemination" component of Nutbeam's Stages of Research and Evaluation Model" (Nutbeam, 1998), where the intervention (Riverway) is evaluated to assess the impact on neighbourhood physical activity behaviour and to assess aspects of the intervention that influence this.

4.3. Methods

4.3.1 Design

The methodology for the Riverway study was described in Chapter Three but in summary was a quasi-experimental study that used a pre- and post-intervention and an external comparison group to assess changes following a local government initiated environmental modification. The Riverway modification, which was described fully in Chapter One stretches for 5 km along the banks of the Ross River and consisted of path redevelopment, boardwalks, swimming lagoons, a cultural centre, café/restaurant, picnic/barbeque areas and landscaping. Adults residing in homes within 1.5 km of Riverway were eligible to be included in the intervention group while participants in the comparison group lived in adjoining neighbourhoods more than 1.5 km from the

Riverway area. As described in Chapter Three, the 1.5 km radius was chosen on the assumption that a typical walking gait in a healthy adult is approximately 6 km per hour. This means that it would take approximately 15 minutes to walk 1.5 km which is seen as a reasonable time and distance to get to a destination (Allan, 2001). Although it is acknowledged that people are also likely to drive to places that are attractive and conducive of physical activity, this study investigated if the environmental modification impacted the behaviour of neighbourhood residents who were in close proximity to Riverway. Eligible participant addresses were provided from the Thuringowa City Council who used geographical information system (GIS) maps to identify addresses of potential participants. Addresses were then randomly selected from the list provided by the Council.

Post modification photos are shown in Figures 4.1 to 4.6.

Figure 4:1: Pathway post-modificaion

Figure 4:2: Pathway post-modification

Figure 4:3: Boardwalk post-modification

Figure 4:4: Boardwalk post-modification

Figure 4:5: Swimming lagoons post-modification

Figure 4:6: Swimming lagoons post-modifiation

4.3.2 Data collection

Participants were mailed a survey similar to the one conducted at baseline in 2004 (Appendix 4.1) and the administration process is described fully in Chapter Three. The only difference in the survey was that there were questions specific to the existence of Riverway that could not be asked before the modification occurred and the questions on beliefs about physical activity and intent to be active were not included in the 2006 survey. The survey consisted of the following components, which were described in more detail in Chapter Three:

- Self reported physical activity participation (Questions 1–10)
- Barriers to physical activity (Questions 11 (a–t) and 12)
- Riverway questions regarding current use of the Riverway complex, Loam Island and river paths, purpose of use, and how areas were accessed (Questions 13–22)
- Impact of Riverway development on own and others physical activity (Questions 23 and 24)
- Self efficacy (Questions 25–30)
- Perceived physical environment and safety (Questions 31–45)
- Social environment (Questions 46–49)
- Perception of neighbourhood physical activity levels (Question 50)
- Demographics (Questions 51–64 and question 74)
- Dog ownership (Questions 65–66)
- Health related questions (Questions 67–73)

It was requested that an adult in the household complete the survey and a reply paid envelope was included.

Initially 2,100 surveys were posted (1,200 to the intervention area and 900 to the comparison area). Surveys were also sent to the cohort of original respondents at baseline (236 intervention participants and 184 comparison participants). After 'return to sender' surveys were discounted, a total 1,365 (cross-section n= 1,141 and cohort n=224) surveys were sent to participants residing in the intervention area and 1008 (cross-section n= 836 and cohort n=172) to participants residing in the comparison area. As with the baseline, two mail-outs were used two weeks apart with an incentive to return the survey offered (movie gift vouchers). Initially it was proposed that a cohort be followed through to assess changes at an individual level, however, due to the very low response rate (only 68 participants from the intervention area and 46 from the comparison area responded), these were included in the overall cross-section and data was analysed in an unpaired way.

4.3.3 Analysis

Categorical variables were described as percentages. Depending on the distribution, numerical data were summarized using mean and standard deviation (SD) or median and inter-quartile range (IQR). Standard bivariate statistical tests such as t-tests for approximately normally distributed data, Chi-square tests for categorical data, and non-parametric Wilcoxon tests for numerical data not normally distributed, were utilized to compare responses from before the intervention (2004) with after the intervention (2006) and for comparing participants closer to the intervention area in 2004 and 2006 to participants further away, respectively. Responses to the 20 barrier questions, the 6 perceived self-efficacy questions, the 15 physical environment and safety questions, and to the 4 social support questions were added up, respectively, to create four new numerical scores as described in detail in Chapter Three.

The total level of physical activity was skewed and therefore log-transformed for normalisation. All categorical variables were dummy coded. Multiple linear regression analysis was used to judge the impact of the environmental intervention (interaction between survey year and intervention or comparison area) on the transformed level of physical activity adjusted for confounding. In addition, multiple linear regression analysis was used to identify predictors for level of physical activity in 2006. All characteristics not in the models were considered as potential confounders. Coefficients with and without a potential confounder were compared and a confounder was considered identified if coefficients changed by more than 10%.

Statistical analysis was conducted using SPSS, release 14 for Windows and STATA, release 8. A significance level of 0.05 was assumed throughout the analysis.

4.3.4 Ethical considerations

Participation in the follow up of the Riverway study was completely voluntary and informed consent was implied on completion of the survey. Ethics approval was gained from the James Cook University Human Ethics Subcommittee – Number 1911 as described in Chapter Three and following National Health & Medical Research Council guidelines, the data will be stored securely for at least five years.

4.4. Results

4.4.1 Follow up Survey

Participants and demographics

A total of 471 residents responded to the questionnaire in 2006; 295 respondents (21.5% response rate) were from the intervention group; and 176 respondents (17.5% response rate) were from the comparison group. This gave an overall response rate of 19.5%. Participant demographics were compared for 2004 and 2006 and were mostly similar except for the mean age (43.9 years in 2004 and 46.0 years in 2006 – $p=0.030$) and median number of children in the household (1 in 2004 and 0 in 2006, – $p = 0.032$). Demographic characteristics of the intervention and comparison groups were also compared in 2004 and 2006 with no significant differences identified. Table 4.1 contains the comparison of demographic characteristics of participants living in the intervention area with participants living in the comparison area in 2004 (baseline) and in 2006. Table 4.2 contains the comparison of demographic characteristics of participants of the two cross-sections 2004 and 2006.

Table 4:1: Comparison of demographic characteristics of participants living in the intervention area with participants living in the comparison area in 2001 (baseline) and 2006

	Before intervention (2004)			After intervention (2006)		
Demographic factor	**Intervention group (n=236)**	**Comparison group (n=184)**	**p value**	**Intervention group (n=295)**	**Comparison group (n=176)**	**p value**
Mean age (± SD)* years	44.2 (14.0)	43.4 (13.2)	0.556	46.2 (15.3)	45.5 (14.0)	0.616
% Female	72.0%	74.2%	0.625	71.6%	73.9%	0.598
% Country of birth Australia	89.8%	83.0%	0.364	83.1%	84.1%	0.833
Mean time lived in Australia (± SD) years	42.5 (14.9)	39.7 (14.1)	0.054	42.7 (16.2)	41.8 (15.5)	0.555
Median time lived in the tropics (IQR)**	24 (10.3, 40)	23 (10, 35)	0.282	27 (13, 40)	25 (13, 36)	0.357
% of Aboriginal, Torres Strait Islander or South Sea Islander descent	2.1%	3.8%	0.305	5.4%	2.3%	0.102
% With Year 12 education	49.8%	56.0%	0.298	53.0%	50.0%	0.957
% With post-schooling education	53.2%	62.8%	0.057	56.0%	61.7%	0.246
% Currently employed	66.0%	64.5%	0.646	59.7%	55.5%	0.275
% Living with children (single or with partner)	58.3%	59.0%	0.799	46.9%	52.3%	0.672
Median number of children in household (IQR)	1 (0, 2)	1 (0, 2)	0.540	0 (0, 2)	0 (0, 2)	0.321
% With children under 5 years of age	17.8%	22.3%	0.215	12.8%	17.6%	0.256
% Earning ≥ $AU 1000 per week	40.5%	43.8%	0.471	39.2%	47.2%	0.103

Table 4:2: Comparison of demographic characteristics of participants from the two cross-sections, 2004 and 2003

Demographic factor	Before intervention (2004) (n=420)	After intervention (2006) (n=471)	p value
Mean age (± SD)* years	43.9 (13.7)	46.0 (14.8)	**0.030**
% Female	73.0%	72.5%	0.865
% Country of birth Australia	86.8%	83.5%	0.510
Mean time lived in Australia (± SD) years	41.3 (14.6)	42.3 (16.0)	0.323
Median time lived in the tropics (IQR)** years	23 (10, 38)	26 (13, 38)	0.271
% of Aboriginal, Torres Strait Islander or South Sea Islander descent	2.9%	4.2%	0.284
% With Year 12 education	52.5%	51.9%	0.902
% with post-schooling education	57.3%	58.1%	0.817
% With tertiary qualification	19.0%	27.2%	0.507
% Currently employed	65.3%	57.8%	0.157
% Living with children (single or with partner)	58.6%	48.9%	0.080
Median number of children in household (IQR)	1 (0, 2)	0 (0, 2)	**0.032**
% With children under 5 years of age	19.8%	14.8%	0.190
% Earning ≥ $AU 1000 per week	42.0%	42.2%	0.788

Barriers to physical activity:

Significant differences in barriers reported by participants residing in the intervention and comparison areas in 2004 were in relation to lack of good health (with intervention participants citing this as a greater barrier, p=0.033) and fear of injury (with intervention participants citing this as a greater barrier, p=0.002). The comparison of barriers experienced by participants living in the intervention area compared to participants living in the comparison area in 2004 is provided in Table 4.3.

In contrast, the 2006 participants reported that lack of energy or feeling too tired was a significant barrier for physical activity (with intervention participants citing this as a greater barrier - p=0.029). The comparison of barriers experienced by participants living in the intervention area compared to participants living in the comparison area in 2006 is also provided in Table 4.3.

Table 4:3: Comparison of barriers of participants living in the intervention area with participants living in the comparison area in 2001 (baseline) and 2006.

	Before intervention (2004)			After intervention (2006)		
% Participants reporting barriers "sometimes", "often", or "very often"	**Intervention group (n=236)**	**Comparison group (n=184)**	**p value**	**Intervention group (n=295)**	**Comparison group (n=176)**	**p value**
"Self conscious about my looks when I exercise"	32.1	27.8	0.342	34.8	28.2	0.223
"Lack of interest in exercise or physical activity"	57.9	55.1	0.575	55.1	49.6	0.347
"Lack of self-discipline"	76	74.6	0.742	71	65.8	0.337
"Lack of time"	81.8	77.3	0.269	78.6	74.6	0.411
"Lack of energy/too tired"	83.3	81.6	0.658	82.1	71.6	**0.029**
"Lack of company"	48.6	45	0.468	45.9	46.1	0.977
"Lack of enjoyment from exercise or physical activity"	43.7	43	0.892	43.7	35	0.129
"Being discouraged (from past attempts)"	27.6	23	0.298	25.9	26.1	0.969
"Lack of equipment"	33.2	30.2	0.520	33.0	29.8	0.565
"Weather too hot or humid"	79.6	79.6	01.00	69.3	69.8	0.929
"Weather too cold"	14.6	14	0.873	15.7	11.2	0.273
"Lack of skills"	25.3	19.6	0.171	28.6	20.2	0.102
"Lack of facilities"	35.5	38.9	0.458	32.1	26.1	0.260
"Lack of knowledge on how to exercise"	26.9	22.5	0.306	26.5	27	0.935
"Lack of good health"	43.8	33.3	**0.033**	31.5	34.2	0.625
"Fear of injury"	24.8	12.8	**0.002**	21	17.2	0.417
"Lack of pleasant environment to be active in"	38.5	40	0.754	31.1	28.7	0.653
"Lack of safe place to be physically active"	38.2	39.4	0.797	36.9	39.1	0.691
"Lack of motivation to be physically active"	65.8	69.1	0.483	62.2	52.6	0.097
"No child care assistance"	22.6	27.5	0.257	24.2	20	0.408

When comparing the 2004 and 2006 reported barriers to physical activity, significant differences were found in relation to the weather being too hot or humid (with participants in 2004 citing this as a greater barrier - p=0.002), lack of a pleasant environment to be active in (with participants in 2004 citing this as a greater barrier - p=0.013), and lack of motivation to be physically active (with participants in 2004 citing this as a greater barrier - p=0.019). The comparison of barriers experienced by participants in 2004 compared to 2006 is provided in Table 4.4.

Table 4:4: Comparison of barriers of participants from 2004 with 2006.

% Participants reporting barriers "sometimes", "often", or "very often"	Before intervention (2004) (n=420)	After intervention (2006) (n=471)	p value
"Self conscious about my looks when I exercise"	30.2%	32.4%	0.531
"Lack of interest in exercise or physical activity"	56.7%	53%	0.330
"Lack of self-discipline"	75.4%	69.1%	0.062
"Lack of time"	79.8%	77.1%	0.387
"Lack of energy/too tired"	82.5%	78.2%	0.151
"Lack of company"	47%	46%	0.787
"Lack of enjoyment from exercise or physical activity"	43.4%	40.5%	0.437
"Being discouraged (from past attempts)"	25.6%	26%	0.904
"Lack of equipment"	31.8%	31.8%	0.997
"Weather too hot or humid"	79.6%	69.5%	**0.002**
"Weather too cold"	14.4%	14%	0.896
"Lack of skills"	22.7%	25.5%	0.394
"Lack of facilities"	36.9%	29.9%	0.050
"Lack of knowledge on how to exercise"	24.9%	26.7%	0.597
"Lack of good health"	39.2%	32.5%	0.062
"Fear of injury"	19.4%	19.6%	0.942
"Lack of pleasant environment to be active in"	39.2%	30.2%	**0.013**
"Lack of safe place to be physically active"	38.8%	37.7%	0.775
"Lack of motivation to be physically active"	67.3%	58.7%	**0.019**
"No child care assistance"	24.8%	22.6%	0.502

Physical activity

Although there was a 2% increase in the number of 2006 participants who were sufficiently active for health compared to 2004, this was not a statistically significant difference (Table 4.5). There was also no significant difference in participants in the intervention and comparison groups in relation to median physical activity in MET minutes or in the percentage of participants who were sufficiently active for health in 2004 or in 2006 (Table 4.5).

Table 4:5: Comparisons of physical activity intervention and comparison 2004, 2006 and comparison between 2004 and 2006.

	Intervention group (n=236)	Comparison group (n=184)	p value
2004 (Before intervention)			
Median Physical activity (MET min)	255 (90, 540) Range 0 - 1818	295 (92.5, 611) Range 0 – 4800	0.570
% Sufficiently active for health	66.8%	66.8%	0.993
	Intervention group (n=295)	**Comparison group (n=176)**	
2006 (After intervention)			
Physical activity (MET min)	300 (120, 600) Range 0 - 5100	280 (100, 570) Range 0-2700	0.404
% Sufficiently active for health	70%	66.7%	0.460
	Before intervention (2004) (n=420)	**After intervention (2006) (n=4710)**	
Physical activity (MET min)	270 (90, 600) Range 0-4800	300 (120, 600) Range 0 - 5100	0.404
% Sufficiently active for health	66.8%	68.8%	0.541

Walking

In 2004 there was no significant difference between the intervention and the comparison group in relation to destination walking (p=0.740), recreational walking (p=0.960) or overall walking combined (p=0.945).

In 2006 there was no significant difference between the intervention and the comparison group in relation to destination walking (p=0.498), recreational walking (p=0.128) or overall walking combined (p=0.162).

When comparing 2004 participants with 2006 participants there was no significant difference in relation to destination and recreational walking combined (p=0.309).

Self-efficacy and social environment

In 2004 there was no significant difference in participants in the intervention and comparison groups in relation to self-efficacy or social support (Table 4.6). In 2006 the intervention participants had a significantly higher level of social support compared to the comparison participants (Table 4.6). There was no difference in participants between 2004 and 2006 in relation to self-efficacy or social support (Table 4.7).

Table 4:6: Comparisons of self-efficacy and social environment between intervention and comparison in 2004 and 2006.

	Before intervention (2004)			After intervention (2006)		
	Intervention group (n=236)	**Comparison group (n=184)**	**p value**	**Intervention group (n=295)**	**Comparison group (n=176)**	**p value**
Mean total self-efficacy score (SD)	16.9 (5.5)	16.9 (5.2)	0.991	17.2 (5.4)	17.7 (5.7)	0.356
% Above mean value for self-efficacy score	50.2%	50.8%	0.903	54.3%	55.9%	0.338
Mean total social support score (SD)	11.2 (3.4)	11.5 (3.3)	0.276	12 (3.1)	11.1 (3.6)	**0.015**
% Above mean value for social support	42.3%	48.9%	0.178	55.4%	42%	**0.019**
% Dog ownership	61.3%	68.5%	0.126	60.1%	64.6%	0.338
% Dog owners who take dog for walk	22.6%	24.5%	0.665	19.7%	19.4%	0.951

Table 4:7: Comparisons of self-efficacy and social environment between 2004 and 2006.

	Before intervention (2004) (n=420)	**After intervention (2006) (n=471)**	**p value**
Total self-efficacy score	16.9 (5.4)	17.4 (5.5)	0.210
% Above mean value for self-efficacy score	50.5%	54.9%	0.196
Total social support score	11.3 (3.4)	11.7 (3.3)	0.131
% Above mean value for social support	45.2%	50.6%	0.142
% Dog ownership	64.4%	61.8%	0.413
% Dog owners who take dog for walk	23.4%	19.6%	0.160

Perceived physical environment and safety

In both 2004 and 2006, participants in the intervention area were significantly more likely than participants in the comparison area to report that “there are pleasant walks to do in the neighbourhood” ($p<0.001$); “shops and services are within walking distance in the neighbourhood” ($p<0.001$); “there are busy streets to cross when out on walks in the neighbourhood” ($p<0.001$); “the footpaths are in good condition in the neighbourhood” ($p=0.001$); “there is heavy traffic in the neighbourhood” ($p<0.001$); “the streets are well lit in the neighbourhood” ($p<0.001$); “there are open spaces such as parks and ovals for people to walk in or around in the neighbourhood” ($p=0.053$); “there are bicycle or walking paths/trails within walking distance of their homes in the neighbourhood” ($p<0.001$) (Table 4.8).

In contrast, only in 2004 were participants in the intervention area significantly more likely than participants in the comparison area to report “the neighbourhood is kept clean and tidy” ($p=0.007$) while in 2006 significantly more intervention than comparison participants reported that “dogs frighten people who walk in the neighbourhood” ($p=0.006$); “crime is high in the neighbourhood” ($p=0.045$); and “they often see people out on walks in the neighbourhood” ($p=0.021$) (Table 4.8).

In 2006 compared to 2004 significantly more participants reported that “crime is high in the neighbourhood” ($p<0.001$); “there are pleasant walks to do in the neighbourhood” ($p<0.001$); “there are busy streets to cross when out on walks in the neighbourhood” ($p=0.005$); “there is heavy traffic in the neighbourhood” ($p=0.010$); “there are open spaces such as parks and ovals for people to walk in or around in the neighbourhood” ($p=0.002$); “there are bicycle or walking paths/trails within walking distance of their homes in the neighbourhood” ($p=0.016$) (Table 4.9).

Table 4:8: Comparison of physical environment and safety between intervention and comparison in 2004 and 2006.

	Before intervention (2004) (n=420)			After intervention (2006) (n=471)		
% Participants agreeing or strongly agreeing	**Intervention (n=236)**	**Comparison (n=184)**	**p value**	**Intervention (n=295)**	**Comparison (n=176)**	**p value**
It is safe to walk in the neighbourhood	63%	62%	0.681	61.6%	68.8%	0.294
Dogs frighten people who walk in the neighbourhood	45.1%	48.9%	0.527	39.6%	57.6%	**0.006**
The neighbourhood is friendly	67.2%	67.2%	0.635	65.3%	72.1%	0.287
Crime is high in the neighbourhood	17.9%	20.1%	0.075	34.7%	23.7%	**0.046**
There are pleasant walks to do in the neighbourhood	67.9%	50.5%	**<0.001**	82%	37%	**<0.001**
Shops and services are within walking distance in the neighbourhood	85.5%	59.2%	**<0.001**	88.3%	64.4%	**<0.001**
They often see people out on walks in their neighbourhood	90.2%	87.5%	0.105	92.5%	85.1%	**0.021**
The neighbourhood is kept clean and tidy	73.6%	66.1%	**0.007**	76.2%	72.3%	0.541
There are busy streets to cross when out on walks in the neighbourhood	72.3%	48.4%	**<0.001**	80.8%	57.1%	**<0.001**
The footpaths are in good condition in the neighbourhood	63.4%	37.1%	**<0.001**	64.3%	46.8%	**<0.001**
There is heavy traffic in the neighbourhood"	66%	44%	**<0.001**	75.6%	52.1%	**<0.001**
It is safe to cycle in the neighbourhood	63.8%	67.9%	0.231	59.2%	66.9%	0.214
The streets are well lit in the neighbourhood"	51.3%	25.5%	**<0.001**	45.8%	36.6%	**0.041**
There are open spaces such as parks and ovals for people to walk in or around in the neighbourhood	75%	64.1%	**0.053**	85.7%	69.1%	**<0.001**
There are bicycle or walking paths/trails within walking distance of the homes in the neighbourhood	86.4%	69.9%	**<0.001**	90.8%	75.4%	**<0.001**

Table 4:9: Comparison of perceived physical environment and safety between 2004 and 2006

% Participants agreeing or strongly agreeing	Before intervention 2004 (n=420)	After intervention 2006 (n=471)	p value
It is "safe to walk in their neighbourhood"	62.5%	64.3%	0.415
Dogs frighten people who walk in their neighbourhood	46.8%	46.1%	0.782
The neighbourhood is friendly	67.2%	67.8%	0.750
Crime is high in the neighbourhood"	18.9%	30.9%	**<0.001**
There are pleasant walks to do in the neighbourhood	60.3%	76.2%	**<0.001**
Shops and services are within walking distance in the neighbourhood	74%	79.8%	0.178
They often see people out on walks in the neighbourhood	89%	89.7%	0.608
The neighbourhood is kept clean and tidy	70.3%	74.8%	0.279
There are busy streets to cross when out on walks in the neighbourhood	61.8%	72.3%	**0.005**
The footpaths are in good condition in the neighbourhood	52.1%	57.8%	0.077
There is heavy traffic in the neighbourhood	56.3%	67.2%	**0.010**
It is "safe to cycle in the neighbourhood	65.6%	62%	0.390
The streets are well lit in the neighbourhood	40%	42.3%	0.467
There are open spaces such as parks and ovals for people to walk in or around in the neighbourhood	70.2%	79.5%	**0.002**
There are bicycle or walking paths/trails within walking distance of their homes in their neighbourhood	79%	85.1%	**0.016**

Comparison of the 2004 and 2006 intervention participants in relation to perceived physical environment and safety

When comparing the 2004 and 2006 intervention respondents, 2006 intervention respondents were significantly more likely to report that "there are pleasant walks to do in the neighbourhood" (p<0.001) "the footpaths are in good condition in the neighbourhood" (p=0.030); "there are open spaces such as parks and ovals for people to walk in or around in the neighbourhood" (p=0.002); "there are bicycle or walking paths/trails within walking distance of their homes in the neighbourhood" (p=0.043) (Table 4.10).

Table 4:10: Comparison of intervention area between 2004 and 2006.

% Participants agreeing or strongly agreeing	Before intervention 2004 (n=236)	After intervention 2006 (n=295)	p value
It is "safe to walk in their neighbourhood"	63%	61.6%	0.861
Dogs frighten people who walk in their neighbourhood	45.1%	39.6%	0.419
The neighbourhood is friendly	67.2%	65.3%	0.614
Crime is high in the neighbourhood"	17.9%	34.7%	**<0.001**
There are pleasant walks to do in the neighbourhood	67.9%	82%	**<0.001**
Shops and services are within walking distance in th neighbourhood	85.5%	88.3%	0.694
They often see people out on walks in the neighbourhood	90.2%	92.5%	0.332
The neighbourhood is kept clean and tidy	73.6%	76.2%	0.053
There are busy streets to cross when out on walks in the neighbourhood	72.3%	80.8%	0.095
The footpaths are in good condition in the neighbourhood	63.4%	64.3%	0.834
There is heavy traffic in the neighbourhood	66.0%	75.6%	0.083
It is "safe to cycle in the neighbourhood	63.8%	59.2%	0.530
The streets are well lit in the neighbourhood	51.3%	45.8%	0.294
There are open spaces such as parks and ovals for people to walk in or around in the neighbourhood	75%	85.7%	**0.002**
There are bicycle or walking paths/trails within walking distance of their homes in their neighbourhood	86.4%	90.8%	**0.043**

Riverway path use

There was no significant difference in participants in the intervention and comparison groups in relation to river path use in 2004 (remembering that in 2004 both groups had access to the existing unmodified path along the river bank). In 2006 there was a significant increase in path use by participants in the intervention group compared to the comparison group ($p<0.001$) and significantly more participants from the intervention group walked to the paths ($p<0.001$) and used the paths for walking ($p=0.001$) compared to the comparison group (Table 4.11).

In relation to use of the actual Riverway complex (where the swimming lagoons, cultural centre, cafe/restaurant and picnic/barbeque areas are) in 2006 there was no difference between use in the intervention group and comparison group but participants in the intervention group were significantly more likely to walk to the Riverway complex ($p<0.001$). In relation to Loam Island participants in the comparison group were significantly more likely to drive to Loam Island in comparison to participants in the intervention group ($p=0.007$) (Table 4.11).

Table 4:11: Comparison of river path use between intervention and comparison in 2004 and 2006.

	Before intervention (2004)			After intervention (2006)		
	Intervention (n=236)	**Comparison (n=184)**	**p value**	**Intervention (n=295)**	**Comparison (n=176)**	**p value**
Riverway paths along Ross River						
% users of paths along Ross River	52.8%	47.8%	0.314	60.9%	43.9%	**<0.001**
% how to get there – walk	39.5%	32.1%	0.117	43.4%	23.6%	**<0.001**
% how to get there – drive self	8.2%	15.2%	**0.024**	15.9%	20.6%	0.202
% how to get there – someone drives you	1.3%	0.5%	0.436	2.0%	1.7%	0.807
% how to get there - bicycle	16.7%	15.2%	0.675	14.6%	13.7%	0.796
% how to get there - bus	0.4%	1.1%	0.432	0.3%	0.6%	1.000
% how to get there - other	2.1%	0%	**0.046**	1.0%	0.6%	1.000
% using paths for walking	42.9%	40.2%	0.579	52.5%	36.6%	**<0.001**
% using paths for jogging	7.7%	7.1%	0.799	5.4%	5.7%	0.894
% using paths for cycling	18.5%	19.6%	0.774	17.6%	14.9%	0.444
% using paths for other	3.4%	1.1%	0.120	3.4%	1.1%	0.135
% using river for canoeing	3.8%	3.8%	0.982	3.7%	6.9%	0.129
% using river for kayaking	1.7%	1.1%	0.699	1.7%	0.6%	0.419
% using river for rowing	0.4%	1.6%	0.325	0.3%	2.3%	0.066
% using river for skiing	4.3%	3.8%	0.810	1.7%	2.9%	0.399
% using river for other	11.1%	12.5%	0.661	11.5%	8.6%	0.311
Riverway Complex						
% people using Riverway Complex				62.8%	58%	0.304
% how to get there – walk				24%	3.4%	**<0.001**
% how to get there – drive self				45.6%	54.3%	0.069
% how to get there – someone drives you				8.1%	5.3%	0.276
% how to get there - bicycle				7.4%	4.0%	0.134
% how to get there - bus				0.3%	1.1%	0.558
% how to get there - other				1.0%	0%	0.298
% using swimming lagoon				31.1%	31.4%	0.937
% using restaurant				27.5%	28%	.0.899
% using Riverway and surrounding paths				44.3%	34.9%	0.450
% using Riverway arts centre and gallery				24.4%	26.3%	0.650
Loam Island						
% people using Loam Island				21.1%	26.3%	0.196
% how to get there – walk				13.2%	8%	0.086
% how to get there – drive self				11.5%	20.6%	**0.007**
% how to get there – someone drives you				1.7%	1.1%	1.000
% how to get there - bicycle				2.7%	6.9%	0.031
% how to get there - bus				0%	0%	
% how to get there - other				1.0%	1.1%	1.000
% using scouts				0.7%	1.7%	0.365
% using rowing club				1.0%	2.9%	0.154
% using water ski club				0.3%	1.1%	0.558
% using paths and parkland				17.2%	17.1%	0.981
% who believe that Riverway development will have/has had an increase on residents' activity levels	89.7%	94.5%	P=0.188	91.9%	91.8%	0.164
% who believe that Riverway development will have/has had an increase on own activity levels	70%	71.2%	P=0.302	49.7%	54.9%	0.192

When comparing path use between 2004 and 2006 the only significant difference was in participants who drove to the path with more participants driving in 2006 compared to 2004 (p=0.007) (Table 4.12).

Table 4:12: Comparison of river path use between 2004 and 2006

	Before intervention (2004) (n=420)	**After intervention (2006) (n=471)**	**p value**
% users of paths along Ross River	50.6%	54.6%	0.234
% how to get there – walk	36.2%	36%	0.956
% how to get there – drive self	11.3%	17.7%	**0.007**
% how to get there – someone drives you	1.0%	1.9%	0.239
% how to get there - bicycle	16.1%	14.3%	0.452
% how to get there - bus	0.7%	0.4%	0.452
% how to get there - other	1.2%	0.9%	0.670
% using paths for walking	41.7%	46.6%	0.742
% using paths for jogging	7.4%	5.5%	0.145
% using paths for cycling	18.9%	16.6%	0.249
% using paths for other	2.4%	2.6%	0.353
% using river for canoeing	3.8%	4.9%	0.882
% using river for kayaking	1.4%	1.3%	0.439
% using river for rowing	1.0%	1.1%	0.838
% using river for skiing	4.1%	2.1%	1.000
% using river for other	11.7%	10.4%	0.093
% who believe that Riverway development has had an increase on residents' pa levels	91.3%	91.9%	0.081
% who believe that Riverway development has had an increase on own pa levels	70.5%	48.3%	**<0.001**

When 2004 and 2006 data were combined those participants who use the River paths are significantly more likely to be sufficiently active for health (p<0.001).

Perception of the impact of Riverway on residents' physical activity levels or on own physical activity levels

There was no significant difference in the percentage of participants in the intervention and comparison groups in 2004 and 2006 in relation to whether they believed that the Riverway development would or had increased residents' physical activity levels or their own physical activity levels.

Multi-variable analysis: Impact of intervention on physical activity levels

To test the main hypothesis of the study "whether the intervention group had improved levels of physical activity in 2006 compared to the comparison group" multi-variable linear regression analysis was conducted assessing the effect of the interaction between the intervention and comparison area and the survey years (before and after the intervention). The linear regression model was hierarchical using the log-transformed physical activity outcome variable. A statistically significant interaction would show that the intervention group had significantly improved levels of physical activity in 2006 compared with 2004. The interaction between intervention and survey year was not significant, unadjusted (p=0.395) and adjusted for confounding factors (p=0.512), including the total self-efficacy score, environmental concerns, level of education, and country of birth. Hence the main hypothesis was not confirmed. The level of physical activity in the intervention people responding in 2004 was not statistically significantly different from the level in people responding in 2006.

Characteristics that influenced physical activity

Multi-variable linear regression analysis was used to identify characteristics that predicted the log-transformed level of physical activity (Table 4.12). The higher the total self-efficacy score (p<0.001) and the higher the total score for social environment (p<0.001), the higher the level of physical activity. Participants born in Australia had higher levels of physical activity than people born elsewhere (p=0.030). Being a single parent (p=0.028) and an increasing number of health problems (p=0.008) had a negative effect on the level of physical activity. These results are shown in Table 4.13.

Table 4:13: Result of multi-variable linear regression analysis* identifying predictors of level of physical activity (log-transformed).

Characteristic	Coefficient	95%-confidence interval	p value
Total self-efficacy score	0.098	[0.071, 0.124]	**<0.001**
Total social environment score	0.080	[0.040, 0.120]	**<0.001**
Born in Australia	0.438	[0.043, 0.832]	**0.030**
Being single parent	-0.515	[-0.974, -0.055]	**0.028**
Number of chronic health problems	-0.193	[-0.335, -0.050]	**0.008**

*This model was adjusted for the confounding effects of age (confounded being single parent and number of chronic health problems), being Aboriginal, Torres Strait Islander or South Sea Islander (confounded being single parent), and being current smoker (confounded being single parent).

Discussion

This study aimed to evaluate the impact of recreational environmental modifications in a community setting (The Riverway) on the physical activity levels of neighbourhood residents. The study used the unique advantage of a real life intervention or "natural experiment" and specifically aimed to assess the impact that the Riverway modification had on overall physical activity levels of residents who reside in five suburbs adjacent to the proposed Riverway development before and after the Riverway development; the relationship between physical activity and proximity to environmental areas that are conducive of physical activity (Riverway) before and after the Riverway development; resident's perceptions of the impact of environmental modifications on physical activity in terms of aesthetics, facilities, safety, self efficacy and social connectivity before and after the Riverway development; and resident's perceptions of the barriers to physical activity before and after the Riverway development.

Despite there being a 2% increase in the proportion of participants who were sufficiently active for health in 2006 compared to 2004, our study was unable to show a statistically significant increase in physical activity as a result of the Riverway modification. The participants in our study were already quite active with 66.8% being sufficiently active for health in 2004 and 68.8% being sufficiently active for health in 2006. This is higher than the overall rates of physical activity participation in Australia - 56.8% in 2000 (Bauman, Ford and Armstrong, 2001), and in Queensland - 45% in 2001 (Queensland Health, 2003). It is likely that results may suffer from selection bias and it is possible in a more representative sample some changes could have been detected. The response rate was very low and people who took the time to complete the questionnaire were likely to be already interested in the topic and likely to be already quite motivated to be physically active due to this interest.

However, despite the inability to show statistically significant changes in physical activity levels as a result of the Riverway development, there are some encouraging results in relation to respondents' perception of the environment and their usage of the modified environment. Overall significantly less respondents in 2006 reported that "there was a lack of a pleasant environment to be active in" as a barrier, compared to 2004. In 2006 significantly more respondents from the intervention area reported that "they often see people out on walks in their neighbourhood" compared to the comparison area whereas no difference was reported in 2004. In both 2004 and 2006 significantly more respondents from the intervention area reported that "there are pleasant walks to do in the neighbourhood", "there are open spaces such as parks and ovals for people to walk in or around in the neighbourhood" and "there are bicycle or walking paths/trails within walking distance of their homes in the neighbourhood" however, the percentages of respondents reporting this were higher in 2006. This was also observed when comparing the 2004 and 2006 respondents collectively (both intervention and comparison) as well as comparing just those respondents in 2004 and 2006 from the actual intervention area. Respondents from the intervention area in 2006 were also significantly more likely to report higher levels of social support compared to respondents from the comparison area and this is in contrast to 2004 where no differences were seen.

In relation to usage of the modified area changes were also seen. Significantly more respondents from the intervention area reported using the paths along the river, walking to the paths and using the paths for walking compared to respondents in the comparison area in 2006, which is in contrast to 2004 where no differences were seen between the groups. Although there was a difference in the percentage of intervention and comparison participants who used the river paths in 2006 there was no difference in the percentage of intervention and comparison participants who used the Riverway facility. What was different was that participants in the intervention area were significantly more likely to walk to the Riverway complex than those living further away in the comparison area (24% versus 3.4%). This was also seen in relation to the Loam Island area. This is not surprising given previous research that reported that proximity to destinations impacts on physical activity (Addy, Wilson, Kirtland, Ainsworth, Sharpe, Kimsey, 2004; Powell, et al., 2003; Troped et al, 2001; Handy, Boarnet, Ewing & Killingsworth, 2002). Interestingly there was no significant difference between the percentage of people in the intervention and comparison groups who drove to the Riverway complex indicating that for some people in the intervention group proximity still fails to encourage walking. In Gordon et al.'s, 2004 study, they found that 77.5% of trail users were habitual exercisers and given the high percentage of Riverway participants that were already active it may well be that in our research the participants who were active and walking to the facilities would be active and walking anyway whereas the non-active people were still unlikely to become active without other incentives or interventions.

While there have been a number of studies that have examined the environmental factors (usually together with individual and social factors) to assess their association with physical activity (these have been described in Chapter Two), this is one of the limited number of intervention studies that specifically evaluated the impact of modifying an environment in a neighbourhood setting. At the time that this research was conducted, no other Australian studies had been conducted specifically of this nature and as such there is little other similar literature with which to compare these results. However, a study was conducted at a similar time in North Carolina where a multi-use trail was evaluated (Evenson, Herring and Huston, 2005) and the findings of the Riverway study are discussed in relation to the findings from the North Carolina study as well as in relation to other studies that looked at trail use and public open space use (Brownson et al., 2000; Brownson et al., 2004; Merom et al., 2003; Gordon et al., 2004; Troped et al., 2001; Troped, Saunders & Pate, 2005; Giles-Corti et al, 2005; Librett, Yore & Schmid, 2006).

The results of our study are similar to those of the study conducted in North Carolina which also used a quasi-experimental design and aimed to evaluate the change in physical activity with the building of a multi-use trail (Evenson et al., 2005). The study surveyed adults who resided within two miles (3.2 km) of an abandoned railroad bed which was converted to a 10 foot wide trail and paved for pedestrians, bicyclists and others. The first 3.2 mile (5 km) re-modification was opened in June 2000. While the trail aspect of this study is similar to Riverway (i.e. 5km of pathways along a river were upgraded), it did not include any wider facilities that are at Riverway (i.e. the lagoons and picnic areas, etc., as described in Chapter One). As with the current study, the Evenson et al., (2005) study was not able to demonstrate an increase in adult physical activity among adults residing near the trail after the study compared to the baseline. However unlike Evenson et al's., study that found no relationship between trail use and meeting recommendations for physical activity, the current study showed that when the 2004 and 2006 data were combined, those participants who use the River paths are significantly more likely to be sufficiently active for health ($p<0.001$) indicating that usage may relate to physical activity behaviour.

Brownson et al., (2004) also conducted a quasi-experimental designed study that examined changes in walking behaviour in six rural intervention communities in Missouri compared to six comparison communities in Arkansas and Tennessee. In their study six walking trails were developed mostly in residential park areas. The trails varied in length from 0.13 miles (200 m) to 2.38 miles (3.8 km) with a mean of 0.68 miles (1 km). Unlike the Riverway study this study also used promotional activities to encourage trail use. Brownson et al., (2004) found that those who were not regular walkers were more likely to increase their physical activity due to the trail than those who were already regular walkers and suggested that this might be due to regular walkers using the trail to maintain activity while those who are inactive use it to start to be more active and as a result increase their activity. This could well be the case for participants in the Riverway study given that a large proportion of respondents were already sufficiently active for health and that they felt that the Riverway development had not impacted on their own activity. Interestingly, over 90% of our Riverway participants believed that the precinct had increased the physical activity of other residents. It is likely that these participants valued a physically active life and that by having access to pleasant environments to be active in, encouraged and facilitated physical activity adherence.

As discussed in Chapter Two, the importance of having recreational facilities for physical activity within close proximity of peoples' homes was supported by a number of studies (Sallis, Frank, Saelens & Kraft, 2004; McCormack, Giles-Corti, Lange, Smith, Martin & Pikora, 2004; Powell et al., 2003; Troped et al., 2001; Merom et al., 2003; Handy et al., 2002). Brownson et al.'s (2000) study conducted in Missouri showed that among persons with access to walking trails, 38.8% had used them; indicating that if such facilities are constructed they will be used. In the currrent study there was no change in the percentage of people who used the Riverway paths between 2004 and 2006, however, in 2006 significantly more people in the intervention area used the paths along the river compared to those in the comparison area (60.9% versus 43.9%). Not surprisingly, nearly double the people in the intervention area walked to the paths from their homes compared to those in the comparison area (43.4 % versus 23.6%). Of those who used the paths, more people in the intervention area used the paths for walking compared to those who used the paths in the comparison area (52.5% versus 36.6%).

The Riverway results also highlight the importance of social support as an element in motivating people to be active and this has been found in other research (Giles-Corti & Donovan, 2002; Leslie, Owen, Salmon, Bauman, Sallis & Lo, 1999; Sallis & Owen, 1999; Stah et al., 2001).

This research on the Riverway precinct confirms that if facilities are constructed, people both in close proximity as well as those further away will use it. What remains to be determined however is what other activities people use such facilities for (i.e. for active or inactive activities). The Riverway study looked at activities such as walking, jogging, bicycling, swimming and other water activities but did not ask about more inactive activities such as picnicking. Further research in this area is needed. What does appear to be clear is that access to paths for walking does impact on physical activity and when 2004 and 2006 data were combined those participants who used the river paths were significantly more likely to be sufficiently active for health. Librett et al., (2006) also found that trail users were significantly more likely to be sufficiently active for health and Troped et al., (2005) reported that more trail users performed recreational physical activity compared to non-users. As previously discussed, it is possible that those who are sufficiently active already continue to use the paths to maintain their activity rather than increase it. While this should be encouraged and supported, strategies are required to shift inactive people towards more physically active lives as this is where the greatest health benefit lie (Blair, Kohl, Barlow, Paffenbarger, Gibbons & Macera, 1995).

The role of aesthetics in influencing physical activity has been discussed by Humpel et al., (2002); Trost, Owen, Bauman, Sallis & Brown, (2002); Lee and Moudon (2004); Owen, Humpel, Leslie, Bauman, Sallis, (2004); and McCormack et al., (2004) who describe the impact of environmental aesthetics in a neighbourhood including attributes such as the presence of trees, and having a variety of views and enjoyable scenery around the home and local area, as well as in the area where exercise is carried out (McCormack et al., (2004). The 2004 respondents in the Riverway study reported that the lack of a pleasant environment to be active in was a significant barrier to physical activity compared to participants in 2006 (39.2% versus 30.2%). In 2006 overall participants were significantly more likely to report that there were pleasant walks to do in their neighbourhood (76.2% versus 60.3%); that there were open spaces such as parks and ovals for people to walk in or around in their neighbourhood (79.5% versus 70.2%); and that there were bicycle or walking paths/trails within walking distance of their homes in their neighbourhood (85.1% versus 79%). When comparing intervention and comparison group participants in 2006, more people in the intervention group felt that there were open spaces such as parks and ovals for people to walk in or around in their neighbourhood (85.7% versus 75%); and that there were bicycle or walking paths/trails within walking distance of their homes in their neighbourhood (90.8% versus 86.4%). These results suggest that the modified Riverway area has impacted on neighbourhood perceptions of features that are conducive to physical activity. Giles-Corti et al., (2005) also found that the attractiveness of public open space was related to higher levels of walking.

Limitations of the study

While the results of the current study provide some insight into the relationship between modified environments and physical activity it is unlikely that they are a true reflection of the impact of Riverway on all people residing within 1.5 km of the modification. While inherently one would expect that the creation of environments that are supportive of physical activity would impact on physical activity at a population level, well designed, rigorous quasi-experimental studies are lacking and there is a need to provide evidence for policy makers and organizations such as local government to support the ongoing development of neighbourhood environments that are conducive to physical activity. Sallis, Bauman and Pratt (1998) suggested that the lack of such studies could illustrate the challenges in evaluating such complex interventions and the evaluation of the Riverway project was certainly not without its challenges.

Initially this study was designed as a pre post intervention and comparison group with both the intervention and comparison groups having similar access to existing path ways along the river but being differentiated by the distance to the river. The Thuringowa City Council assisted us in the selection of participants and the instructions were to use GIS maps to identify ALL participants who lived within 1.5 km of the river way paths both in the intervention area and the comparison area at baseline and follow up. At the time of the baseline when the Council provided the addresses they were unable to provide individually geo-coded addresses. However in 2009 access was gained to GIS data via the James Cook University Geography Department where it became clear that some addresses in the comparison group were in fact further away than the 1.5 km distance from the existing river path that had been specified (the GIS component that was added to this study in 2009 is described in Chapter Five). This meant that some residents in the comparison group were further away than originally planned and as a result were less similar to the intervention group in that some participants were outside the 1.5 km radius to the river paths. Although disappointing, the pre and post intervention and comparison group design was still of use but meant that the comparison group was not as similar to the intervention group as hoped.

A significant limitation with the current study is the low response rate from the surveys. Although this was anticipated and the sample size was initially inflated to try and counteract this, the response rate was even lower than expected. A further limitation to this study is that the data is cross-sectional so causal relationships are difficult to infer. As discussed previously, it is likely that self-selection bias resulted in a sample that was already more active than the overall population in the study area. Despite being a lower socio-economic area (Australian Bureau of Statistics [ABS], 2001) there was an under-representation of lower socio-economic participants in this study. Brownson et al., (2000) discuss the possibility that walking trails may assist people in lower socio-economic areas to initiate and increase their activity however our data was not able to support this finding. Given that marginalised groups are a priority for physical activity interventions (Commonwealth Department of Health and Aged Care [CDHAC], 1998) it was disappointing that this group was not captured in this research.

Due to budgetary constrictions the data used in the study was self-report and is open to reporting biases. Although a validated questionnaire was used to assess physical activity (the Active Australia questionnaire, CDHAC, 1998), it is possible that physical activity may have been under or over reported. Use of pedometer or accelerometer measured physical activity could provide more objective data and should be considered in future studies of this nature.

At baseline in 2004 an observational study of Riverway usage was conducted. This study was not repeated at follow up. This was because a bridge linking two sides of the river was constructed and opened in late 2006 which resulted in people that were not in the initial study area gaining ready access to the Riverway area. Due to the higher socio-economic status of residents on the other side of the river and that they came from a different geographical area and would previously had to drive to the Riverway area this would make comparisons between the 2004 baseline observation study and 2006 difficult and irrelevant.

Initially it was intended to conduct the follow up survey 12 months after the baseline study but due to the delayed completion of Riverway the follow up was postponed by 12 months. It was conducted at the same time of the year when weather was similar, however, it is difficult to determine if other interventions within the community that focused on physical activity might have influenced the results (for example, the local public health unit was conducting the community based 10,000 steps programs during this time period).

Regardless of these limitations this study does provide some information regarding the impact of modifying the physical environment on physical activity. As highlighted by Giles-Corti et al., (2005), the design (and/or re-design) of public open spaces can enhance the attractiveness of these spaces in a way that encourages active use by multiple users. In the case of Riverway there are opportunities for physical activities such as walking, jogging, cycling, swimming, and other water activities and further exploration of how and why Riverway is used would increase our understanding of the attributes of such environments that facilitate physical activity participation.

Conclusion

Although this prospective study evaluating the impact of a modification to the physical environment failed to show a significant increase in physical activity levels after completion of the Riverway redevelopment, the observed effects may have been attenuated as a result of the limitations discussed above. Further well designed prospective studies that rigorously evaluate environmental modifications are needed and the results and insights from this study will contribute to future environmental intervention studies of this nature. Since the completion of the Riverway study in 2006, other studies relevant to this topic have been conducted and the findings from these studies will be further discussed in relation to the Riverway study in Chapter Ten of this thesis.

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Chapter 5. The role of proximity in physical activity participation

5.1. Abstract

Objective: The aim of this study is to examine the association between objectively measured proximity to paths along the river and other public open space, and self-report measures of physical activity, use of areas and mode of access to areas and to undertake a comparison before and after the Riverway redevelopment.

Methods: Participants were drawn from the Riverway study and were survey respondents from 2004 (n=415) and 2006 (n=461). Objectively measured proximity used Geographical Information Systems (GIS) to geocode the 2004 and 2006 survey respondents' homes to create three objective variables in relation to the distance to: the pathway along the Ross River; the Riverway complex; and the Riverway precinct.

ArcGIS 9 software was used for data acquisition and development, and subsequent spatial analysis. Self-report physical activity was assessed using the Active Australia questionnaire as described previously.

Results: No relationship was identified between proximity to paths or environments that have been modified to make them more conducive for physical activity, in relation to overall physical activity, those who were sufficiently active for health or those who walked for destination or recreation. In both 2004 and in 2006, participants who used the pathways lived significantly closer than those who did not use the paths (by 362 meters - $p=0.009$ in 2004 and by 424 meters - $p<0.001$ in 2006). In 2006, participants who used the Riverway precinct lived 444 meters closer – $p<0.001$. In 2006 users of the Riverway complex lived significantly closer than those who did not use the complex (by 868meters - $p=0.002$) but no significant difference was seen in 2004 in relation to the same vicinity when it was in its original state. These same patterns were observed in relation to those who walked to the areas with those residents living closer to the modified areas and paths being more likely to walk to the areas.

Conclusion: Creating community environments to make them more conducive for physical activity can result in increased usage by residents if the environments are within close proximity to where they reside. This could help reinforce and maintain

already healthy, active lifestyles however may not be enough to engage those who are not already engaging in physical activity.

5.2. Introduction

As described in previous chapters, the Riverway study was originally designed as a pre- and post-intervention and comparison group study with both the intervention and comparison groups at baseline having access to the existing path ways along the river and living within 1.5 km of the pathway. The addresses of all residents who supposedly lived within 1.5 km of the existing paths was provided by the Thuringowa City Council and were randomly selected to receive the survey. At the time of the study the Thuringowa City Council used Geographical Information Systems (GIS) maps to identify the 1.5 km boundary but did not have the capacity to provide individually geocoded addresses. However, in 2009 GIS data was able to be accessed via the James Cook University Geography Department and it was decided to undertake a proximity study using this data to assess the impact of objectively measured distance on physical activity. At this time that it became clear that some addresses in the comparison group were in fact further away than the 1.5 km distance from the existing river path that had been specified. This meant that the comparison group had become broader than originally planned and as a result was less similar to the intervention group in that some participants were more than 1.5 km from the existing and later modified paths along the river. The pre- and post-intervention and comparison group design was still able to be used but it meant that the comparison group was not as similar to the intervention group as originally planned in regards to distance from existing river paths.

As discussed in the previous chapters there are a number of environmental factors that have been shown to relate to physical activity. In particular, having proximate access from one's residence to public open space such as the Riverway area could result in residents being more physically active. The associations with proximity have been observed both in relation to perceived proximity (Humpel, Owen & Leslie, 2002; Duncan, Spence and Mummery, 2005) and objectively measured proximity (Troped, Saunders, Pate, Reininger, Ureda & Thompson, 2001).

The redevelopment of the Riverway and surrounding area upgraded a large empty public open space with minimal built and aesthetic features to one that was enhanced aesthetically and contained multiple features including paved paths, boardwalks, picnic, playground and sporting facilities providing an ideal opportunity to assess the relationship between public open space and trail/path proximity, aesthetics and features with physical activity.

Thus the aim of this study was to examine the association between objectively measured proximity to paths along the river and other public open space and self-report measures of physical activity, use of areas and mode of access to areas and to undertake a comparison before and after the Riverway redevelopment.

5.3. Methodology

Participants were drawn from the Riverway study (previously described in Chapters Three and Four) and were survey respondents from 2004 (n=415) and 2006 (n=461). Objectively measured proximity used GIS to geocode the 2004 and 2006 survey respondents' homes to create three objective variables in relation to the distance to:

- *The pathway along the Ross River* – included the existing, unmodified path in 2004 and the upgraded path in 2006 that extended for 5 km as well as the unmodified path that continued along the river.
- *The Riverway complex* – the area comprising the swimming lagoons, cultural centre, playgrounds, amphitheatre, coffee shop/restaurant/sporting complex, river edge development.
- *The Riverway precinct* – included the Riverway precinct and the 5 km path and surrounds upgrade.

Distances were measured in metres and were based on the shortest possible road network route between a survey respondent's home to the three different destinations described above. ArcGIS 9 software was used for data acquisition and development, and subsequent spatial analysis. Self-report physical activity was assessed using the Active Australia questionnaire as described previously.

Figures 5.1 to 5.3 contain examples of GIS measured distance from a residential address to the Riverway complex, Riverway precinct and river pathway.

Figure 5:1: Example of GIS measured distance from residential address to Riverway Complex

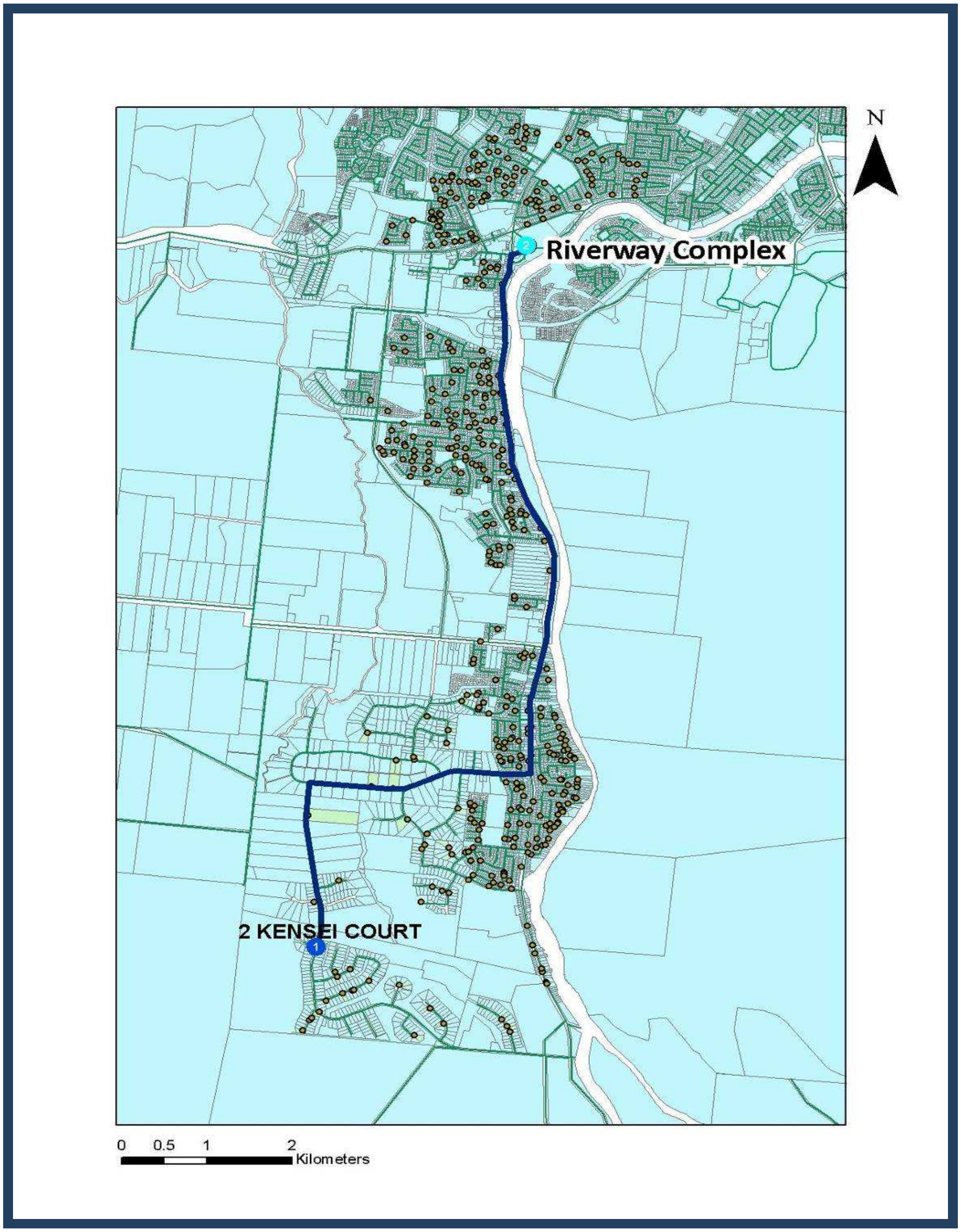


Figure 5:2: Example of GIS measured distance from residential address to Riverway precinct.

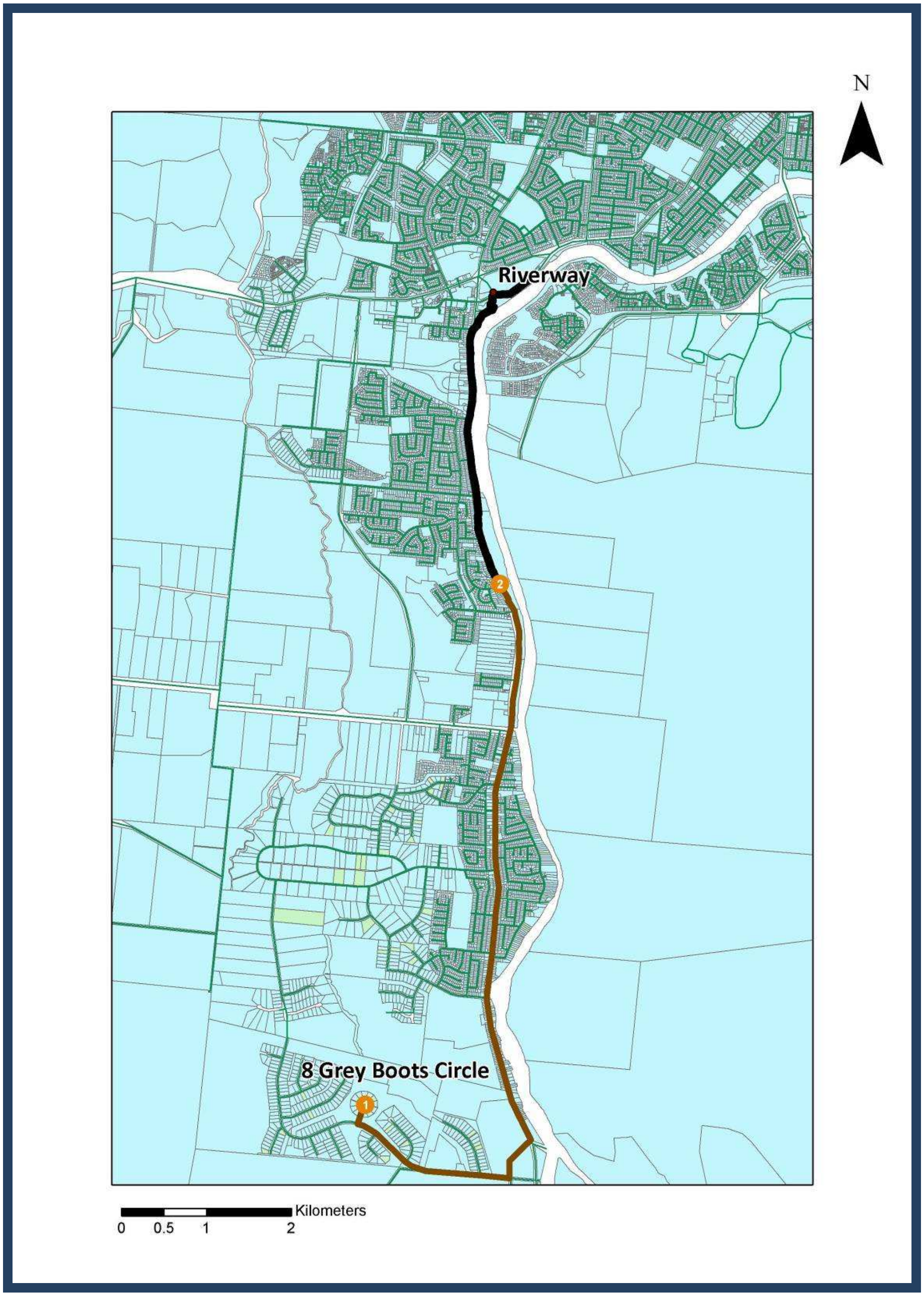
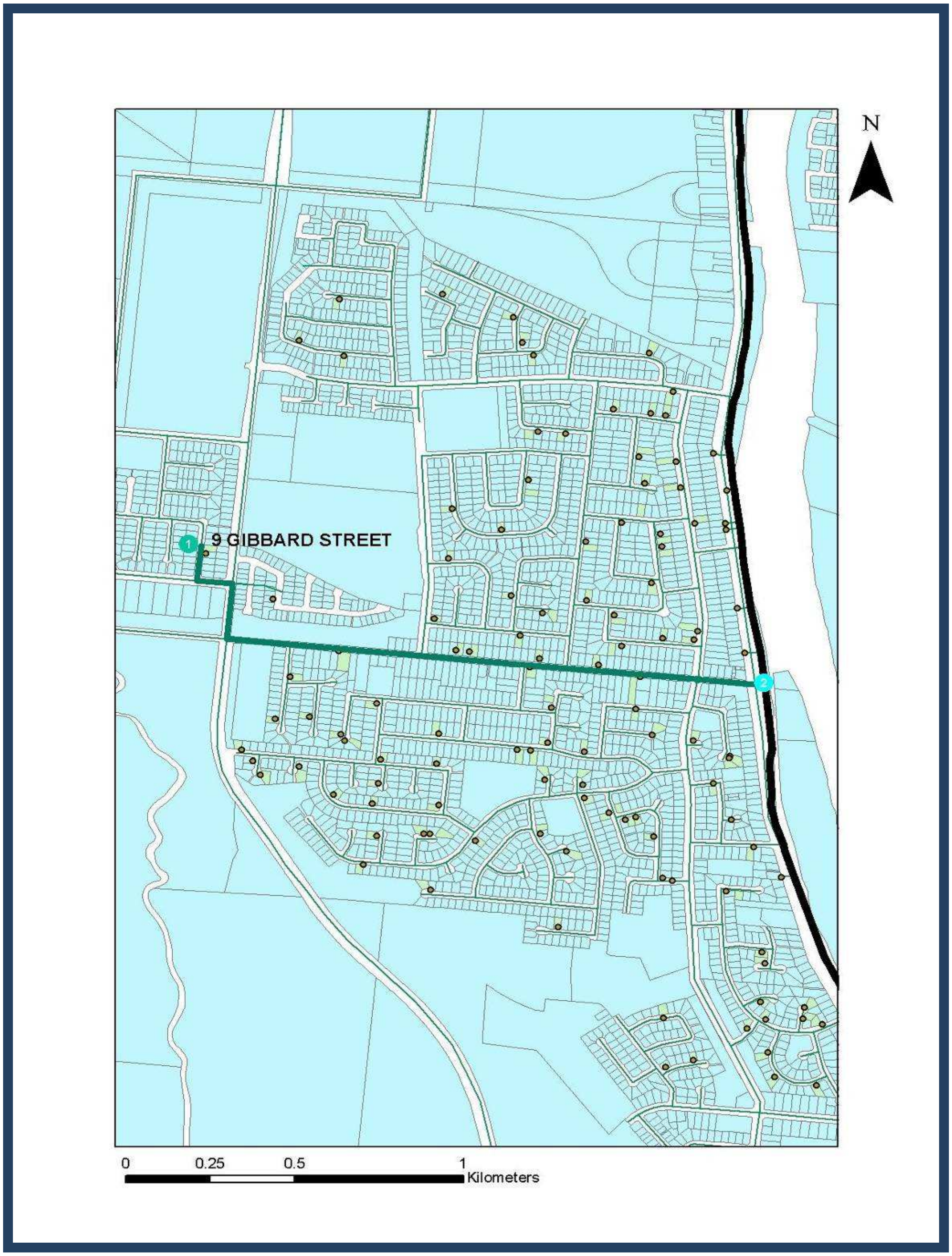


Figure 5:3: Example of GIS measured distance from residential address to river pathway.



Statistical analysis

Distance measures were skewed hence these numerical data were summarized using median, inter-quartile range (IQR) and range. The Spearman rank correlation coefficient or non-parametric Wilcoxon tests were calculated between total physical activity score, those who were sufficiently active for health, walking for leisure, walking for destination, total walking time, current use of river pathways, walking to river pathways, and bicycling to the river pathways based on the postal questionnaire and GIS proximity data. The correlation coefficient was squared to calculate the coefficient of determination. The coefficient of determination x 100 provides the percent of variance of the characteristic under investigation which was explained by thw GIS measured distance. Statistical analysis was conducted using SPSS, release 17 for Windows. A significance level of 0.05 was assumed throughout the analysis.

5.4. Results

The demographics of participants in 2004 and 2006 have been described previously in Chapters Three and Four and are not repeated here.

5.4.1 Median distance of 2004 and 2006 participants to the Riverway complex, Riverway precinct and river pathways

The median distance of 2004 and 2006 participants to the Riverway complex, Riverway precinct and river pathways is presented in Table 5.1.

Table 5:1: Median distance of 2004 and 2006 participants to the Riverway complex, Riverway precinct and river pathways

	2004 (n=415)	2006 (n=461)
Median distance between home and Riverway complex* (IQR), range [m]	5902 (2187,7810), range 506-13,402	3898 (1872, 7568), range 432 – 13076
Median distance between home and river pathways (IQR), range [m]	1651 (1011,2450), range 4-7969	1448 (873, 2247), range 20 – 9071
Median distance between home and Riverway precinct* (IQR), range [m]	2323 (1170,4192), range 4-9770	1719 (1018, 4065), range 23 - 9451

* Please note that in 2004 the Riverway complex did not exist and the Riverway precinct had not been redeveloped so the distances are to the areas only, not the redeveloped areas.

5.4.2 Associations between GIS distance to Riverway complex and physical activity, use of the area and mode of access

The associations between GIS distance to Riverway complex and physical activity, use of area and mode of access is presented in Table 5.2. Only 2006 data was examined as the Riverway complex did not exist in 2004. There were no statistically significant correlations between GIS distance to the Riverway complex and total physical activity in the 2006 cohort (p=0.782). Coefficients of determination between physical activity and GIS measurements were all below 0.5%. There was no statistically significant difference in the median GIS measured distance to the Riverway complex between participants who were sufficiently active for health and the ones who were not in 2006 (p= 0.534). In 2006 current users of the Riverway complex resided almost 900m closer than non-users (p=0.002) and those who walked to the Riverway complex resided more than 1 km closer than non-users (p=0.001).

Table 5:2: Associations between GIS distance to Riverway complex and physical activity, use of the area and mode of access

Activity characteristics	Association with GIS data	p value
Total PA in last week [MET mins]		
2004	r (Spearman)= -0.01 (r^2=0.0001)	0.841
2006	r (Spearman) = 0.013 (r^2=0.0002)	0.782
% Sufficiently active for health		
2006	Sufficiently active: median distance 3862; IQR= (1843, 7517.5) Not sufficiently active: median distance 3984; IQR= (1945, 7629.5)	0.534
Walking time for recreation in last week		
2006	r (Spearman)= -0.041(r^2=0.0017)	0.379
Walking time for destination in last week		
2006	r (Spearman)=-0.063 (r^2=0.0034)	0.182
Total walking time in last week		
2006	r (Spearman)=-0.054 (r^2=0.0030)	0.247
% Current use of riverway complex		
2006	Non user: median 4514; IQR= (2316.5, 7873.7) User : Median 3646; IQR= (1812, 7029)	**0.002**
% Walking to riverway complex		
2006	Walk to riverway complex: median 3306; IQR= (1799, 6650) Don't walk to riverway complex: median 4441; IQR= (2002,7829)	**<0.001**
% Bicycling to riverway complex		
2006	Cycle to riverway complex: median 3921; IQR= (1923,7691) Don't cycle to riverway complex: 3882; IQR= (1851, 7571.75)	0.815

IQR = inter-quartile range

5.4.3 Associations between GIS distance to Riverway precinct and physical activity, use of the area and mode of access

The associations between GIS distance to Riverway precinct and physical activity, use of area and mode of access is presented in Table 5.3. Only 2006 data was examined as the Riverway precinct had not been modified in 2004. There were no statistically significant correlations between GIS distance to the Riverway precinct and total physical activity for the 2006 cohort ($p=0.974$). There was no statistically significant difference in the median GIS measured distance to the Riverway precinct between participants who were sufficiently active for health and the ones who were not in 2006 ($p= 0.654$). In 2006 current users of the Riverway precinct resided almost 445m closer than non-users ($p<0.001$) and those who walked to the Riverway precinct resided 617 m closer than non-users ($p<0.001$).

Table 5:3: Association between GIS distance to Riverway precinct and physical activity, use of the area and mode of acces.

Activity characteristics	Association with GIS data	p value
Total PA in last week [MET mins]		
2006	r (Spearman) = 0.004 (r^2=0.00002	0.974
% Sufficiently active for health		
2006	Active: Median distance: 1670; IQR= (933,4017.5) Not sufficiently active: Median distance 1736; IQR= (1126.5,4137.5)	0.654
Walking time for recreation in last week		
2006	r (Spearman)= 0.020 (r^2=0.0004)	0.811
Walking time for destination in last week		
2006	r (Spearman)= 0.033 (r^2=0.0011)	0.702
Total walking time in last week		
2006	r (Spearman)= 0.034 (r^2=0.0012)	0.668
% Current use of riverway precinct		
2006	Non user: Median distance 1993.5; IQR= (1277,4285.5) User : Median distance 1549; IQR= (832,3513)	**<0.001**
% Walking to riverway precinct		
2006	Walk to riverway precinct: Median distance 1317; IQR= (575,3070) Don't walk to riverway precinct: Median distance 1934; IQR= (1273,4263)	**<0.001**
% Bicycling to riverway precinct		
2006	Cycle to riverway precinct: Median distance 1729; IQR= (1023,4213) Don't cycle to riverway precinct: Median distance 1712.5; IQR= (1020.5, 4059)	0.980

IQR = inter-quartile range

5.4.4 Associations between GIS distance to any path and physical activity, use of the area and mode of access

The associations between GIS distance to any path and physical activity, use of area and mode of access is presented in Table 5.4. Both 2004 and 2006 data were examined as a path existed at both points in time. There were no statistically significant correlations between GIS distance to the path and total physical activity for 2004 (p=0.787) or for 2006 (p=0.955) cohorts. There was no statistically significant difference in the median GIS measured distance to the path between participants who were sufficiently active for health and the ones who were not in 2004 (p=0.733) nor 2006 (p= 0.654). In 2004 and 2006 current users of the paths resided closer than non-users (362m; p=0.009 in 2004) and (424m; p<0.001 in 2006) and those who walked to the paths resided closer than non-users (505m; p<0.001 in 2004) and (612m; p<0.001 in 2006).

Table 5:4: Associations between GIS distance to any path and physical activity, use of the area and mode of access

Activity characteristics	Association with GIS data	p value
Total PA in last week [MET mins]		
2004	r (Spearman)= -0.013 (r^2=0.0002)	0.787
2006	r (Spearman) = -0.003 (r^2=0.00001)	0.955
% Sufficiently active for health		
2004	Active: Median distance 1594; IQR= (932,2431) Not sufficiently active: median distance 1706; IQR= (1125.5,2506.5)	0.733
2006	Active: Median distance 1448; IQR= (866.5,2192.5) Not sufficiently active: Median distance 1435; IQR= (858.5,2279.5)	0.654
Walking time for recreation in last week		
2004	r (Spearman)= 0.005 (r^2=0.00003)	0.918
2006	r (Spearman)= -0.081 (r^2=0.0066)	0.085
Walking time for destination in last week		
2004	r (Spearman)= -0.085 (r^2=0.0072)	0.083
2006	r (Spearman)= -0.044 (r^2=0.0012)	0.349
Total walking time in last week		
2004	r (Spearman)= - 0.026 (r^2=0.0007)	0.595
2006	r (Spearman)= -0.087 (r^2=0.0076)	0.063
% Current use of path		
2004	Non user: Median 1822; IQR= (1268,2554) User: Median 1460; IQR= (807.5,2252.5)	**0.009**
2006	Non user: median 1694; IQR= (1128.75,2520.5) User : Median 1270; IQR= (732,1811)	**<0.001**
% Walking to path		
2004	Walk to path: median 1292; IQR= (562.5,2186) Don't walk to path: median 1797; IQR= (1244.5,1797)	**<0.001**
2006	Walk to path: median 1077; IQR= (485,1661) Don't walk to path: median 1689; IQR= (1176,2463)	**<0.001**
% Bicycling to path		
2004	Cycle to paths: median 1511; IQR= (935.25,2193.75) Don't cycle to paths: median 1702; IQR= (1033.5,2484.5)	0.378
2006	Cycle to paths: median 1361; IQR= (819,2265) Don't cycle to paths: median 1460; IQR= (884.5,2248.5)	0.980

IQR = Inter-quartile range

5.5. Discussion

This study examined the relationship between proximity of neighbourhood residents to paths and modified physical environments in order to assess the impact of such features on physical activity and use. No relationship was found between proximity to paths or environments that have been modified to make them more conducive for physical activity, in relation to overall physical activity, those who were sufficiently active for health, or those who walked for destination or recreation.

In both 2004 and in 2006, participants who used the pathways (please note that in 2004 there was no Riverway complex or modified Riverway precinct, just existing paths) lived significantly closer than those who did not use the paths (by 362 m - $p=0.009$ in 2004 and by 424 m - $p<0.001$ in 2006. In 2006 participants who used the Riverway precinct lived 444 m closer – $p<0.001$. In 2006 users of the Riverway complex lived significantly closer than those who did not use the complex (by 868 m - $p=0.002$) but no significant difference was seen in 2004 in relation to the same vicinity when it was in it's original state. These same patterns were observed in relation to those who walked to the areas, with those residents living closer to the modified areas and paths being more likely to walk to the areas. The lack of differences in relation to path use in 2004 and 2006 could be due to participants enjoying using the existing paths regardless of their condition due to the scenic locale along the banks of the Ross River. This study's findings have shown that those participants who use the paths along the river are significantly more likely to be sufficiently active for health ($p<0.001$).

The difference in the Riverway complex area could be due to the fact that before modification the area was a large empty open space with minimal features. The introduction of multiple features such as walking trails, boardwalks, picnic areas, swimming lagoons and landscaped gardens may have made it a more appealing location to use and to walk to. Kaczynski, Potwarka and Saelens, (2008) found that having a greater number of features in a public open space were an important predictor of physical activity.

As highlighted in the previous three chapters, there is a growing body of evidence that suggests that proximity, attractiveness and size of public open space influences use and are associated with physical activity, particularly walking (Giles-Corti, et al., 2005; Owen, Humpel, Leslie, Bauman, Sallis, 2004; McCormack Giles-Corti, Lange, Smith, Martin & Pikora, 2004). Previous research by McCormack, Giles-Corti and Bulsar (2008) has shown that proximity to destinations particularly those with a mix of destinations such as post boxes, bus stops, convenience stores, news agencies, shopping malls and transit stations were strongly associated with walking for transport but not for recreation (McCormack et al., 2007). No associations were found between walking for destinations and proximity in our study but the destinations that were under consideration (Riverway complex, Riverway precinct and paths) were more likely to be used for recreational purposes, which is in line with McCormack et al.,'s (2007) study which found that the presence of parks was not associated with either recreational walking or vigorous activity. The lack of association between parks and recreational walking and physical activity has also been found by Duncan and Mummery (2005) and Hoehner, Brennan, Ramirez, Elliott, Handy, & Brownson, (2005). Giles-Corti et al., (2005) also found no association between a distance only accessibility model for public open space but, when models included measures of attractiveness and size, higher levels of walking were evident. This indicates that both proximity and the attractiveness of destinations are important considerations when designing environments such as the Riverway to support physical activity (McCormack et al., 2008).

While the use of objective GIS data has added strength to the study some limitations do remain including the cross-sectional design of the study and self-report measures of physical activity.

5.6. Conclusion

The findings of this study support that creating pleasant environments to make them more conducive for physical activity can result in increased usage if the environments are within close proximity to where people reside. Such modifications could help reinforce and maintain already healthy, active lifestyles but may not be enough to enhance overall levels of physical activity participation particularly in those who are not sufficiently active for health.

5.7. References

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Chapter 6. Understanding Workplace Influences on Physical Activity

6.1. Abstract

Objectives: This literature review identifies existing reviews and other studies up to 2005 that examine evidence for the effectiveness of interventions to promote physical activity in workplace settings.

Methods: A literature search for review papers and original studies published between 1996 and 2005 was conducted using searches of electronic databases including Google Scholar, MEDLINE, PubMed, SPORT Discus, and CINAHL in combination with hand searching of reference lists in identified studies and of personal journal libraries. The following search terms were used in combination: ("physical activity" OR fitness OR exercise) AND (workplace OR worksite OR employee OR employer) AND (review OR meta-analysis) AND (intervention OR program).

Results: Sixteen papers (six review studies and ten other studies) were identified. Findings were inconsistent in regard to workplace programs increasing physical activity. Three of the review articles found no evidence to support the use of workplace interventions to increase physical activity while three found some evidence to support the use of workplace interventions. Most of the original non-review studies were limited by methodological issues including self-selection of participants, inability to recruit participants who were not already motivated to change, lack of randomised designs, self-report data and poor retention of participants, which made it difficult to draw conclusions about the effect of workplace programs on physical activity. These criticisms were also made by authors of the systematic reviews with respect to the papers they examined.

Conclusions: There is inconsistent evidence regarding the success of workplace physical activity programs to increase physical activity. While some evidence shows a positive effect of workplace physical activity interventions in the short-term, there is a lack of evidence to support long-term effectiveness. Methodological quality of studies is generally poor and there needs to be greater methodological rigor in future studies to allow for more definitive conclusions to be made. Despite the lack of evidence to

support workplace physical activity interventions, workplaces should be encouraged to work collaboratively with employees to design interventions that can be carefully evaluated, expanding the evidence available. More information is also important from an employer perspective as they are more likely to support interventions if there are benefits for both employees and employers.

6.2. Introduction

It is acknowledged that the places in which we live, work and play should support and promote good health (Radoslovich & Barnett 1998). This way of thinking is known as a settings approach to health promotion (Radoslovich & Barnett 1998). The World Health Organisation (WHO) defines a setting as "the place or social context in which people engage in daily activities in which environmental, organizational and personal factors interact to affect health and wellbeing" (WHO, 1998). A setting usually has defined physical boundaries, a range of people within the setting who have defined roles, and an organisational structure (WHO, 1998).

The settings approach in health promotion stems from the new public health movement and in particular the Ottawa Charter for Health Promotion (WHO, 1986). The Ottawa Charter stated that "health is created and lived by people within the settings of their everyday life; where they learn, work, play and love" (WHO, 1986). Workplaces, schools, hospitals, cities, islands and marketplaces, have been established as priority settings for health promotion into the 21st century (Chu et al., 2000). Riedel, Lynch, Baase, Hymel & Peterson, (2001) describe the workplace as a setting that has potential for health promotion programs to influence the health, productivity and quality of life of employees (Riedel et al., 2001). With most adults spending approximately half their waking hours at work, there is an ideal opportunity to influence healthy behaviour through employee health promotion programs (Engbers, van Poppel, Paw & van Mechelen, 2005; Dishman, Oldenburg, O'Neal & Shephard, 1998; Proper, Koning, van der Beek, Hildebrandt, Bosscher & van Mechelen, 2003). Chu et al. (2001) see the workplace as an important setting that affects the physical, mental, economic and social well-being of workers, and in turn the health of their families, communities and society; offering an ideal setting and infrastructure to support the promotion of health of a large audience.

Chu, Driscoll and Dwyer (1997) say the workplace is an important health promotion setting for a number of reasons. Firstly, to be productive at work, employees need to be fit and healthy. Secondly, because such a significant amount of the population spends a large proportion of their time at work, there is an ideal opportunity to reach a large and captive group of adults to whom health promotion programs can be delivered. This allows access to some groups who are historically difficult to reach, including males and people from lower socio-economic backgrounds. The gap in health outcomes between blue-collared and white collared workers is widely recognised (Marmot & Wilkinson, 1999) and the workplace might provide an opportunity to address these inequalities. The workplace has an existing infrastructure including resources and networks that can facilitate easier implementation of health promotion programs (DiNubile & Sherman, 1999). As Chu et al. (2000) observed, *"The concept of the health-promoting workplace is becoming more important and more relevant as more private and public organizations increasingly recognize that future success in an increasingly globalized marketplace can only be realized with a healthy, qualified and motivated workforce."*

It has been suggested that a healthy workplace can produce many benefits including a healthier workforce, improved morale, increased job satisfaction and reduced absenteeism, which in turn improves productivity and the quality of working life (Chu et al 1997; Riedel et al., 2001) as well as being able to reduce the overall health care costs (Lowe, 2003). Health promotion in these settings has an opportunity to influence these areas (Riedel et al., 2001). Despite the suggested benefits of work place health promotion, there remains a paucity of evidence as to what interventions work in these settings.

Harden, Peersman, Oliver, Mauthner & Oakley (1999) conducted a systematic review of the effectiveness of health promotion interventions in the workplace and concluded that the majority of outcome evaluations were not sufficiently rigorous to make a strong case for the effectiveness of workplace health promotion. It is clear that there is a need for rigorous approaches to be used in determining the effectiveness of the workplace as a setting for health promotion actions.

One area of particular relevance to workplace health promotion is physical activity. It has been suggested that physically active employees are less likely to suffer from major health problems, less likely to take sickness leave and less likely to have an accident at work (Dishman et al., 1998). Workplace physical activity health promotion programs evolved in the United States of America and Australia in the 1970s, where many large companies felt there were advantages in reducing cardiovascular risk factors for senior company members (Bauman, Bellew, Vita, Brown & Owen, 2002). Corporate fitness programs were developed with the aim of promoting regular vigorous activity for senior staff and eventually broadened to include employees across all levels. The impact of these programs is unclear although it is now recognised that individually focused lifestyle-change programs are limited. It is recommended that socio-behavioural approaches need to be combined with structural-environmental changes (Bauman et al., 2002). This approach is more in line with European health promotion initiatives which have a greater focus on changing the workplace organization to support healthier choices (Dishman et al., 1998). Regardless of the approach, it is important that careful evaluation of all health promotion initiatives in the workplace be conducted in order to establish evidence of the effectiveness of interventions including those that have a focus on physical activity.

As outlined in earlier chapters, local governments have a potential role to play in increasing physical activity both at a community level and at a workforce level. To be successful in influencing the physical activity of employees, it is important to have a clear understanding of the evidence regarding workplace physical activity initiatives.

Hence this chapter provides a summary of the existing evidence concerning the effectiveness of physical activity interventions in workplace settings up to 2005. The need for this review stems from my work on the Riverway project at which time managers at the Thuringowa City Council expressed interest in extending the work to incorporate some workplace physical activity initiatives. Understanding the current evidence about physical activity in the workplace was important to inform future work to address the issue of physical inactivity in the Council workplace.

The objectives of this review are to:

1. Identify existing review studies that examine the evidence for the effectiveness of interventions to promote physical activity in workplace settings;
2. Identify studies published since the reviews or not included in the reviews that examine the evidence for the effectiveness of interventions to promote physical activity in workplace settings; and
3. Provide direction for the future development of physical activity interventions within a local government workplace setting.

6.3. Methods

6.3.1 Review papers

A literature search for peer reviewed "review" papers published between 1996 and 2005 was conducted using computerised searches of electronic databases including Google Scholar, MEDLINE, PubMed, SPORT Discus, and CINAHL in combination with hand searching of reference lists in identified studies and of personal journal libraries. The following search terms were used in combination: ("physical activity" OR fitness OR exercise) AND (workplace OR worksite OR employee OR employer) AND (review OR meta-analysis).

The inclusion criteria for the reviews were: that they were published in the last ten years (between 1996 and 2005); were published in the English language; that the studies used in the reviews examined the relationship between the workplace setting and physical activity; evaluated interventions to increase physical activity; reported physical activity as the primary outcome (with the exception of one review that examined work-related outcomes); and used Randomised Controlled Trials (RCTs) or quasi-experimental designs. Reviews that used studies of a qualitative or descriptive nature only were excluded.

All titles were independently reviewed and relevant abstracts extracted for further review. A full text of all articles assessed as potentially relevant was obtained (eight articles). To assist in this process each article was assessed using a checklist identified from the Critical Appraisal Skills Programme (CASP) in the United Kingdom. The CASP checklist had "10 questions to help you make sense of reviews" and was adapted by CASP from Oxman, Cook & Guyatt (1994). The checklist is included as Appendix 6.1.

Following the full text review, five relevant articles were identified (see Figure 6.1 for the search process for review articles included in this review).

Figure 6:1: Flow Chart detailing search process for review articles

Database search
Google Scholar (n=85)
Medline (n=81)
Pubmed (n=80)
Sport Discus (n=49)
Cinahl (n=24)
Total - 81 articles identified (some overlap)

↓

Title and abstract screening
8 articles remain

↓

Screening of full text using CASP checklist: “10 questions to help you make sense of reviews”
6 articles remain

↓

Final number of review articles selected as relevant to this study
5

6.3.2 Original studies published since review papers or not included in reviews up to 2005.

Following the identification of the “review” articles a further search was conducted to identify original studies published since the review papers or not included in the reviews. Again, computerised searches of electronic databases including Google Scholar, MEDLINE, PubMed, Cinahl and Sport Discus in combination with hand searching of reference lists in identified studies and of personal journal libraries was conducted. The following search terms were used in combination: (“physical activity” OR fitness OR exercise) AND (workplace OR worksite OR employee OR employer) AND (intervention OR program).

The inclusion criteria for the papers were that they had been published since the reviews and/or were not included in the reviews: The search was limited to 2001–2005 to ensure that the most recent papers were accessed; were published in the English language; that the studies examined the relationship between the workplace setting and physical activity; evaluated interventions to increase physical activity; reported physical activity as the primary outcome; used a Randomised Controlled Trial (RCT), experimental design or quasi-experimental design. Again, papers that were qualitative or descriptive only were excluded. All titles were reviewed by myself and relevant abstracts extracted for further review. A full text of all articles that were assessed as being potentially relevant was obtained. If the study was a Randomised Control Trial the CASP checklist for Randomised Control Trails (6.2) was used. This checklist had been adapted by CASP from Guyatt, Sackett, and Cook (1993, 1994).

Following a full text review, 10 articles were identified as being relevant (see Figure 6.2 for the search process for the other recent studies published since review papers or not included in reviews).

Figure 6:2: Search process for other studies included in this review

Database search
Google Scholar (n=334)
Medline (n=249)
Pubmed (n=218)
Sport Discus (n=252)
Cinahl (n=70)
1,123 articles identified (some overlap)

↓

Title and abstract screening
28 articles remain

↓

Screening of full text using CASP Checklist
10 articles remain

↓

Final number of articles selected as relevant to this study
10

6.4. Results

6.4.1 Review papers

Six review papers published between 1998 and 2005 that examined the effectiveness of workplace physical activity programs on employee physical activity levels were identified although one focused on work-related outcomes more than physical activity. These six review papers examined 92 original source papers published between 1980 and 2004 (see Table 6.1 for the articles that were covered in the reviews).

Table 6:1: Studies about the effectiveness of workplace physical activity programs included in the review articles.

*** This table has been adapted from one used by Gebel et al (2005).

Author	Year	Journal	Dishman et al 1998	Proper et al 2002	Proper et al 2003	Marshall 2004	Engbers, et al 2005
Addley et al	2001	J Occup Med				✓	
Agnotti et al	2000	Am J Health Promot				✓	
Bassey et al	1983	Eur J App Physiol			✓		
Bauer et al	1985	Am J Epidemiol	✓				
Beresford et al	2001	Prev Med					✓
Blair et al	1986	JAMA		✓	✓		
Blair et al	1986	Prev Med	✓				
Blake et al	1996	Am J Health Promot				✓	
Boudreau et al	1995	J Occup Environ Med	✓				
Boutelle et al	2001	Am J Public Health				✓	
Bowles et al	2001	Res Q Exerc Sport				✓	
Braeckman et al	1999	Occup Med					✓
Bulaclac	1996	J Nurs Manag				✓	
Campbell et al	2002	Prev Med				✓	
Cardinal and Sachs	1995	Am J Health Promot	✓				
Cole et al	1998	Psychol Rep				✓	
Cook et al	2001	NZ Med J				✓	
Cox et al	1981	Ergonomics		✓	✓		
Shephard and Cox	1982	Sports Sci			✓		

Author	Year	Journal	Dishman et al 1998	Proper et al 2002	Proper et al 2003	Marshall 2004	Engbers, et al 2005
Danileson and Danielson	1982	Report	✓				
Durbek et al	1972	Am J Cardiol	✓				
Edye et al	1989	Med J Aust	✓				
Emmons et al	1999	J Occup Environ Med			✓	✓	✓
Eriksen et al	2002	J Occup Med				✓	
Fisher and Fisher	1995	J Am College Health			✓		
Gamble et al	1993	Occup Med			✓		
Genaidy et al	1974	Ergonomics			✓		
Gerdle et al	1995	J Occup Rehabil			✓		
Gomel et al	1993		✓				
Glascow et al	1995	Am J Public Health					✓
Glascow et al	1997	J Behav Med					✓
Grandjean et al	1996	J Sport Med Fitness			✓		
Gronningsater et al	1992	Pychol Health		✓	✓		
Gundewall et al	1993	Spine			✓		
Hallum and Petosa	1998	Am J Health Promot				✓	
Hammond et al	2000	Am J Health Promot				✓	
Harma et al	1988	Ergonomics			✓		
Hartig and Henderson	1999	Am J Sports Med			✓		
Harrell et al	1996	AAOHN J			✓		
Hebert et al	1993	Am J Public Health					✓

Author	Year	Journal	Dishman et al 1998	Proper et al 2002	Proper et al 2003	Marshall 2004	Engbers, et al 2005
Heirich et al	1993	J Occup med	✓				
Henritze et al	1992	Am J Health Promot					
Hilyer	1990	J Occup Med			✓		
Hope et al	1999	Am J Health Promot				✓	
Kerr and Vos	1993	Work Stress		✓	✓		
King et al	1988	Prev Med	✓				
Kronenfeld et al	1987	Health Ed Quart	✓				✓
Lee and White	1997	Psychol Health			✓		
Lindsay-Reid and Morgan	1979	Am J Public Health	✓				
Lombard et al	1995	Health Psychol	✓				
Lovibond et al	1986	J Behav Med	✓				
Maes et al	1998	Am J Public Health				✓	
Marcus and Stanton	1993	Res Quart Exerc Sport	✓				
Marcus et al	1998	Am J Health Promot				✓	
Marshall at al	2002	Health Educ Res				✓	
Marshall et al	2003	Am J Prev med				✓	
Mutrie et al	2002	J Epidemiol Community Health				✓	
Napolitano et al	2003	Ann Behav Med				✓	
Nichols et al	2000	Am J Health promot				✓	
Norms et al	1990	J Psychosom Res			✓		
Norris et al	1990	J Psychsomatic Res		✓			

Author	Year	Journal	Dishman et al 1998	Proper et al 2002	Proper et al 2003	Marshall 2004	Engbers, et al 2005
Nurminnen et al	2002	Scand J Work Environ Health				✓	
Oden et al	1989	Fitness Business	✓	✓	✓		
Oja	1991	J Med Sci Sport			✓		
Ostwald	1989	J Occup Med	✓		✓		
Pavet et al	1987	Stress Med			✓		
Pegus et al	2002	J Occup Med Environ Health					✓
Peterson and Aldana	1999	Am J Health Promot				✓	
Pohjonen and Ranta	2001	Prev Med				✓	
Poole et al	2001	Am J Health Promot				✓	
Pritchard	1997	J Am Diet Assoc			✓		
Proper et al	2003	Am J Prev Med				✓	
Puterbaugh and Lawyer	1983	J Occup Med	✓				
Robbins et a l	1987	Health Ed	✓				
Robinson et al	1992	Med Sci Sports Exerc	✓				
Rosenfeld et al	1989	Ergonomivs		✓	✓		
Ruskin et al	1990	Human Kitetics	✓				
Russell et al	1999	Am J Health Promot				✓	
Sharpe and Connell	1992	Gerontologist	✓				
Shephard	1992	Am J Health promot	✓				
Sherman et al	1989	Pub Health Nurs	✓				
Skargren and Oberg	1999	ScandJ Rehabil med		✓	✓		

Author	Year	Journal	Dishman et al 1998	Proper et al 2002	Proper et al 2003	Marshall 2004	Engbers, et al 2005
Song et al	1981	J Sports Med Phys Fit	✓				
Sorenson et al	2002	Cancer Causes Control					✓
Sorenson et al	1998	Am J Public Health					✓
Sorenson et al	1996	Am J Public Health					✓
Sorenson et al	1992	Am J Public Health					✓
Sorenson et al	1999	Am J Public Health					✓
Stave	2001	Am J Health Promot				✓	
Talvi et al	1999	J Occup Med				✓	
Titze et al	2001	Psychol Sport Exerc				✓	
Titze et al	2001	Soz Praventivmed				✓	
Webster	2001	Am J Health Promot				✓	
Weir et al	1989	Aviat Space Environ med	✓		✓		
Total number of studies reviewed			26	8	26	32	13

Summary of "review" findings

All reviews reported similar findings in relation to the effectiveness of workplace physical activity programs and these are summarised in Table 6.2 (presented in the order of the year that the review was conducted).

Table 6:2: Summary of review articles examining the relationship between physical activity and the workplace.

Authors/Journal/Year	Type of review	Search strategy	Years	Inclusion	No of studies included	Main findings	Comments/Weaknesses
Dishman, Oldenburg, O'Neal, Shephard **American Journal of Preventive Medicine** **1998**	Meta-analysis	Searched four databases and reference lists and consulted with experts	1972-1997	Dependent variable is a measure of PA or physical fitness. Independent variable was a workplace intervention. Dependent variable was quantified in a way that permitted change after the intervention to be calculated and compared with change in a comparison group not receiving the intervention. An effect size could be expressed as a Pearson correlation coefficient r permitting calculation of effect sizes	26 studies	No clear evidence to support that workplace interventions increase PA or fitness.	Interventions were very diverse. Most studies had poor design and measurements. Many limitations of studies identified. Poor application of theory in studies. Potential of workplace interventions is not realised. Must have rigorous methodological approaches to evaluation in order to establish an evidence base.

Authors/Journal/Year	Type of review	Search strategy	Years	Inclusion	No of studies included	Main findings	Comments/Weaknesses
Proper, Staal, Hildebrandt, van der Beek, van Mechelen. **Scandanavian Journal of Work and Environmental Health** **2002**	Systematic review	Searched five databases, searched reference lists, searched personal databases	1980-2000	English, German and Dutch publications. RCTs or CTs. Working population. Worksite program intended to increase PA or fitness. Work related outcomes.	8 studies (4 Randomised Control Trials and 4 Control Trials)	Limited evidence to support the effectiveness of workplace PA programs on absenteeism. Inconclusive evidence on job satisfaction and stress. No positive effect on staff turnover (insufficient studies). Contradictory results for productivity.	Diverse interventions - Interventions consisted of structured physical activity/exercise sessions including aerobic components such as jogging, dancing, bicycle ergometer and ball games and anaerobic training including weights. Other aspects addressed strength, flexibility and relaxation and some interventions included health education classes. Poor methodological quality of studies was highlighted – lack of RCTs
Proper, Koning, van der beek, Hilde Brancht, Bosscher, van Mechelen. **Clinical Journal of Sports Medicine.** **2003**	Systematic review	Searched five databases, searched reference lists, searched personal databases	1980-2000	English, German and Dutch publications. RCTs or CTs. Working population. Worksite program intended to increase PA or fitness. Work related outcomes.	Fifteen Randomised Control Trials and 11 non-randomised control trials	Worksite PA programs has a positive effect on physical activity levels and musculoskeletal disorders. Inconclusive evidence that workplace PA programs affected cardiorespiratory fitness, muscle flexibility, muscle strength, body weight, body composition, general health, blood serum lipids, and blood pressure. Limited evidence that supported a positive effect on fatigue.	

Authors/Journal/Year	Type of review	Search strategy	Years	Inclusion	No of studies included	Main findings	Comments/Weaknesses
Marshall. **Journal of Science and Medicine in Sport** **2004**	Narrative review	2 databases (MEDLINE PUBMED) searched reference lists, searched personal databases	1998-2003	Workplace interventions reporting PA changes as the key outcome.	32 (5 Randomised Control Trials 6 Randomised Trials, 7 Quasi Experimental Trials with a comparison, 14 non-experimental cohort studies with no control or comparison condition	No clear evidence that workplace interventions are successful in increasing physical activity.	Similar conclusions to Dishman 1998. Discussed lack of description about interventions and evaluation methods. Difficult to identify successful components of multi-strategy interventions.
Engbers, van Poppel, Paw, van Mechelen **American Journal of Preventive Medicine 2005**	Systematic review	MEDLINE (entrez PUBMED), EMBASE + snowball search – ie selected studies were screened for additional relevant studies.	1985-2004	RCTs Intervention included environmental modification Main outcome included PA or dietary intake or health risk indicators Healthy workers, employees Study written in English, Dutch or German Peer reviewed	13 studies (mostly multi-centre and focused on dietary intake and other health behaviours. Only 3 focused specifically on PA	Inconclusive evidence about workplace interventions on PA	This review looked at worksite health promotion programs with environmental change broadly and only 3 studies were identified that were relevant specifically to PA. All studies reviewed were rated as ‘low quality’.

A brief summary of each review and the key points is provided below.

Dishman et al., (1998), under took a meta-analytic review of studies which had been conducted in workplaces and measured physical activity in a way that allowed changes to be measured post-intervention. The interventions used in the 26 reviewed studies were very diverse and included: health education, health risk assessments, screening, mail delivered physical activity instructions, exercise prescription, onsite and offsite exercise opportunities, supervised and unsupervised exercise opportunities, financial and other incentives, prizes, and telephone prompting. The analysis indicated that worksite interventions that aimed to increase physical activity yielded a small but not statistically significant positive effect and a limited basis for confidence in workplace physical activity programs being able to increase physical activity was revealed. The reviewers commented on the poor research design and measurement of the studies under review. They discussed how results may have been exaggerated by self-selection of participants into programs, influences of offering incentives to participate, use of poorly validated outcome measures, and poor or inappropriate use of comparison groups and methods of statistical analysis. They also identified that poor application of theory to interventions and the number of strategies used in multi-strategic programs made it difficult to determine which specific components of the intervention had led to success. They concluded that the potential for workplaces to improve staff physical activity levels was largely unrealised and emphasised that rigorous methodological approaches were needed to evaluate the effectiveness of workplace physical activity interventions.

The second (Proper, Staal, Hildebrandt, van der Beek & van Mechelen, 2002) and third (Proper, Hildebrandt, van der Beek, Twisk & van Mechelen, 2003) reviews used the same data set with the second review reporting work-related outcomes and the third review looking at physical activity, physical fitness and health outcomes. It was decided to summarise both these reviews as the findings are of interest in regards to future workplace interventions in the local government setting. Each review is summarised separately.

A systematic review by Proper et al., (2002) assessed the effectiveness of worksite physical activity programs on work-related outcomes. Four Randomised Control Trials (RCTs) and four controlled trials were included in the review. Interventions consisted of structured physical activity/exercise sessions including aerobic components such as jogging, dancing, bicycle ergometer and ball games and anaerobic training including weights. Other aspects addressed strength, flexibility and relaxation and some interventions included health education classes. As with the previous review, the poor methodological quality of studies was highlighted. Results demonstrated limited evidence to support the effectiveness of workplace physical activity programs on absenteeism from work. There was inconclusive evidence of the effect of workplace physical activity programs on job satisfaction and stress. In regard to productivity there were contradictory results, which the authors concluded could mean that workers' perceptions of productivity may not reflect their actual productivity. In regard to staff turnover, there were insufficient studies available for review to indicate any positive or negative effect of workplace physical activity programs. The authors acknowledged that the conclusions from this review resulted from a lack of RCTs of high methodological quality rather than being a reflection of the true situation.

The third review by Proper et al., (2003) was a systematic review that examined the effectiveness of worksite physical activity programs on physical activity, physical fitness and health. Fifteen RCTs and 11 non-randomised controlled trials were included in the review. As with the review above, all interventions consisted of structured physical activity/exercise sessions. Results demonstrated that worksite physical activity programs had a positive effect on physical activity levels and musculoskeletal disorders. However, evidence that workplace physical activity programs affected cardio respiratory fitness, muscle flexibility, muscle strength, body weight, body composition, general health, blood serum lipids, and blood pressure was inconclusive. There was only limited evidence that supported a positive effect on fatigue. The issue of methodological shortcomings was also discussed in this review and the methodology used in most studies evaluating the effectiveness of workplace physical activity programs was viewed as generally poor. In particular the issue of using self-report data for physical activity and health outcomes was raised and only one study reviewed had an objective physical activity measure.

The fourth review by Marshall (2004) was a narrative review of workplace intervention studies that reported physical activity changes as a key outcome. Thirty two studies were reviewed – eleven randomised trials, seven quasi-experimental trials using a comparison group and the remainder were non-experimental cohort studies that used no control or comparison condition. Marshall (2004) identified that the most common strategies implemented in workplaces to promote physical activity were health checks, education programs, motivational prompts to be more active including prompts to use stairs, workplace exercise programs, incentive based programs, self-directed behaviour change, individualised counselling, or a combination of a number of these strategies. The programs reviewed had varying degrees of success and often seemed to attract those participants who were already motivated and considering changing their behaviour or who were already active. The challenge of how to engage those who most needed to change their behaviour was highlighted. The findings from the review offered little evidence to support long-term effectiveness of workplace physical activity programs but again the methodological quality of studies was discussed with only six of the studies included in the review being seen as having sufficient data to calculate effect sizes. Marshall (2004) concluded that the most promising strategies are the promotion of incidental activity (such as stair use); incorporating social support for physical activity; and increasing active transport to and from work. The review emphasised the need to undertake comprehensive workplace approaches that look at changing the overall organisational structure and culture of the workplace thus providing an overall environment that supports physically active lifestyles.

The final review, by Engbers et al., (2005) , aimed to systematically assesses the effectiveness of workplace physical activity programs with environmental modifications, on physical activity as well as on dietary intake and health risk indicators. Thirteen studies were included in the review – 11 were RCTs and two were quasi-experimental with a controlled design. All but one study were large multi-centre trials. Only three studies specifically examined the effect of workplace physical activity programs on physical activity and provided inconclusive evidence that workplace physical activity programs had any effect on the physical activity of employees. Examples of environmental modification strategies included creation of a walking track near a workplace, provision of exercise space and equipment and a marked walking route. Skills training and mass media to promote physical activity were also used. The authors commented that the included studies were of a relatively poor quality due to use of self-report measures and this resulted in the reviewers' lack of confidence in the quality of the studies' results.

6.4.2 Original studies on the effectiveness of workplace physical activity programs published between 2001 and 2005

Table 6.3 contains a summary of ten studies regarding workplace physical activity programs that were published since the systematic reviews (the studies are listed alphabetically by author surname).

Table 6:3: Summary of original articles examining the relationship between physical activity and the workplace.

Authors/Journal/ Year	Research topic	Study design	Study population	Intervention	Results	Comments/Weaknesses
Aittasalo, Miilunpalo & Suni **Patient Education and Counseling** **2004**	The effectiveness of PA counseling and/or fitness testing in a worksite setting.	Randomised Control Trial	N= 155 Counseling only (n=52); Counseling + fitness testing (N=51); Control (N=52)	Counseling sessions with occupational health staff. Physiotherapists who administered fitness testing.	No statistically significant differences between groups in any PA measures at follow-up.	Good design. Grounded in theory. Used valid and reliable physical activity measures. Minimal drop outs. Limited by self-selection of participants who were motivated to increase PA. Baseline – participants already quite active.
Aldana, Greenlaw, Diehl, Salberg, Merrill, Ohmine **Journal of Environmental and Occupational Medicine** **2005**	Assessed the behavioral and clinical impact of a worksite chronic disease prevention program.	Randomised Control Trial	N=66 - intervention. N= 79 - control	2 hrs for 4 wks – education sessions with text book and workbooks Pre-set dietary and pa goals Pedometers and exercise logs	25% increase in step count at 6 weeks but did not meet recommended 10,000 steps– by six months it had dropped to 16% in the intervention group. No change in step counts in the control group.	Self motivated participants Self-report data Short term follow up. Control group might have started to make changes due to future participation in the program.
Auweele, Boen, Schapendonk, Dornez. **Journal of Sport and Exercise Psychology** **2005**	Does placing a health sign increase stair use? Does a doctor initiated email increase stair use?	Pre post experimental design	135 employees in worksite (only 4 males)	Int 1 – health sign linking stair use to health and fitness. Int 2 – additional email 1 week later by worksite doctor re health benefits of stair use	Sig increase in stair use after intervention 1 and 2. But returned to baseline use after 1 week	Not possible to determine if the sign or email had the most effect. Not only staff used stairs. No assessment of overall effect on PA. No external control group

Authors/Journal/ Year	Research topic	Study design	Study population	Intervention	Results	Comments/Weaknesses
Badland and Schofield **Health Promotion Journal of Australia** **2005**	Do posters promoting stair use increase objectively measured PA?	Pre post experimental design	Participants were from two Council departments in New Zealand. All were office based. 46 participants (27 men and 19 women)	Participants wore a sealed pedometer at work and home for 3 days on 4 separate occasions (3 week blocks).	Posters had no effect on PA overall or at work.	Didn't assess actual stair use but PA overall. No self-report data used. Small sample size. No external control group
Brox and Froystein **Occupational medicine** **2005**	Physical exercise effects on health related quality of life and sickness absence in community nursing home employees.	Randomised Control Trial	N= 129 Intervention = 65 Control = 64	Weekly exercise class consisting of light aerobic exercise, muscle strengthening and stretching for a six month period.	Self-reported PA increased in the intervention group compared with the control group	Relied on self-report data.
Chan, Ryan, Tudor-Locke **Preventive Medicine** **2004**	Assessing the effects of a pedometer-based physical activity intervention on pa and specific health indices.	Pre post experimental design	106 participants from 5 workplaces	Four week adoption phase - 30-60 minutes weekly session with a facilitator who led them through a curriculum about benefits of being more active, learning how to initiate new behaviours to achieve goals, and strategies for overcoming relapse. Individual steps per day goals and used pedometer to monitor progress. Weeks 5-12 - self-monitoring of steps with limited input from the facilitator.	Statistically significant increase in steps per day from baseline.	Voluntary participation and self selection. No external control group.

Authors/Journal/ Year	Research topic	Study design	Study population	Intervention	Results	Comments/Weaknesses
Croteau **American Journal of Health Promotion** **2004**	Evaluated the effects of an 8-week, pedometer-based lifestyle physical activity intervention on physical activity levels.	Pre post experimental design	37 college employees who volunteered to participate in the study.	Goal setting, pedometer use, self-monitoring, and weekly e-mail reminders.	Results indicate a statistically significant increase in average daily steps from baseline compared to after the program.	Self-selection of participants. No external control group
Kerr, Eves, Carroll. **Journal of Occupational Health** **2001**	To assess the effectiveness of a poster prompt to increase stair use in two worksites	Pre post experimental design	Two worksites Worksite 1 – no numbers given Worksite 2 – 2,694	Two week intervention using a poster "stay healthy, use the stairs" positioned at the entrance to the elevator and adjacent to the stairs in a nine story worksite.	No significant affect was identified for stair ascent but there was for stair descent.	Self-reported stair use and objective observation. Small follow up response to survey. employees on lower floors were more likely to use the stairs than employees on higher floors and this could have impacted on the observed effect; No external control group
Plotnikoff, McCargar, Wilson & Loucaides **American Journal of Health Promotion** **2005**	Evaluation of a 12-week workplace e-mail intervention designed to promote PA and nutrition behaviour	Pre post experimental design	I = 1,566 C = 555	12-week workplace e-mail intervention	Significant increase in PA in the intervention group and a significant decrease in PA in the control group although the effect size was small	No external control group. Self-report PA

Authors/Journal/ Year	Research topic	Study design	Study population	Intervention	Results	Comments/Weaknesses
Purath & Mccabe **Canadian Journal of Nursing Research** **2004**	Evaluation of a brief, tailored counselling intervention for increasing PA targeting inactive women in the workplace	Randomised Control Trial	I = 134 C = 153	Intervention group - a health screening, a brief intervention tailored to exercise behaviour and a follow up telephone call two weeks later. Control group - health counselling but it was not tailored to their exercise behaviour and no follow up telephone call.	Significant increase in PA in the intervention group compared to the control group.	Self report data and self-selection into study.

The findings are presented according to the key intervention areas, although acknowledgement is made of the mix of strategies used in some of the studies.

Posters promoting stair use

Three studies (Kerr, Eves & Carroll, 2001; Auweele, Boen, Schapendonk & Dornez, 2005; Badland & Schofield, 2005) examined the effect of poster use to increase stair use and physical activity.

Auweele et al., (2005) conducted an evaluation of two interventions - the first one involved placing a health sign linking stair use to health and fitness on an easel beside the elevator and the stairs on every floor (of which there were five) and the second intervention was an additional email sent out one week later by the workplace's doctor pointing out the health benefits of stair use. This observational study used a before and after design. Trained observers were used to record stair and elevator use. There was a significant increase in stair use after the first intervention compared to the baseline and after the second intervention compared to the baseline. Stair use also significantly increased between intervention one and two. However at follow up one month after the sign was removed, stair use was not significantly different from baseline. These findings support the usefulness of the health sign in conjunction with the email although it is not possible to determine which had the most effect. This study was limited because visitors also used the stairs and could not be identified as being different from employees and that baseline stair use was quite high to start with. The use of visible observers could also have made employees more reactive. It was also impossible to see if the effect was on all employees or just a few. The impact on health benefits could also not be determined.

Kerr et al., (2001) conducted a before and after study to assess whether posters reading "stay healthy, use the stairs" positioned at the entrance of the elevator (adjacent to the stairway) prompted stair use in a nine floor workplace. Self-reported stair use was reported via a survey and objective observation of stair and elevator use was undertaken. As with Auweele et al.,'s (2005), study there was some indication of increased stair use. In Kerr et al.'s (2001) study memory recall of the poster was high, however, no significant effect was identified for stair ascent although there was for stair descent. Results showed that employees on lower floors were more likely to use the stairs than employees on higher floors and this could have impacted on the observed effect. The study was also limited by its small follow up response rate (27.6%) to the survey.

Badland and Schofield (2005) undertook a study to determine if posters promoting stair use were effective in increasing overall physical activity. Two sizes of posters were used – small posters mounted adjacent to elevator buttons and on bulletin boards and large banners on stairwell landing walls. Forty six participants (27 men and 19 women, all office based) from two Council departments in New Zealand wore a sealed pedometer at work and home for a three day period. The two departments received the same intervention but at different times. The results showed that there was no change in overall or work time physical activity but the findings of this study cannot be compared to Auweele et al.,'s (2005) study because different outcome variables were used.

Pedometer interventions

Three studies (Chan, Ryan & Tudor-Locke, 2004; Aldana, Greenlaw, Diehl, Salberg, Merrill & Ohmine, 2005; and Croteau, 2004) examined the effect of pedometer interventions.

Chan et al., (2004) conducted a before and after study to assess what impact a pedometer-based walking intervention had on physical activity and specific health indices. The program had two phases. Firstly there was a four week adoption phase where participants met in workplace groups with a facilitator for 30–60 minutes each week. The facilitator presented a curriculum about benefits of being more active, learning how to initiate new behaviours to achieve goals, and strategies for overcoming relapse. Participants then set individual steps per day goals and used a pedometer to monitor their progress. Weeks 5–12 was an 8-week adherence phase in which participants continued to self-monitor their steps but with limited input from the facilitator. At follow up there was a statistically significant increase in steps per day from baseline. Participants had significant reductions in Body Mass Index (BMI), waist girth and resting heart rate and reductions in waist girth and heart rate were significantly related to the increase in steps per day. While this study provides support for pedometer interventions it is limited by its lack of a control group and randomization, and the self-selection and voluntary nature of participants.

Croteau (2004) undertook a preliminary study to investigate the effect of an 8-week, pedometer-based lifestyle physical activity intervention on physical activity levels. Participants were 37 college employees who volunteered to participate in the study. The intervention consisted of goal setting, pedometer use, self-monitoring, and weekly e-mail reminders. Physical activity was measured by pedometer with a survey at baseline and immediately following the intervention. Similar to Chan et al.,'s (2004) study, the results from Croteau's (2004) study indicate a significant increase in average daily steps ($p < .01$), from 8565 (±3121) steps at baseline to 10,538 (±3681) steps after the program. The study lacked rigour due to the small, self-selected sample and lack of a control group and it is not possible to assess what had the most impact – the pedometer or the email reminders.

Aldana's et al.,'s (2005) study is discussed in further detail under the combined programs heading however in regards to the pedometer component of this study, there was a 25% increase in steps at follow up but this dropped to a 16% increase at 6 months and did not meet the recommended 10,000 steps (Aldana et al., 2005).

Workplace physical activity counselling

Two studies, (Aittasalo, Miilunpalo and Suni (2004); and Purath, Miller, McCabe and Wilbur (2004), used targeted counseling to increase physical activity within the workplace. Aittasalo et al., (2004) undertook a randomised controlled trial to assess whether theoretically grounded counseling and/or fitness testing have long-term effects on inactive employees' leisure time physical activity. Occupational nurses performed counseling sessions and physiotherapists preformed fitness assessments. At follow up there was no statistically significant difference between groups in leisure time physical activity with both intervention and control participants increasing their physical activity levels. Counseling did not increase physical activity in the long term (at 12 months) in the intervention group compared to the control group and the effect of counseling was not improved by fitness testing. While the design of this study was good and grounded in theory, used reliable and valid physical activity measures, and had minimal drop-outs during the program, it was limited by the self-selection of participants who indicated a desire to increase their physical activity in the near future. At baseline a large number of participants were already quite active.

Purath et al., (2004) assessed the effectiveness of a brief, tailored counselling intervention for increasing physical activity targeting inactive women in the workplace. The study used a prospective randomised trial design and the intervention was grounded on the Transtheoretical Model which assesses individuals in relation to their stage of readiness to change behaviour. The intervention group (n=134) received a health screening, a brief intervention that was tailored to each woman's reported exercise behaviour, and a follow up telephone call from a nurse practitioner two weeks later. The control group (n=153) received health counselling but it was not tailored to their exercise behaviour and they did not receive a follow up telephone call. Unlike Aittasalo et al.,'s, (2004) study, where no change in physical activity was seen, in Purath et al.,'s (2004) study, at the six week follow up, the intervention group had significantly improved their physical activity, increasing their amount of weekend physical activity as well as minutes walked for exercise, on errands, total walking, and total daily blocks walked. In comparison to the control group the gains were significantly greater. This study provides support for the use of tailored brief interventions in a workplace setting.

Organised physical activity programs

Only one study (Brox and Froystein, 2005), was identified that involved organised workplace physical activity programs. In this study the effectiveness of a weekly 60 minute exercise class over six months was evaluated. There was a significant increase in self-reported physical activity in the intervention group compared to the control group ($P<0.01$) at six months although no differences were noted in physical fitness (assessed by the Urhu Kaleva Kekkonen walking test), or quality of life (feelings, daily activities, social activities, change in health) assessed by the COOP/WONCA (Co-operation-World Organization of Colleges Academics) charts. The authors suggest that self-selection of participants and the low participation rate may have biased results in favour of the intervention group.

Computer tailored interventions - Email prompts

Four studies (Plotnikoff, McCargar, Wilson and Loucaides, 2005; Auweele et al., 2005; Croteau, 2004; and Vandelanotte, De Bourdeaudhuij , Sallis, Spittaels , Brug, 2005) used computer tailored interventions, including email prompts, as part of their intervention.

Plotnikoff et al., (2005) undertook an evaluation of a 12-week workplace e-mail intervention designed to promote physical activity and nutrition behaviour. A pre- and post-test design was used to assess differences between the intervention and control group. The email messages were grounded on social-cognitive theories. Results identified a significant increase in physical activity in the intervention group and a significant decrease in physical activity in the control group although the effect size was small. While this study provides support for motivational emails it was limited by the self-report physical activity measures used.

As described in the stair use section, Auweele et al., (2005) conducted an evaluation that looked at both a health sign linking stair use to health and fitness as well as a second intervention that was an additional email sent out one week later by the workplace's doctor pointing out the health benefits of stair use. Unlike Plotnikoff et al.'s (2005) study where physical activity was the outcome variable, Auweele et al., (2005) used stair use as the outcome variable. While stair use significantly increased between intervention one (the health sign) and intervention two (the email) it was not possible to determine which had the most effect.

Croteau et al.,'s. (2004) study (described under pedometer interventions) also used weekly electronic mailings to serve as a cue to activity and provided motivational tips for increasing physical activity. While the results of this study showed an increase in daily steps it cannot be determined which component of the program (the pedometer or the weekly electronic mailings) had the greatest impact and if the e-mail component had any impact at all.

Vandelanotte et al., (2005) undertook a study to examine the effectiveness of interactive computer-tailored interventions for increasing physical activity and decreasing fat intake and to assess which intervening mode, sequential or simultaneous, is most effective in behavior change. Seven hundred and seventy one people were randomly assigned to one of four groups: (1) one group received the physical activity and fat intake interventions simultaneously at baseline; (2) another group received the physical activity intervention at baseline and the fat intake intervention 3 months later; (3) the third group received the fat intake intervention at baseline and the physical activity intervention 3 months later; or (4) a control group. Physical activity outcomes were measured using the International Physical Activity (IPAQ) questionnaire and a 48-item food frequency questionnaire was used to measure fat intake. Follow up of participants six months after the intervention showed that the computer tailored interventions produced significantly higher physical activity scores, and lower fat intake scores, in all experimental groups when compared to the control group. For both physical activity and fat intake, the sequential and simultaneous approaches were effective; although for those in the fat intake intervention and for those participants who did not meet the physical activity recommendation in the physical activity intervention, the simultaneous mode appeared to work better than the sequential mode. The self-report nature of the study was a limitation and could have lead to response bias

Combined programs (physical activity, diet and overall lifestyle).

As well as Vandelanotte et al.,'s, (2005) study, one other study used a combined program looking at both physical activity and nutrition (Aldana et al., 2005). This study determined the behavioral and clinical impact of a worksite chronic disease prevention program. One hundred and forty five working adults (86% women) participated in a randomised clinical trial of an intensive lifestyle intervention. The intervention consisted of pre-set diet and exercise goals, dietary advice, pedometers and exercise advice and logs. Nutrition and physical activity behavior and several chronic disease risk factors were assessed at baseline, six weeks, and six months. Results of this program showed that cognitive understanding of the requirements for a healthy lifestyle increased at the end of the program. There was a 25% increase in steps at follow up but this dropped to a 16% increase at 6 months and did not meet the recommended 10,000 steps. This study was limited by the self-selection and self-motivation of participants into the intervention and the use of self-report data. The control group was from the same company but started 6 months later and, as a result of earlier participants already being in intervention, may have already started to make changes.

6.5. Discussion

The purpose of this overview was to identify existing review studies as well as other studies published since the reviews or not included in the reviews, that examined the evidence for the effectiveness of interventions to promote physical activity in workplace settings. The six review papers identified examined 92 original source papers published between 1980 and 2004, although interestingly there was not a lot of overlap in the studies that were examined. This could be due to the diversity of countries that the authors were from and the types of databases that they accessed. The strength of this, however, is that the reviewers did identify a wide range of papers and still came to similar conclusions regarding the lack of methodological rigour used in workplace physical activity interventions that has lead to poor quality evidence about which interventions are most likely to work.

The findings from review papers and other papers show somewhat different conclusions regarding the impact of workplace physical activity programs on physical activity. In the studies reviewed by Dishman et al., (1998), Marshall et al., (2004) and Engbers et al., (2005) little evidence was found to support the impact of workplace interventions on physical activity. However the review by Proper et al., (2003) identified strong evidence that workplace physical activity interventions positively affect physical activity participation. In particular they relied upon the findings of two randomized controlled trials that used individually focused activities and exercise programs that resulted in increased physical activity. These findings are supported by Brox and Froystein's (2005) study which showed that a weekly exercise class run, over a six month period, was successful in increasing physical activity in the intervention group.

Marshall (2004) suggested that individually-tailored behavioural skills training had potential. This is supported by Puarath et al.,s (2004) study which showed an increase in physical activity as a result of a tailored brief intervention. However the study by Aittasalo et al., (2004) showed that counseling (and fitness testing) had no impact on physical activity.

Marshall (2004) found some evidence for point of decision prompts to encourage stair use. The potential of stair use is supported by the study conducted by Auwele et al., (2005) although the issue of sustainability was highlighted in this study. However the studies by Kerr et al., (2001) and Badland and Schofield (2005) did not provide evidence to support stair interventions.

Marshall (2004) reported that inter-office communication had some potential in influencing physical activity behaviour and in a study conducted by Plotnikiff et al., (2005) physical activity increased as a result of an email intervention. Marshall (2004) also identified that incorporating social support for physical activity and increasing active transport to and from work show promise however no studies using these interventions were identified other than those included in the reviews.

Pedometer interventions were not specifically discussed in the review papers however three of the papers reviewed (Chan et al., 2004; Aldana et al., 2005; and Croteau, 2004) showed that pedometer interventions can have some success in increasing step counts. Although Aldana et al.,'s. (2005) study did achieve an increase in step counts, it did not meet the recommended 10,000 steps a day.

While the authors of the papers examined in this review all support the value of workplace physical activity programs and there is evidence for the potential of certain strategies as described above, it is clear that generally there is a paucity of convincing evidence to support any specific strategies as being the most effective. The authors of the review papers highlight that this may not be due to ineffective interventions, rather it is because of the difficulty in establishing cause and effect due to poorly designed studies, poor analysis and biased participants who self-selected into the studies or were encouraged by the use of incentives (Dishman et al., 1998; Proper et al., 2002; Proper et al., 2003; Marshall 2004; Engbers, 2005). It was also noted that a reason for poor methodological design could be a result of the organizational and logistic problems that are encountered in workplace settings that may compromise methodological rigour (Engbers et al., 2005).

The reviews and subsequent original papers included in this review highlight a number of methodological issues that should be considered by researchers and practitioners when developing future workplace physical activity interventions. One issue is the lack of controlled experimental designs in studies that can more clearly demonstrate cause and effect between interventions and physical activity outcomes. There is also the problem of self-selection of participants into studies (Dishman et al., 1998; Engbers et al., 2005; Croteau, 2004). Many of the participants who engage in workplace interventions are already motivated and ready to change or already physically active (Aittasalo et al., 2004: Aldana et al., 2005; Badland & Schofield, 2005; Proper et al., 2003: McCarty & Scheuer, 2005). The challenge is to recruit participants who are most at need including those who wouldn't normally find organized programs appealing – in particular those who are inactive (Marshall, 2004). There is also a need to use more objective measurements that avoid self-reporting of behavior, which can result in reporting bias (Proper et al., 2003). The other problem highlighted in the reviews and other papers is that changes are often not sustained (Auweele et al., 2005; Aldana et al., 2005). Not only do workplace interventions need to be well designed with an emphasis on recruiting representative participants, but there also needs to be a focus on participant retention (Marshall, 2004).

Limitations of the review

A limitation of this review for the current study, which is common to most reviews, is that the searches may not have identified all the relevant published literature related to this topic, which could lead to selection and publication bias (Proper et al., 2002; Engbers et al., 2005). The review studies cited in this review may also have had the same problem. However, there was an overall consistency in regards to the findings in relation to physical activity and the methodological issues that were experienced. Another limitation of the review is that the identified studies focused mainly on behavioural interventions within the workplace. Given the complexity of changing human behaviour and the acknowledgement that socio-enviromental approaches which incorporate environmental and policy initiatives are important in achieving sustainable changes to behaviour (Sallis, Bauman and Pratt, 1998), it is disappointing to see that at the time of the research limited reference is made to such approaches in the workplace setting (with the exception of Engber's 2005 review, which did mention some environmental modification strategies).

6.6. Conclusion

In conclusion, the results of this literature review show inconsistency regarding whether workplace physical activity programs are successful in increasing physical activity. While there is some evidence showing a positive effect of workplace physical activity interventions there continues to be a lack of evidence to support the long-term effectiveness of workplace physical activity interventions or the effectiveness of environmental and policy interventions. However it is clear that this may not simply be due to the fact that interventions don't work. There is a need for well designed research and evaluation studies to provide a stronger evidence base for workplace physical activity programs in particular in relation to studies that apply a socio-ecological framework to underpin the interventions. While fully randomized designs are the ideal, it has to be acknowledged that this can be difficult to achieve in a workplace setting. At the very least the use of equivalent comparison groups should be encouraged. It is also important to use rigorous data collection methods that are more objective in nature, to be able to more definitively define physical activity behaviour.

Despite the current lack of evidence regarding effective physical activity interventions in the workplace setting, workplaces should be encouraged to work collaboratively with employees to design interventions that can be carefully evaluated. The use of well designed evaluation will lead to findings which will contribute to the evidence. Changing individual behaviour is challenging but combined with organisational, environmental and policy initiatives within the workplace setting, changes in physical activity patterns is possible.

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Chapter 7. Physical activity programs in the workplace – employee perceptions

7.1. Abstract

Objective: This study explored Thuringowa City Council employees' perceptions about: the role of the workplace in promoting physical activity; physical activity as an issue generally; what the perceived barriers to physical activity were; and what might be some possible ways that the workplace could promote the physical activity of employees.

Methods: An exploratory descriptive study was conducted and a sample of Thuringowa City Council staff participated in focus groups and telephone interviews.

Results: Twenty three indoor employees and 19 outdoor employees participated in focus groups and five managers participated in semi-structured in-depth phone interviews. Both indoor and outdoor employees (including managers) expressed that physically active lives were important. All saw physical activity as an individual's responsibility although indoor employees did see the value of workplace physical activity interventions. Outdoor employees were strongly opposed to workplace physical activity interventions, feeling their work already provided sufficient activity. They did feel, however, that workplace interventions would be appropriate for indoor employees. Despite feeling their work was active, outdoor employees expressed an interest in being able to quantify activity and suggested that pedometer assessment of physical activity would be useful. Indoor employees had a range of suggestions regarding interventions that would be suitable in the workplace including workplace challenges using the 10,000 steps approach; emailed prompts to be active; education media and seminars; flexible work hours to allow physical activity to be more easily incorporated into the working day; and upgrade of facilities such as showers and change facilities. Active transport to work was also suggested as a useful activity.

Conclusions:

Despite differences in the indoor and outdoor employee perceptions regarding physical activity, there was overall consensus that physical activity in the workplace was an important health priority and that workplace interventions do have the potential to

impact on employee physical activity levels. Some suggestions of appropriate interventions were made and there is an opportunity to develop physical activity interventions in the future, based on these suggestions.

7.2. Introduction

As highlighted in Chapter Six, the workplace is recognised as an important setting for health promotion (Chu, Driscoll & Dwyer, 1997). Interventions in this setting have the potential to produce many benefits including a healthier workforce, improved morale, increased job satisfaction and reduced absenteeism, which in turn improves productivity and the quality of working life of the workforce (Chu et al., 1997; Riedel, Lynch, Baase, Hymel & Peterson, 2001). The workplace is recognized as a setting in which physical activity interventions can be implemented and it has been suggested that physically active employees are less likely to suffer from major health problems, less likely to take sickness leave and less likely to have an accident at work (Dishman, Oldenburg, O'Neal & Shephard, 1998).

Workplace physical activity health promotion programs evolved in the United States of America and Australia in the 1970s where many large companies felt there were advantages of reducing cardiovascular risk factors for senior company members (Bauman, Bellew, Vita, Brown & Owen, 2002). Corporate fitness programs were developed with the aim of promoting regular vigorous activity for senior staff. This was eventually broadened to include employees across all levels. However, as discussed in Chapter Six, the evidence to support workplace physical activity approaches remains inconclusive, mainly due to the poor methodological quality of the studies in this area that have failed to show measurable outcomes. From literature reviews that have examined the impact of workplace physical activity interventions, there is overall consensus that research into this area should continue and that interventions should be designed using sound theoretical underpinnings based on theories of behavioural change and/or organizational change, should be comprehensively described and should be rigorously evaluated using valid and reliable measures (Dishman, et al., 1998; Marshall, 2004). The role of using Randomised Controlled Trials was suggested as the gold standard for research in this area although the complexity of doing this in workplace settings was acknowledged (Dishman et al., 1998; Proper, Staal, Hildebrandt, van der Beek & van Mechelen, 2002).

The Thuringowa City Council became interested in the topic of physical activity, from a workplace perspective, as a result of my involvement in the evaluation of the Riverway project and requested James Cook University to explore what opportunities existed for some workplace physical activity programs to be implemented within their workplace.

In line with Stage One and Two of Nutbeam's Model of Research and Evaluation Model (Nutbeam, 1998), it was important to start the process by undertaking research to gain a clear understanding of the topic. Conducting such research is an essential part of any health promotion program as it contributes to a thorough understanding of issues so that appropriate interventions can be developed. The literature review described in Chapter Six was part of this process, however, it was also important to have a clear understanding of employee and manager views as the potential target groups for interventions. Nutbeam (1998) discusses the importance of having community participation in the problem definition and solution generation stages as it allows an in-depth understanding of issues from the participants' perspective as well as an understanding of the scope for change in relation to the issues defined (Nutbeam, 1998). Thesenvitz, (2003) also emphasised the importance of participatory planning in workplace health promotion project and highlighted that the primary focus should always be on employees' perceived needs. This is supported by Titze, Martin, Seiler and Martin (2001) who discuss that involving employees in the planning stage of intervention design can have a positive effect on physical activity outcomes in the longer term. By taking this approach there is a shift of focus from workplaces simply being a site for health promotion activity, to one that involves employees and managers jointly in creating a health promoting setting within their workplace (Chu et al., 1997).

Actively engaging with and involving staff in the problem definition stage can inform the solution generation and innovation testing stages of Nutbeam's model (Nutbeam, 1998).

This approach is also in line with core health promotion values and principles described by Rootman et al., (2001), and ensures that health promotion approaches in this setting are:

- *Empowering (enabling individuals and communities to assume more power over the personal, socioeconomic and environmental factors that affect their health);*
- *Participatory (involving all concerned at all stages of the process);*
- *Holistic (fostering physical, mental, social and spiritual health);*
- *Intersectoral (involving the collaboration of agencies from relevant sectors);*
- *Equitable (guided by a concern for equity and social justice);*
- *Sustainable (bringing about changes that individuals and communities can maintain once initial funding has ended); and*
- *Multi-strategy (using a variety of approaches – including policy development, organizational change, community development, legislation, advocacy, education and communication – in combination).*
- (Rootman et al., 2001).

The overall aim of this research was to actively engage Thuringowa City Council employees' in order to explore their perceptions about the role of the workplace in promoting physical activity.

The objectives of the research were to:

- Assess employees' perceptions regarding physical activity as an issue;
- Describe barriers to physical activity as perceived by Thuringowa Council employees; and
- Explore possible ways that the workplace can promote the physical activity of employees.

7.3. Methods

7.3.1 Study design

An exploratory descriptive study was conducted using a qualitative research approach. A qualitative approach was chosen as it allowed for a detailed exploration of the topic and what it meant for participants and also allowed for a process of engagement for future work with the Council.

7.3.2 Participants and sampling

The Thuringowa City Council has approximately 340 employees, all of whom were invited via e-mail to voluntarily participate in this study. Employees work across a range of areas but predominantly are in positions requiring either indoor work or outdoor work: some employees' are involved in both indoor and outdoor work.

7.3.3 Data Collection

Data was collected from indoor and outdoor employees via focus groups and from managers via telephone interviews.

Focus Groups

Five focus groups were conducted over two weeks in March and April 2005 by third year occupational therapy students studying at James Cook University, under the supervision of the author. These students took the role of either a moderator and observer. Prior to the data collection commencing, focus group moderators were trained and scripts developed to ensure interviews and focus groups were conducted in a consistent manner. Observers for the focus groups were also trained to ensure consistency in observations.

Due to the different nature of indoor and outdoor work it was thought that perceptions regarding physical activity would be different. As a result, participants were allocated to either an indoor or an outdoor focus group. Three focus groups were run with indoor employees and two focus groups were run with outdoor employees. In each focus group there was a moderator and one or two observers. The doctoral candidate was present at each focus group to support and guide the students. Focus groups were taped with participant consent and observers took notes during the focus groups and wrote down information that may not be picked up by the tape such as non-verbal behaviour.

Focus group questions were developed in consultation with managers from Thuringowa City Council staff and the doctoral candidate. Once developed, questions were piloted with two Thuringowa City Council employees before being used in the focus groups. No changes to the questions were required. Questions asked during the focus groups included:

1. What does physical activity mean to you?

2. Who do you think is responsible to motivate or encourage you and your co-employees to participate in physical activity?

3. It has been suggested that the workplace is a setting that may incorporate physical activity. What are your thoughts on/about this?

4. If a physical activity promoting program was to be set up in you workplace, what type of activities or approaches would you like to see incorporated?

5. What would give Thuringowa Council employees further incentive or encouragement to participate in workplace physical activity activities?

6. What might prevent Thuringowa Council employees participating in workplace physical activity programs?

7. Is there anything else relevant to this topic that you would like to discuss?

The focus group questions, prompts and script are provided as Appendix 7.1.

Semi-structured, in-depth phone interviews

Five semi-structured in-depth phone interviews were conducted with managers from the Thuringowa City Council in March and April 2005. Interviews were chosen rather than focus groups at the request of managers who felt that they could timetable the interviews more easily into their work responsibilities. These interviews were individually undertaken by occupational therapy students. All phone interviewers were trained by the doctoral candidate and scripts developed to ensure interviews and focus groups were conducted in a consistent manner. Phone interviews were taped with participant consent. Interviewers also took notes during the interviews.

Questions asked during the telephone interviews were the same as those asked of employees in the focus groups except for question three which had a slight variation:

It has been suggested that the workplace is a setting that may incorporate physical activity. As a manager within the Thuringowa City Council what are your thoughts on/about this?

7.3.4 Data analysis

Focus group sessions and telephone interviews were transcribed verbatim and reviewed by the facilitators, observers the doctoral candidate in concert with the audiotapes and field notes. A thematic analysis was undertaken and responses were sorted into categories. Students were responsible for coding and themes and these were checked by the doctoral candidate as a form of analyst triangulation, i.e. using multiple analysts to review findings (Patton, 2002).

7.3.5 Ethical considerations

Participation in the study was completely voluntary. All participants received an information sheet (Appendix 7.2) and signed a consent form (Appendix 7.3). Ethics approval was obtained prior to the commencement of the study from the James Cook University Human Ethics Subcommittee.

7.4. Results:

Forty seven Thuringowa City Council employees were recruited to participate in the study (14% of the overall workforce). Of these, 23 indoor employees and 19 outdoor employees participated in focus groups and five managers participated in semi-structured in-depth phone interviews. The majority of participants in the outdoor groups were Caucasian males (only two females participated), whilst there was an even gender distribution in the indoor employees group. All managers who were interviewed were male.

Results from the manager interviews are combined with the results from the indoor focus groups as the themes were very similar. Outdoor worker findings were somewhat different and are presented separately.

7.4.1 Indoor employees

The level of participation was high in all focus groups and also during the interviews. Participants were enthusiastic about sharing their views. In each of the focus groups and interviews, the participants raised a variety of factors relevant to this topic. During analysis, four common and consistent themes were identified and the main findings of the research are reported under these:

1. Who is responsible for motivating and encouraging physical activity
2. Benefits of having physically active staff
3. Barriers to physical activity generally and in the workplace
4. Suggestions for physical activity in the workplace

Who is responsible for motivating and encouraging physical activity

Most participants strongly agreed that individuals needed to take responsibility for deciding if and how they should be physically active. There was acknowledgement, however, that this is not always easy for individuals and there was general agreement that the workplace could be a suitable environment in which to assist people to become more active.

Benefits of having physically active staff

The benefits of having physically active staff were discussed from the perspective of the benefits to the individual employee and the benefits to the employer. From an employee perspective there was the feeling that it increased mental capacity and overall health and wellbeing. It assisted in keeping a balance in life and was important for managing stress. From an employer perspective it was felt that staff who were physically active were more productive and less likely to be absent from work for illness or other reasons.

Barriers to physical activity generally and in the workplace

A number of barriers to physical activity were identified. These were under three main headings; individual, facilities and environment.

At an individual level there were many barriers that prevented people participating in physical activity. These included lack of time, lack of awareness about how important it was and how much should be done, individual preference to do other activities in spare time, family commitments and child care issues, lack of competitiveness in relation to participating in organised sport and inflexibility of work hours. Cost to do exercise was also cited as a barrier.

The importance of having good facilities for staff in the workplace was discussed and the lack of facilities at Thuringowa City Council was identified as a significant issue. People felt that there was limited shower and locker space and no place to iron or hang clothes. It was also felt that there were limited general recreational areas where staff could get together and be active. Staff were realistic that to change some of the identified issues would incur considerable cost but it was felt that these issues actively prevented staff from commuting to work and from being active during breaks such as lunchtime.

At an environmental level the hot weather experienced in Townsville was seen as a significant barrier to physical activity.

Suggestions for physical activity in the workplace

Staff were enthusiastic about the potential of implementing physical activity interventions in the workplace. From an employer perspective it was felt that it was good for the overall image of the Thuringowa City Council to promote physical activity for their employees as well as for the overall community. It was suggested that working relationships among staff could be enhanced by incorporating physical activity interventions.

A number of suggestions were made as to the sort of interventions that could be used in a local government workplace setting. These included workplace physical activity challenges such as the 10,000 Steps Program that had been recently implemented across the Townsville community by the Townsville City Council. It was felt that the competitive nature of these challenges would have a positive impact on employee and employer physical activity levels. The use of educational and motivational prompts during working hours was discussed. Suggestions relevant to this included educational and motivational seminars, e-mailed educational and motivational prompts and the use of media such as pamphlets, posters and newsletters. The availability of subsidies for Council employees at local swimming pools and gyms, and flexible working times such as having longer lunch hours in which to do physical activity, were also raised as possible strategies to promote physical activity in employees. The promotion of active commuting to work was also discussed and there was a suggestion that there needed to be access to free food for those who took this option. It was emphasised that any initiatives to conduct workplace physical activity programs should be a collaborative effort between employees and employers.

The findings of the indoor focus groups and semi structured, in-depth interviews are summarised in Table 7.1.

Table 7:1: Themes and categories from data given by indoor employees via focus groups and managers via phone interviews

Theme	Major categories	Minor categories
Responsibilities of who should motivate and encourage physical activity	Employees perceptions	• Individuals' own responsibility • Workplace can create support environment • Dual participation to increase motivation – employer and employee
Benefits of physical activity in the workplace	Employee/individual	• Increases mental capacity • Increases health and well being during the aging process • Balance mind and body • Stress relief
	Employer	• Increased productivity • Decrease absenteeism
Barrier of physical activity in the workplace	Individual	• Cost to enter • Family commitment/ child care • Lack of time available • Time management skills • Lack of awareness • Need more information about physical activity - e.g. how much required, what facilities are available • Individual preference of time • Some are competitive some aren't • Fixed starting work time
	Facilities	• Limited showers • No place to hang clothes • No irons or ironing boards • No recreational area • Not enough lockers • Expensive to build
	Environment	• Weather • Too hot – sweat
Incentives to participate in physical activity in the workplace	Employee/individual	• Increased lunch time/flexible hours • Increased motivation • Educational prompts – emails, posters, newsletters • Educational and motivational seminars • Gym/pool subsidy • Employee run not management • Free food for those who ride
	Employer	Good image for TTC if promote physical activity Workplace challenges Increased working relationships

7.4.2 Outdoor employees

The level of participation in the outdoor focus groups was not as high as in the indoor focus groups and not all participants could be regarded as contributing to the overall discussion. Despite this, however, there was valuable information gained from these groups. During analysis, five common themes were identified.

1. Perceived importance of physical activity
2. Who is responsible for motivating and encouraging physical activity
3. Benefits of physical activity in the workplace
4. Barriers of physical activity, generally and in the workplace
5. Incentives to participate in physical activity in the workplace

Perceived importance of physical activity

Generally participants were aware of the importance of a physically active lifestyle and felt that due to the nature of their work, that they were quite physically active. There was some discussion as to whether their activity involved strength based activity more than cardiovascular based activity and it was felt that physical activity levels during work might vary considerably depending on the type of job being performed. In one focus group the use of pedometers was raised as a way of determining how many steps an employee does a day. This created some discussion about the different roles and responsibilities that Council employees had and the participants started to question just how active some of them were. The use of pedometers to identify how active one is and as a tool to prompt and motivate physical activity was seen as something that could have potential for outdoor employees.

Responsibility for an individual's physical activity

It was strongly felt that the responsibility for physical activity is up to the individual. In terms of physical activity in the workplace the outdoor employees felt that they were sufficiently active in their daily work and that they did not need to be involved in workplace physical activity interventions. There was some discussion as to whether getting involved in extra physical activity outside of work could have detrimental effects on productivity although this was not widely supported. There was acknowledgement, however that there could be some benefits for indoor employees to be involved in workplace physical activity interventions.

Benefits of physical activity in the workplace

The outdoor employees could not see physical activity interventions in the workplace as being personally beneficial, although there was some suggestion that there could be social benefits of getting employees together for barbeques and social sporting activities out of hours. The overall benefits of active lifestyles were acknowledged.

Barriers of physical activity, generally and in the workplace

There were a number of barriers identified by outdoor employees that prevented physical activity participation. The actual job that was assigned to an individual would affect how tired they would feel at the end of the day and this impacted on whether or not they would want to participate in any extra activity. The climate was a significant issue with employees feeling that working in the hot North Queensland conditions was exhausting and that the last thing they wanted to do before or after work was more physical activity. The general issues of time constraints and child care were also raised as was the impact of people's overall busy lifestyles. Some participants expressed that they found physical activity such as swimming and walking boring and others felt there was a general lack of physical activity facilities in the community. For some participants lack of motivation was an issue as was having health issues that prevented active lifestyles. Expense of some activities was also an issue. Safety was raised as a general issue and dogs, busy roads and lack of footpaths were discussed as relevant to this issue. Fear of injury was also mentioned as a barrier for some people. Participants were strongly opposed to work times being changed to accommodate physical activity and simply did not see this as relevant to them.

Incentives to participate in physical activity in the workplace

Generally participants did not think workplace physical activity interventions were important to them however the suggestion of subsidised membership fees at pools and gyms was seen to be a good idea. Social activities were suggested as a way for getting Council employees more active and it was also seen as a team building activity.

The findings of the outdoor focus groups are summarised in Table 7.2.

Table 7:2: Themes and categories that emerged from data given by outdoor employees via focus groups.

Themes	Categories
Importance of physical activity	• Feel they are active enough • Are aware of the importance of physical activity in their lifestyles • Cardio vs. strength training regarding greater physical activity benefits • Pedometers: used as a tool/prompt to increase awareness and motivate
Responsibility for an individual's physical activity	• Responsibility is up to individual • Responsibility is partially up to council regarding indoor employees' level of fitness • Council's responsibility to set up social activities • Increased physical activity may decrease productivity
Benefits of physical activity in the workplace	• Social benefits appear as an incentive • No benefit at a personal level for outdoor employees
Barriers to physical activity in the workplace	• Climate (heat) resulting in physical exhaustion and dehydration • Lifestyle being too busy, stressful, family orientated. Physical activity can be disruptive to routine • Time constraints • Safety (dogs and roads are an issue) • Expensive • Not enough social stimulation (e.g. just doing laps in a pool) • Lack of facilities and resources present • No foot paths and busy roads • Dependent on what job individual is assigned to at the time • Lack of individual's motivation • Health problems • Opposed to work day time changes • Injury
Incentives to participate in physical activity	• Social stimulation • Workforce challenges and competitions (e.g. using pedometers; 10,000 Steps) • Free items (e.g. beer) • Decrease costs of memberships

7.5. Discussion

The results of this study show that there are variations between the perceptions of indoor and outdoor employees in regard to physical activity in the workplace. Outdoor employees generally felt they achieved sufficient physical activity during their working day and that there was no need for additional physical activity opportunities during work time. This was evident through comments such as *"You might not walk 10,000 steps but you might lift 45 gum trees."* This contrasted with indoor employees who felt that physical activity interventions would be appropriate in the workplace setting. A study conducted by Steele and Mummery (2003) supports this perception. Their study showed that blue collar employees reported significantly higher occupational physical activity than white collar employees and professionals. Based on pedometer recordings, blue-collar employees had significantly higher step counts than white collar employees and professionals. It is likely that the white collar employees and professionals in their study had indoor jobs, however, it is not clear if the blue collar employees were predominantly employed in outdoor positions.

Although outdoor employees in this study saw little need for workplace physical activity interventions they did see this as a need for indoor employees and were supportive of indoor employees having access to workplace physical activity interventions. There was a clear perception that indoor employees were less likely to be active during work hours. A study by Mummery, Schofield, Steele, Eakin and Brown (2005) showed that occupational sitting time was independently associated with overweight and obesity in men who were employed in full-time positions although this was not seen in women. It does highlight however that indoor employees who are likely to be in more inactive positions that require prolonged sitting may be at risk of not only overweight and obesity but also the longer term consequences of these *risk factors.*

Outdoor employees perceived the nature of their work as a barrier to partaking in physical activity outside of work hours whereas indoor employees looked at barriers relevant to the organization, as well as outside of work. Because outdoor employees were not receptive to the idea of work place physical activity programs there was limited further discussion on the incentives to participate in physical activity in the workplace. Indoor employees had numerous suggestions as to the sort of interventions that may be appropriate. Although it was acknowledged by both groups that physical activity is an individual's responsibility, it was felt there was still scope for the workplace to play a role in motivating and facilitating physical activity.

It is evident that further research needs to be undertaken in this area to highlight the full range of benefits of workplace physical activity to employees and employers alike. However as a result of this research there were a number of recommendations that were provided to Thuringowa City Council regarding potential intervention approaches which may be appropriate.

These included:

- The promotion of active transport
- The use of motivational prompts such as posters, e-mails, speakers
- Educational and motivational seminars and speakers
- The creation of a more supportive workplace environment for example through the establishment of improved facilities
- Discounted memberships/subsidies to local pools and gyms.
- Pedometers to count steps as a motivator for physical activity Flexible working hours
- Social days/events involving physical activity
- Workplace challenges such as 10,000 Steps

Limitations

Every effort was made in this research to ensure it was as rigorous and thorough as possible. Three different types of triangulation were used to ensure rigor.

- ***Data source triangulation*** **-** indoor worker, outdoor employees and managers of the council were involved in giving information.
- ***Researcher triangulation*** - 13 student researchers were involved in focus groups and four involved in phone interviews acting as moderators and observers. Multiple student researchers conducted analysis to ensure the information was consistent. All research was supervised by the doctoral candidate.
- ***Methodological triangulation*** **-** in this study in-depth semi structured interviews were used to gather information from the managers and focus groups were used to gain insight from both indoor and outdoor employees.

All questions were piloted and moderators and observers were trained and scripts and prompts were developed for the questions to ensure consistency. Constant reflection was also used to provide helpful hints between moderators.

There are however some limitations that need to be acknowledged. Due to the participation in the study being voluntary, selection bias may have occurred. It is possible that the people who volunteered were those who had a particular interest in this topic. In the outdoor focus groups participants were mainly male, however, this did reflect the workforce population demographics in this area and shouldn't be seen as a significant limitation. When the outdoor focus groups were held at the end of the day, the employees were tired and not particularly interested in the study so the answers given may not be of a high quality. It should also be acknowledged that the student researchers were inexperienced in conducting focus groups and phone interviews. To overcome this the doctoral candidate was present at all focus groups and interviews and was able to provide expert information on content and help guide the discussion in the focus groups.

7.6. Conclusion

This research was useful in exploring perceptions of Thuringowa City Council employees about physical activity in the workplace and provides a starting point for further investigation of this area. Despite differences in the indoor and outdoor employee perceptions, there was overall consensus amongst Thuringowa City Council employees that physical activity in the workplace is an important health priority. This is reflected by one of the participant's statements, *"Physical activity is very important for the reasons of work life balance, and just general health and wellbeing"*.

Regardless of the lack of evidence to support what interventions are most likely to be effective in a workplace setting, a number of workplaces around Australia and internationally are implementing physical activity programs that involve a wide range of strategies. There is a need for a greater understanding as to what the most effective approaches are. Following this initial research, ongoing engagement with Thuringowa City Council provided an opportunity to collaboratively plan and develop physical activity strategies for employees. By evaluating these carefully an opportunity existed to add to the body of knowledge about workplace physical activity.

7.7. References

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Chapter 8. Findings of a pedometer study in a local government setting

8.1. Abstract

Objective: This study measured, described and compared occupational and leisure time physical activity levels of City of Thuringowa Council employees (indoor and outdoor) using pedometer data and self-reported data using the long version of the International Physical Activity Questionnaire (IPAQ).

Methods: Indoor and outdoor employees from the City of Thuringowa Council wore a Yamax Digi-walker (SW 200) pedometer for a one week period after which time they completed the Long Version of the IPAQ to allow a comparison between objective and subjective measures of physical activity.

Results: Forty nine per cent of participants were sufficiently active for health according to pedometer compared to 91.9% of participants who were sufficiently active for health as defined by IPAQ. Participants working in indoor positions undertook significantly less MET minutes of activity per week (median: 3594.0 METmin/week; IQR = [1982.5, 6265.4]), compared to participants working in outdoor positions who undertook a median of 8277.0 METmin/week (IQR = [4818.25, 30813.0]; $p<0.001$). Outdoor employees took significantly more steps than indoor employees (mean: 11987 (SD ±4842.1 compared to 9832 (SD ±3055.5); $p = 0.016$). When comparing indoor and outdoor employees in regards to leisure time pedometer readings, indoor employees were slightly more active in leisure time than outdoor employees but it was not significantly different (mean 6549.4 (SD ±2562.8) compared to 5862.6 (SD ±3322); $p = 0.212$). Comparing indoor and outdoor employees in regards to work time pedometer readings, outdoor employees were significantly more active than indoor employees in their work time (mean: 5897.5 (SD ±3605.8) compared to 3282.1 (SD ±1411.1); $p < 0.001$). Indoor employees got most of their physical activity in their leisure time whereas outdoor employees got their physical activity both in leisure time and in work time. The greatest concordance between pedometer and IPAQ was achieved in work time with no concordance during leisure time.

Conclusions: This study confirmed that in a local Council setting, outdoor employees are generally more active overall than indoor employees. Outdoor employees are

significantly more active during their working day than indoor employees, and are almost as active as indoor employees in their leisure time. Pedometer measurement appears to be more accurate in terms of reflecting what physical activity levels you would expect to see and are in line with national population level physical activity data. IPAQ seems to significantly over-estimate the proportion of participants who are sufficiently active for health.

8.2. Introduction

In Chapter Seven, the findings of a qualitative study conducted with employees at the Thuringowa City Council were described. The study aimed to explore Thuringowa City Council employees' perceptions about the role of the workplace in promoting physical activity. In particular the study aimed to explore employees' perceptions regarding: physical activity as an issue generally; what the perceived barriers to physical activity were; and what might be some possible ways that the workplace could promote the physical activity of employees.

The results of the qualitative study with Thuringowa City Council employees showed that participants were aware of the importance of a physically active lifestyle and acknowledged that being active had benefits for the individual as well as the employer. There was some discussion in the focus groups about the different occupational roles and responsibilities that Council employees have particularly in relation to whether their work was predominantly indoors or outdoors. Indoor employees felt that they were not that active during work hours but generally outdoor employees felt the nature of their work provided opportunities for physical activity to be part of their daily work life. As a result of this occupational activity, some employees felt there was less of a need to engage in leisure time activity.

Many of the population surveys that are conducted to assess physical activity levels focus on leisure time activity. The recommended moderate levels of physical activity are often achieved as a result of leisure time pursuits, however, as reflected in the comments of the Thuringowa City Council outdoor employees, it needs to be acknowledged that some occupations involve significant levels of physical activity during the course of a working day (Macera & Pratt, 2000). The emphasis on physical activity accumulated in leisure time without acknowledgement of occupational time physical activity may be an inaccurate reflection of total energy expenditure at a population level (Mummery, Schofield, Steele, Eakin & Brown, 2005; Yore, Ham, Ainsworth, Macera, Jones & Kohl, 2005). Failure to measure energy expended while at work as well as in leisure time may result in people being misclassified as inactive when the opposite is true (Yore, Bowles, Ainsworth, Macera, Kohl, 2006).

The role of occupational physical activity in the overall accumulation of physical activity is unclear and the impact of occupational physical activity on health outcomes is controversial (Steele and Mummery, 2003). Some epidemiological studies that have been conducted examining the association between occupational physical activity and coronary vascular disease (CVD) showed that lower occupational physical activity was associated with premature mortality for CVD (National Public Health Partnership, 2003). Salonen, Slater, Tuomilehto and Rauramaar (1987) found that inactive occupation and lack of leisure time physical activity was associated with an increased risk of CVD. Berlin and Colditz (1990) also showed an increase in relative death from CVD in inactive employees compared to those who had active occupations. Therefore, there is justification for measuring occupational physical activity. However, the National Public Health Partnership (2003) recommends that it is important for occupational and leisure time physical activity to be examined separately.

Physical activity levels among Council employees can vary depending on the type of work performed. Indoor employees work are more likely to work in inactive positions while some outdoor employees engage in a significant amount of physical activity for the performance of daily work assignments. It is not surprising that such employees are reluctant to participate in additional recreational physical activity after an exhausting day at the workplace (Ruzic, Heimer, Misigoj-Durakovic & Matkovic, 2003). For some it may be the case that engagement in occupational physical activity is sufficient, however, for those others there continues to be a need to engage in additional leisure time physical activity.

In the focus groups conducted with the Thuringowa City Council employees, there was some discussion among outdoor employees about the different occupational roles played that impact on how active employees are. Employees started to question just how active some outdoor occupational roles were even though there was an overall perception that if you were an outdoor employee you were active. In one focus group the use of pedometers was discussed and it was felt that some outdoor employees would achieve very few steps a day…“*What about “Joe” on the ride on lawn mower, he wouldn’t get many steps in.”* As a result of these discussions and further consultation with senior management staff at the council, it was suggested that a pedometer study would be useful to assess step counts of both indoor and outdoor Council employees during work and leisure time.

Pedometers are a type of motion sensor that measure ambulatory activity and are useful as they are relatively low-cost, unobtrusive and accurate, and their output (steps) is easily comprehensible (Schneider, Crouter and Bassett 2004). Although activity at work and in leisure time can also be assessed via surveys, pedometers offer a potential advantage over self-report survey data by reducing the bias that can come from poor memory and the over or under reporting that can occur when completing survey questions (Haskell and Kiernan, 2000; Proper, Staal, Hildebrandt, van der Beek & van Mechelen, 2002).

Previous studies using pedometers to assess occupational activity have been conducted. In a study conducted by Steele and Mummery (2003), it was found that there were significant differences in the daily step counts between professional and blue collar employees with blue collar employees reporting significantly more steps than professional employees (Steele and Mummery, 2003). Sequeira, Rickenbach, Wietlisbach, Tullen and Schultz (1995), conducted a large population study of occupational activity and found that individuals pursuing some form of physical activity outside of work hours, were more likely to accumulate more than 10,000 steps a day (the recommended daily step count for adults), whereas those who were only active during work hours, were less likely to reach 10,000 steps a day.

The recommendation that Thuringowa City Council employees undertake a pedometer study provided an opportunity to gain insight into this area and a study was designed in response to this recommendation. It was anticipated that this study would assist in finding out the differences between indoor and outdoor employees in terms of achieving sufficient levels of physical activity and in what part of the day this is achieved. It also allows comparison of what constitutes sufficient activity as defined by pedometer counts and a self-report survey. It is an important aspect of the problem definition stage of Nutbeam’s Stages of Research and Evaluation Model and results can be used to generate solutions (Nutbeam, 1998).

Specifically the aims of the study were:

- To measure and describe self-reported occupational and leisure time physical activity levels of Thuringowa City Council employees (indoor and outdoor);
- To measure and describe pedometer measured occupational and leisure time physical activity levels of Thuringowa City Council employees (indoor and outdoor); and
- To assess the relationship between the number of steps accumulated by indoor and outdoor City Council employees with self-reported data on physical activity using the long version of the International Physical Activity Questionnaire (IPAQ) in terms of who achieved "sufficient" levels of physical activity.

8.3. Methods

8.3.1 Study Design

A cross-sectional single group design study was conducted.

8.3.2 Participants and sampling

Thuringowa City Council has approximately 340 employees, all of whom were invited via e-mail to voluntarily participate in the pedometer study. Employees work across a range of areas but predominantly are in positions requiring either indoor work or outdoor work with some employees' work involving both indoor and outdoor work.

8.3.3 Data collection

Indoor and outdoor employees from the Thuringowa City Council, who voluntarily agreed to participate in the study wore a Yamax Digi-walker (SW 200) pedometer for a one week period after which time they completed the Long Version of the International Physical Activity Questionnaire (IPAQ) to allow a comparison between objective and subjective measures of physical activity.

The Yamax Digi-Walker (SW 200) pedometer was used as studies have shown these pedometers to have consistent and reliable results (Schneider et al., 2004).

There are a multitude of surveys that have been developed to measure self-report physical activity. One such survey is the IPAQ. IPAQ was developed by an international group of physical activity assessment experts as an effort to develop a valid and reliable questionnaire measuring health-related physical activity that would be suitable for both research and surveillance and it has undergone reliability and validity testing in 12 countries (Craig et al., 2003). As a result of their work two questionnaires were developed – a short and a long version, which were designed to assess health-related aspects of physical activity and inactive behaviours. The shorter version of IPAQ was designed for use in surveillance studies and the longer version was designed to provide a comprehensive evaluation of daily physical activity habits. The initial research applications indicated that the IPAQ instruments have acceptable measurement properties, at least as good as other established self-report instruments. For this study the long version of IPAQ (Appendix 8.1) was chosen as it assesses physical activity undertaken across a comprehensive set of domains including:

- Leisure time physical activity
- Domestic and gardening activity
- Work related physical activity
- Transport related physical activity

Participants were requested to wear a pedometer for one week. Steps were recorded as to what was done within work time and what was done in leisure time. Participants were instructed to go about their normal life unrestricted. Before commencing the study all participants were given an information sheet to read (Appendix 8.2) and a consent form to read and sign (Appendix 8.3).

Step counts were recorded on a log sheet (Appendix 8.4). In relation to the pedometer results, participants were classified as sufficiently active if they achieved 10,000 steps or more in a day in line with recommendations by Tudor-Locke and Bassett (2004) who propound the following categories of activity:

- <5,000 – sedentary
- 5,000-7,499 – inactive
- 7,500-9,999 – somewhat active
- >10,000 – active.

IPAQ classifies participants as being in one of the following categories – low, moderate or high activity. Participants are defined as being sufficiently active if they have moderate to high levels of physical activity. The following descriptions of the categories are taken from the "Guidelines for Data Processing and Analysis of the International Physical Activity Questionnaire," (IPAQ, 2005).

Category 1 – Low: This is the lowest level of physical activity. Those individuals who not meet criteria for Categories 2 or 3 are considered to have a 'low' physical activity level.

Category 2 – Moderate: The pattern of activity to be classified as 'moderate' is either of the following criteria:

a. 3 or more days of vigorous-intensity activity of at least 20 minutes per day

   OR

b. 5 or more days of moderate-intensity activity and/or walking of at least 30 minutes per day

   OR

c. 5 or more days of any combination of walking, moderate-intensity or vigorous intensity activities achieving a minimum Total physical activity of at least 600MET-minutes/week.

Individuals meeting at least one of the above criteria would be defined as accumulating a minimum level of activity and therefore be classified as 'moderate'.

Category 3 – High: A separate category labelled 'high' can be computed to describe higher levels of participation. The two criteria for classification as 'high' are:

a. vigorous-intensity activity on at least 3 days achieving a minimum Total physical activity of at least 1500 MET-minutes/week

OR

b. 7 or more days of any combination of walking, moderate-intensity or vigorous-intensity activities achieving a minimum Total physical activity of at least 3000 MET-minutes/week.

8.3.4 Data analysis

Analysis was performed using SPPS Version 12. Numerical data were described using mean values and standard deviations (± SD) or median values and inter-quartile ranges (IQR) depending on the distribution. Chi-square tests, t-tests and non-parametric Wilcoxon statistical tests were used to assess the differences between participants who achieved sufficient levels of physical activity and those who did not and the relationship between work and leisure time physical activity and indoor and outdoor work physical activity.

8.3.5 Ethical considerations

Participation in the study was completely voluntary. All participants received an information sheet (Appendix 8.2) and signed a consent form (Appendix 8.3). Ethics approval was obtained prior to the commencement of the study from the James Cook University Human Ethics Subcommittee – Number H2331 (Appendix 8.5) and following National Health & Medical Research Council guidelines, the data will be stored securely for at least five years.

8.4. Results

8.4.1 Participants and demographics

A total 107 participants participated in the pedometer study. This represents 31.5% of the overall Council workforce. Demographic details are presented in Table 8.1.

Of the initial 107 participants, 104 participants completed the pedometer study over a seven day period and 74 participants completed all 7 days of wearing the pedometer as well as completing the IPAQ survey. Only these 74 were included in the analysis to compare pedometer and questionnaire findings.

Table 8:1: Demographic Characteristics of employees

Demographic factor (n=107)	Percentage
Mean age (± SD)* years	40.8 (± 11.4)
% Female	52.3%
% Male	47.7%
% Country of birth Australia	89.6%
% With Year 12 education	65.6%
% With trade or higher qualification	75.8%
% With fulltime employment	91.7%
% Indoor employees	63.5%
% Outdoor employees	36.5%

8.4.2 Levels of Physical activity Achieved

Pedometer (n=104)

The overall mean steps undertaken by participants were 10,620.0 (SD 3924.5) range: 3,469.9 – 27, 457.1. This equated to 49.0% of participants being defined as sufficiently active for health according to pedometer readings (i.e. 10,000 steps or more per day).

IPAQ (n=74)

The overall median number of METmin/week undertaken by participants was 5,020.0 METmin/week (IQR = [2,118.0, 8,234.0]) range: 671 – 83,925 METmin/week. This equated to the following IPAQ classifications of activity:

- 8.1% low
- 18.9% medium
- 73.0% high

As defined by IPAQ, 91.9% of participants were sufficiently active for health.

The median number of METmin/week undertaken by employees working in indoor positions was 3,594.0 METmin/week (IQR = [1982.5, 6265.4]); range: 671 – 14,596.5 METmin/week. The overall median number of METmin/week undertaken by employees working in outdoor positions was 8,277.0 METmin/week (IQR = [4,818.25, 30,813.0]); range: 720 – 83,925 METmin/week. This difference was statistically significant (p<0.001).

8.4.3 Number of steps that are achieved by indoor and outdoor employees in leisure time and work time

Comparing overall pedometer readings, outdoor employees took on average significantly more steps than indoor employees (mean 11,987 (SD±4,842.1) compared to 9,832 (SD ±3,055.5); p = 0.016).

Indoor employees got more of their physical activity in their leisure time compared to work time (p <0.001) whereas there was little difference between leisure time and work time physical activity in outdoor employees (p=0.967).

When comparing indoor and outdoor employees in regards to leisure time pedometer readings, indoor employees were slightly more active in leisure time than outdoor employees but this difference was not significantly different (mean 6,549.4 (SD ±2,562.8) comapred to 5,862.6 (SD ±3,322); p = 0.212).

When comparing indoor and outdoor employees in regards to work time pedometer readings, outdoor employees were significantly more active than indoor employees in their work time (mean 5,897.5 (SD ±3,605.8) compared to 3,282.1 (SD ±1,411.1); p <0.001)..

The details on number of steps that were achieved by indoor and outdoor employees in leisure time and work time are contained in Table 8.2.

Table 8:2: Number of steps that are achieved by indoor and outdoor employees in leisure time and work time.

	Total pedometer steps (mean ± SD)	Leisure pedometer steps (mean ± SD)	Work pedometer steps (mean ± SD)	p value comparing leisure and work
Indoor employees (n=66)	9,832.4 (SD – 3,055.5)	6,594.9 (SD – 2,562.8)	3,282.1 (SD – 1,411.1)	< 0.001
Outdoor employees (n-38)	11,987 (SD – 4,842.1)	5862.6 (SD – 3,322.0)	5897.5 (SD – 3,605.8)	0.967
p value comparing indoor and outdoor workers	0.016	0.212	<0.001	

8.4.4 Concordance between pedometer and the IPAQ

Although classified as not sufficiently active on pedometer (i.e. less than 10,000 steps per day), 63.9% of employees were classified as highly active on the IPAQ survey and 22.2 % achieved medium levels of physical activity. Concordance between pedometer readings and IPAQ findings is presented in Table 8.3.

Table 8:3: Concordance between pedometer and IPAQ

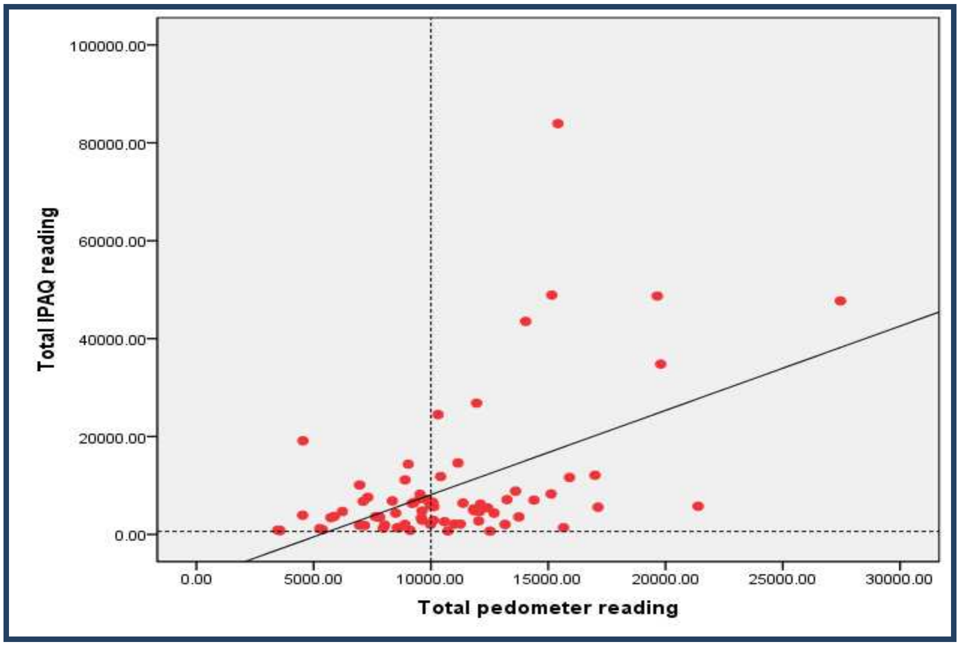
	Pedometer	
IPAQ	**Not sufficient (n=36)**	**Sufficient (n=38)**
Low (not sufficiently active)	5 (13.9%)	1 (2.6%)
Medium and High (sufficiently active)	Medium - 8 (22.2%) High - 23 (63.9%)	Medium – 6 (15.8%) High - 31 (81.6%)

8.4.5 Correlations between pedometer readings and IPAQ

Correlation between pedometer reading and IPAQ (total activity)

In regards to total overall activity, there was – as expected – a correlation between pedometer readings and IPAQ (Figure 8.1). Spearman's correlation coefficient was 0.41 ($p<0.001$).

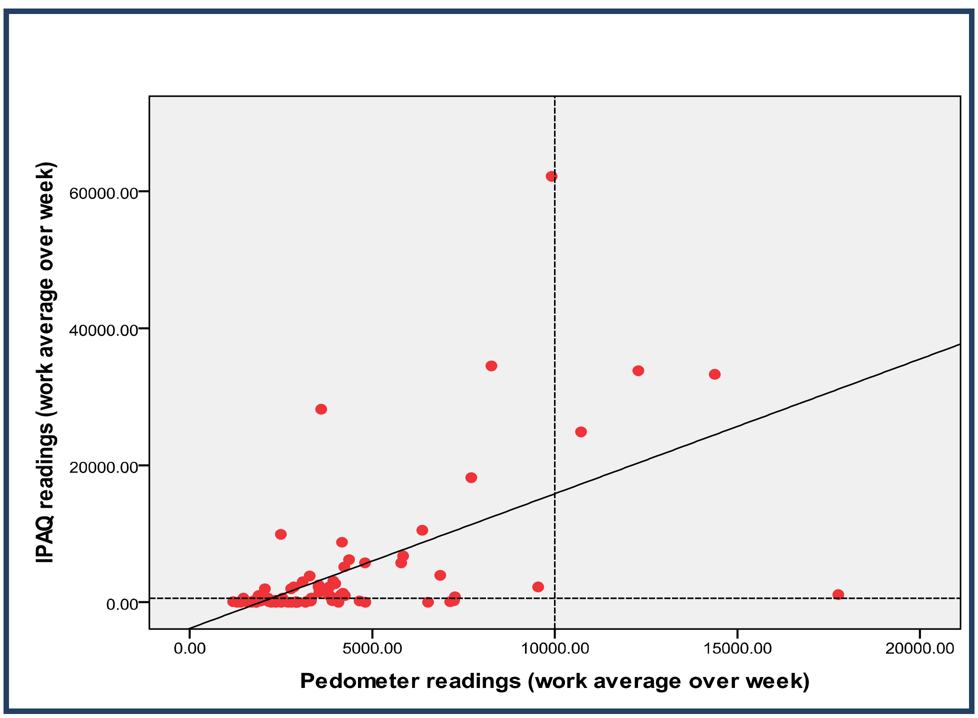
Figure 8:1: Correlation between pedometer reading and IPAQ (Total activity)



Correlation between pedometer reading and IPAQ - Work time activity

During work time there was a correlation between pedometer readings and IPAQ (Figure 8.2). Spearman's correlation coefficient was 0.58 ($p<0.001$).

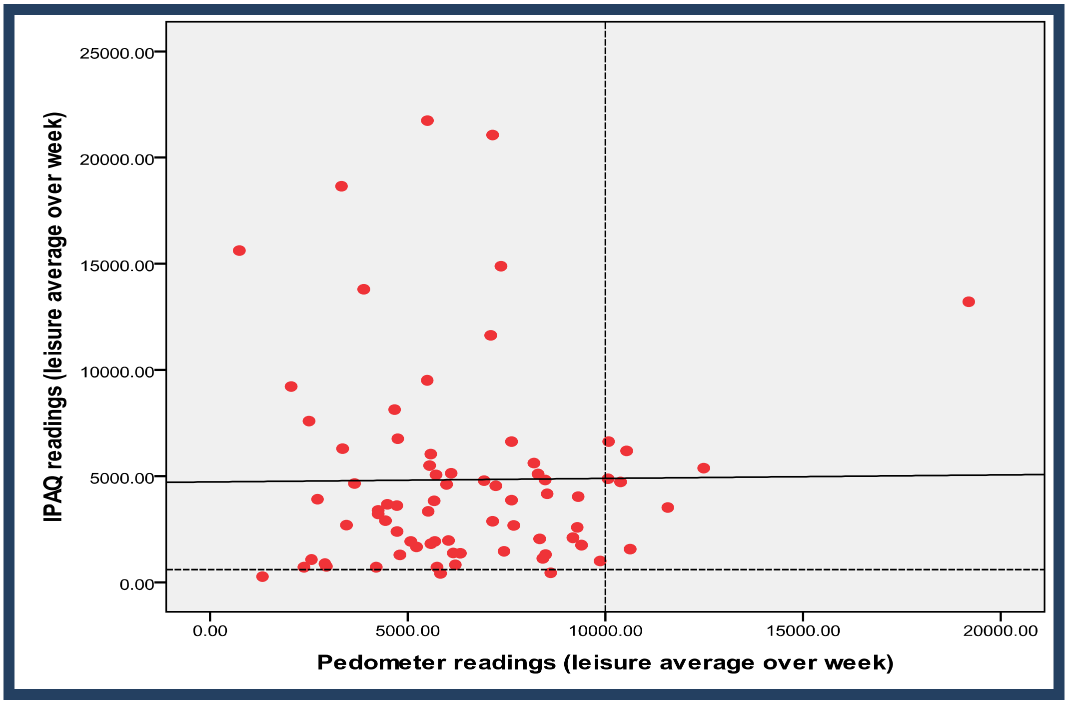
Figure 8:2: Correlation between pedometer reading and IPAQ – work time activity.



Correlation between pedometer reading and IPAQ - Leisure time activity

In leisure time there was no correlation between pedometer readings and IPAQ (Figure 8.3). Spearman's correlation coefficient was 0.03 ($p = 0.835$).

Figure 8:3: Correlation between pedometer reading and IPAQ (leisure time)



8.5. Discussion

The findings of this study contribute to understanding the differences between indoor and outdoor employees in a local Council setting in terms of how much physical activity they do and when they do it. It also illustrates several issues about the selection of physical activity measurement tools and how participants are classified as being "sufficiently" active for health.

The study confirms that outdoor employees are generally more active overall than indoor employees. This is in line with the perception expressed by employees in the focus groups and is consistent with the findings of other workplace pedometer studies (Steele and Mummery, 2003; Schofield, Badlands and Oliver, 2005; Sequeira, et al., 1995). In this study outdoor employees are significantly more active during their working day than indoor employees and this again supports the perceptions in the focus groups. Schofield and colleagues New Zealand study also demonstrated that blue collar workers accumulated more steps in the workplace than other occupations although similar to our study there were no significant differences in non work time (Schofield et al., 2005).

Despite outdoor employees in the current study being more active in the workplace, they continue to be almost just as active as indoor employees in their leisure time and this was important in their achievement of sufficient levels of activity. Indoor employees are slightly more active in leisure time but only by a small amount (on average 732.3 steps). These findings are contrary to the perceptions of employees who participated in the focus groups who felt that outdoor workers would not need to do more activity in their leisure time. However although these perceptions were expressed, the pedometer study does show that most outdoor employees continue to be just as active in their leisure time as the indoor employees.

In regards to describing levels of physical activity, what is defined as "sufficient" might be quite different depending on what instrument is used to measure activity and what cut offs are used for "sufficient". The results from this study show that participants appear to over-estimate their physical activity on the Long IPAQ survey compared to the pedometer and the pedometer results seem more in line with population estimates of the prevalence of physical activity (Bauman, Ford and Armstrong, 2001). Previous studies have shown that achieving 10,000 steps a day is associated with meeting recommended levels of activity (Welk, Differding, Thompson, Blair, Dziura & Hart, 2000; Wilde, Sidman & Corbin, 2001; Le Masurier, Sidman &Corbin, 2003; Tudor-Locke & Bassett, 2004). There is also growing evidence that 10,000 steps a day is associated with indicators of good health such as less body fat (Hatano, 1993) and lower blood pressure (Tudor-Locke, Ainsworth, Whitt, Thompson, Addy & Jones, 2001).

The differences between what IPAQ shows as "sufficient" activity and what the pedometers show as "sufficient" in this study is surprising, however, and in interpreting these results there are a number of things to acknowledge. Long IPAQ has many categories for capturing leisure time activity and this can lead to a greater opportunity for over-reporting. IPAQ is known to show a higher prevalence of physical activity than other surveys (Rzewnicki, Vanden Auweele, & De Bourdeaudhuij, 2003; Johnson-Kozlow, Sallis, Gilpin, Rock, & Pierce, 2006; Ainsworth et al., 2000). In a previous study, the short version of IPAQ (which has less categories than the Long IPAQ) has been shown to demonstrate up to a 26% increase in prevalence estimates of sufficient activity when compared to three other surveys - The Active Australia Survey, Behavioural Risk Factor Surveillance System Survey, National Health Surveys (Brown, Bauman, Chey, Trost & Mummery, 2004). It is a possibility that the long version of the IPAQ could produce even greater discrepancies and this might have been a limitation in the current study.

Pedometers might slightly under-estimate leisure time physical activity because they only reflect ambulatory activity and are not able to capture activities such as swimming, cycling and weight lifting (McCormack, Giles-Corti, Milligan, 2006; Miller, Brown & Tudor-Locke, 2006). In a study conducted by Miller et al. (2006), which aimed to assess the prevalence of non-ambulatory activity undertaken by a sample of Australian workers, it was concluded that non-ambulatory activity accounted for a very small proportion of the physical activity undertaken by the majority of the study participants. It is possible that the participants in this study might have engaged in significant non-ambulatory activity that was not captured on the pedometer and this is a limitation of this study. Despite this, the disparity between the Long IPAQ and pedometer classifications of sufficient activity was quite large.

Participants in this study were not blinded to the pedometer readings and it is possible that this made them more active than normal during the week of the study and as a result their perceptions of how active they were went up. Also participants voluntarily chose to be in this study and might have been more active than the general population because of their possible interest in and self-selection into the study. A number of people did not complete the IPAQ survey and of those who did, there was a trend towards them being higher income earners and having higher education levels. This could mean that IPAQ suits those with a higher level of education (possibly due to better writing and reading skills) and pedometer studies are more suited to people who are not used to writing so much. However, it could also mean that people with lower socio-economic indicators are less likely interested in physical activity (Parks, Housemann & Brownson, 2002).

This study has a number of limitations. While the study was strengthened by using both self-report and objective measures of physical activity, it must be acknowledged that the IPAQ relies on accuracy of recall and the long version that was used has multiple domains, both of which could have led to over-reporting of physical activity. The self-selection of participants means that one cannot make a conclusion regarding the physical activity levels of all indoor and outdoor employees in this Council setting (or other workplaces) as they may have been more interested in the topic and already more active than the employees who did not volunteer for this study. The use of the pedometer itself might also have been a "motivator" prompting employees to take more steps.

A further limitation is that non-ambulatory activity was not captured on the pedometer logs, just the steps actually taken. In assessing physical activity it is useful to capture non-ambulatory activities as well; methods such as using additional diary keeping or using suggested step conversions for non-ambulatory activity could be used. For example the 10,000 Steps website has a step conversion sheet which shows that 10 minutes of moderate intensity activity such as swimming, cycling, gardening, weight training is equal to 1000 steps and ten minutes of high intensity activity such as competitive sport, vigorous rowing, fast cycling, is equal to 2,000 steps (10,000 Steps, n.d.). Miller et al., (2006) suggested that 200 steps be added for every minute of non-ambulatory physical activity. If non-ambulatory activities are not captured significant amounts of physical activity are missed. This is particularly relevant in areas where the weather is conducive of outdoor activities and in particular water sports, as in this current study location.

8.6. Conclusion

This study provided descriptive data regarding the work time and leisure time physical activity levels of Council employees measured by pedometer and IPAQ and allowed for a correlation to be made between these two data collection methods. Results showed that in this Council setting, outdoor employees were more active than indoor employees and that outdoor employees achieved higher levels of physical activity during their working day than indoor employees. Depending on assessment tools used, this study showed that there may be discrepancies as to who is defined as "sufficiently" active. Pedometer measurement appeared to be more accurate in terms of reflecting what physical activity levels you would expect to see and were in line with national population level physical activity data. IPAQ however seemed to over-estimate notably the proportion of participants who are sufficiently active for health and caution is needed in drawing conclusions about physical activity based on these findings.

Although this study is limited by the small numbers included and the self-selection of the participants, it does highlight some important issues to consider when evaluating any future physical activity interventions that might be undertaken at the Council or in other workplace settings. Self-report methods are practical for obtaining data especially on larger samples (Tudor-Locke and Myers, 2001) however the value of using pedometers in achieving reliable objective data on ambulatory activities, especially in smaller studies, should be acknowledged. Pedometers can be useful in overcoming some of the issues around over-reporting that can be seen on self-report surveys.

It is recommended that if future physical activity interventions are undertaken at the Council or in any other workplace setting, pedometers and other methods such as diaries or step conversions could be used to measure physical activity for evaluation purposes. Ultimately the choice of instrument will depend on the nature of the intervention and the resources available.

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Chapter 9. Impact evaluation of a 10,000 Steps Workplace Challenge in a local government setting

9.1. Abstract

Objective: This chapter details the findings of the evaluation of the 10,000 Steps Workplace Challenge conducted with Thuringowa City Council employees in October and November, 2006. The overall aim of the evaluation was to measure and describe the physical activity levels of employees at Thuringowa City Council, pre and post intervention (10,000 Steps Challenge) using pedometer step counts.

Methods: The Thuringowa City Council 10,000 Steps Workplace Challenge was run over a six week period from October to November, 2006 with employees who voluntarily agreed to participate following an e-mail invitation. Prior to commencing the Challenge a baseline study was conducted over a one week period to assess the current number of steps being taken by employees. The Challenge involved employees forming teams and wearing a pedometer for six weeks. Follow up pedometer assessment was conducted 3 months and 6 months after the completion of the Challenge in March and July 2007.

Results: A total of 20 teams participated in the Challenge with a total of 99 participants. The average number of steps taken each day per person was 10,803 steps. There was a significant difference when comparing the steps taken at baseline (median 8766; IQR= [6847, 11252]) compared to those during the Challenge with people taking more steps during the Challenge (median 9666; IQR = [8084, 12935]), p = 0.004. At the six month follow up there was no significant difference between the baseline and the follow up step counts (median 8766; IQR= [6847, 11252] compared to 9609; IQR= [7644, 11637], p=0.588).

Conclusions: Results of the Thuringowa City Council Workplace Challenge showed that workplace challenges were successful in engaging employees to be more physically active during the time of the Challenge, however, the lack of success in sustaining physical activity indicates that other strategies are needed if people are to maintain levels of physical activity sufficient for health benefits. Workplaces, including the Thuringowa City Council, are well placed to contribute positively to the health and well

being of their employees by encouraging and providing opportunities for increased participation in physical activity.

9.2. Introduction

Chapter Eight presented the findings of a pedometer study that was conducted with indoor and outdoor employees at the Thuringowa City Council. These results showed that 51% of the overall participants were not sufficiently active for health (defined as achieving less than 10,000 steps a day). However, more indoor workers (57.5%) were not sufficiently active in comparison to outdoor workers (39.5%). This is not surprising and a similar pattern was reflected in a study conducted by Steele and Mummery (2003), which showed that professional employees took significantly less steps every day than blue collar employees.

The findings of the qualitative research study, discussed in Chapter Seven, which showed that some employees were interested in being involved in physical activity initiatives within the workplace setting, and the findings of the pedometer study, provided a basis for ongoing discussions with Thuringowa City Council regarding the potential for physical activity interventions to be implemented within this local government setting. Underlying these discussions was the acknowledgement that influencing physical activity behaviour in the workplace occurs through multiple levels (Stokols, Pelletier and Fielding, 1996) and needs to be considered within a socio-ecological framework to achieve sustainable changes in behaviour. One of the recommendations that came from the qualitative study was to conduct workforce challenges and competitions (using pedometers to measure physical activity). These recommendations coincided with the local health department in Townsville running a 10,000 steps community challenge that was based on the "10,000 Steps Rockhampton" project (Brown, Eakin, Mummery & Trost, 2003) and this local competition was receiving wide local media promotion. As a result, both managers and employees at the Council had heard of the 10,000 steps challenge and were keen to implement such a program within the workplace. The 10,000 Steps Program is based on a view that 10,000 steps compares to meeting national physical activity guidelines (i.e. 30 minutes a day of accumulated moderate physical activity). Because an average inactive person takes approximately 7,000 steps a day (Tudor-Locke, Ainsworth, Whitt, Thompson, Addy and Jones, 2001), it is anticipated that adding a 30 minute brisk walk brings the daily total to about 10,000 steps (Brown, et al., 2003). The focus is on the accumulation of steps across an entire day, not just on what is achieved in leisure time. Following the success of the Rockhampton project, the 10,000 Steps Program is now being used in several other areas and in particular, workplaces are undertaking 10,000 Steps workplace challenges as a way of promoting physical activity to employees. The Rockhampton 10,000 Steps Program supports these initiatives and provides a website where participants can log their steps. The 10,000 Steps workplace challenge provides an opportunity for employees to participate in a work-specific physical activity program (a challenge) and is a platform for employees and employers to take positive steps towards better health. The workplace challenges aim to:

1. Increase individual's physical activity awareness;
2. Increase the overall physical activity levels among employees; and
3. Create awareness of the coincidental health benefits that can occur in the activities of daily living, including work.

A number of workplace programs have used pedometer interventions (Chan, Ryan, and Tudor-Locke, 2004; Croteau, 2004; Rogers, Ast, Kellerman, Moser, Scott, Woolley and Douglas, 2005; Thomas and Williams, 2006; Wyatt, Peters, Reed, Grunwald, Barry, Thompson, Jones and Hill, 2004) or conducted physical activity challenges (Blake, Caspersen, Finnegan, Crow, Mittlemark and Ringhofer, 1996: Hammond, Leonard, and Fridinger, 2000; Bowles, Morrow, Leonard, Hawkins and Couzelis, 2002), however there is limited information regarding the impact that they have on influencing employee physical activity patterns in relation to long term follow up to ascertain what happens to physical activity patterns over time. This is also complicated by the fact that many studies use multiple strategies to increase physical activity making it difficult to assess the impact of the pedometer and/or competitive nature of the intervention in isolation.

Chan, et al., (2004) evaluated a pedometer based walking intervention in a workplace and found that participants increased their step count by an average of 3,451 steps/day over the time of the 12 week intervention, but no follow up was conducted to assess longer term change. Croteau (2004) conducted a study that consisted of a multi-component intervention including goal setting, pedometer use, self-monitoring and email reminders. Results showed that participants increased their step count by an average of almost 2,000 steps from baseline to the end of the intervention but again no follow up was conducted. Rogers et al., (2005) evaluated a 21 week workplace pedometer intervention and showed a significant increase in step counts at week five of the program compared to the baseline (of 5,689 steps) and this increase was sustained for the remaining 15 weeks of the intervention. Thomas and Williams (2006) undertook a four week pedometer-based workplace physical activity health promotion program and found a 10% increase in number of steps taken on average (but only by 873 steps). They found that those who started with the lowest steps achieved the greatest increases. Wyatt et al., (2004) conducted pedometer interventions in six worksites and participants increased their step count by an average of 2,170 steps/day over the time of the 14 week intervention however no follow up was conducted to assess longer term change.

Other workplace studies have used challenges as the incentive to increase physical activity although physical activity outcomes were not measured using pedometers. Blake et al., (1996) used a one month worksite exercise competition, “Shape-up” challenge, together with incentives to encourage intra-group cooperation and inter-group competition. One hundred and nineteen companies participated in the challenge and competed for awards that were based on the average minutes of exercise achieved per employee. Results showed that participants averaged three hours of activity a week but there was no baseline or control group for comparison. Hammond et al.,(2000) conducted a 50 day, Centre for Disease Control Directors’ Challenge where team captains managed teams of 30–50 employees and goal setting contracts were completed. This study used a pre- and post- design but had no external control group and had a low response rate at follow up. Results indicated that the incentives were useful in encouraging participation and that peer support was important in keeping participants motivated. However, the impact on physical activity was not clear. Bowles et al., (2002) reported on a ten week physical activity challenge called called “March into May” which was conducted as part of the second phase of the Centre for Disease Control’s “Take Charge Challenge”. Participants in this challenge were encouraged to set physical activity goals and participated in teams ranging from 5–42 participants. Participants were given incentives such as gift vouchers to encourage completion of data collection. The study was limited in that there was no comparative baseline and no control group so it is unclear what impact this study had on physical activity behaviour. These studies are reflective of the criticism of many workplace physical activity programs in regards to poor design and evaluation (Marshall, 2004; Dishman, Oldenburg, O'Neal & Shephard, 1998). The implementation of the 10,000 Steps workplace challenge at Thuringowa City Council provided an ideal opportunity to evaluate whether longer term changes in physical activity can be achieved from such initiatives.

Team based challenges that aim to increase physical activity in the workplace reflect the socio-ecological model and can influence health behaviours through multiple levels. This can be at a direct level where opportunities for physical activity are made available (in this case, offering the 10,000 steps challenge) or through the indirect effects that come from the challenge in relation to social support and changing social norms about physical activity behaviour. As shown by Hammond et al., (2000), social support is important in assisting and motivating individuals to be physically active especially in relation to walking. In 1999, Sallis and Owen discussed how a positive social environment can influence individuals to change their behaviour (Sallis and Owen, 1999). This is supported by the findings of research conducted in Western Australia (Giles-Corti & Donovan, 2003) and Central Queensland (Duncan and Mummery, 2004). Giles-Corti and Donovan (2003) found that encouraging people to walk with others was associated with individuals achieving the recommended levels of walking. Duncan and Mummery (2004) found that people who reported high levels of social support for physical activity were 65% more likely to participate in recreational walking than those who reported low levels of social support. The team based nature of 10,000 Steps Challenges makes it ideal to use social support as a motivator for physical activity.

The 10,000 Steps Workplace Challenge was conducted at the Thuringowa City Council in October and November, 2006. Although James Cook University (the doctoral candidate's university) had been commissioned to conduct the qualitative research study and the pedometer study, the intention had always been that the Council itself would take ownership for planning and implementing workplace physical activity initiatives. The doctoral candidate was aware of the limitations of one-off interventions however saw the request to be involved with the 10,000 steps challenge as an important way to build relationships within the Council which in turn was anticipated to form a basis for ongoing work that would enhance the overall Council environment to support physical activity through environmental, organisational and internal policy changes. At the time that the research was occurring this was being driven by a particular department within the Council who was working with Council manangement to develop environmental and policy initiatives to facilitate further opportunities for workplace physical activity. The James Cook University role (through the doctoral candidate) was to provide ongoing advice and support in regards to design and evaluation of programs. Due to previous involvement in the qualitative study and the pedometer study, and ongoing involvement in the Riverway project, the doctoral candidate was asked to assist in the planning and evaluation of the Thuringowa City Council 10,000 Steps Workforce Challenge.

The overall aim of the evaluation was to measure and describe the physical activity levels of employees at Thuringowa City Council, pre- and post- intervention (10,000 Steps Workplace Challenge) using pedometer step counts.

9.3. Methods

9.3.1 Study Design and theoretical basis for the intervention

A single group pre-post design was conducted. The intervention consisted of a 10,000 Steps Workplace Challenge at the Thuringowa City Council, run over a six week period from October to November, 2006.

As described in Chapter One, Nutbeam's Model of Research and Evaluation (Nutbeam, 1998), is being applied to the studies throughout this thesis and this current study relates to the innovation testing component. This stage represents the evaluation of a program or intervention and in this study an impact evaluation is being undertaken.

9.3.2 Participants and sampling

The Thuringowa City Council has approximately 340 employees who work in indoor and outdoor roles, all of whom were invited via e-mail to voluntarily participate in the 10,000 Steps Workplace Challenge.

9.3.2 Data collection

Prior to commencing the Challenge a baseline study was conducted over a one week period to assess the current number of steps being taken by employees. All participants received a written information sheet (Appendix 9.1) and signed a written consent form (Appendix 9.2). At this time employees were asked to maintain their usual level of walking. Yamax Digi-walker (SW200) pedometers were used to assess step counts by employees as studies have shown these pedometers to have consistent and reliable results (Schneider, Crouter & Bassett, 2004).

The Challenge involved employees forming into self-selected teams and wearing a pedometer (provided at no cost) for six weeks. Participants were requested to record the number of steps taken each day in the step diary provided (Appendix 9.3) and surveys were used to collect demographic information. The Challenge was designed to encourage people to achieve at least 10,000 steps a day with a competitive focus. The winning team was offered incentives including restaurant and movie passes.

Follow up pedometer assessment was conducted three months and six months after the completion of the Challenge in March and July 2007. At the follow up assessment participants were required to wear the pedometer for one week. Gym vouchers and membership and restaurant vouchers were offered as incentives to participate in the six month follow up study.

9.3.4 Data analysis Pedometers were returned with the copies of the step diaries. Analysis was performed using SPPS Version 12. Numerical data were described using mean values and standard deviations (± SD) or median values and inter-quartile ranges (IQR) depending on the distribution. The comparison of step counts was conducted using non-parametric paired Wilcoxon tests. Where incomplete data for the pedometer readings existed, an average of what they had completed was calculated.

9.3.5 Ethical considerations

Participation in the study was completely voluntary. As described above all participants received a written information sheet (Appendix 9.1) and signed a written consent form (Appendix 9.2). Ethics approval was obtained prior to the commencement of the study from the James Cook University Human Ethics Subcommittee – Number H2330

(Appendix 9.4) and following National Health & Medical Research Council guidelines, the data will be stored securely for at least five years.

9.4. Results

9.4.1 Teams, participants and step counts throughout Challenge

A total of 20 teams participated in the Challenge with a total of 99 participants. The total number of steps achieved by these participants over the entire six weeks of the Challenge was 42,247,895 and the average number of steps taken each day per person was 10,803 steps.

9.4.2 Participants and demographics

Of the 99 participants who participated in the Challenge not all participated in the baseline study and/or the follow up study so the information below does not relate to all 99 participants. A total of 79 participants participated in the baseline study and of these 69 people went onto participate in the Workplace Challenge. At the three month follow up only 27 people participated and this data was not analysed due to the low number.

Of the 69 participants in the Workplace Challenge who had done the baseline, only 32 (46%) completed the baseline pedometer assessment, the six week challenge and the six month follow up assessment and only these 32 are used to compare longer term physical activity levels.

Demographic details for the Challenge participants and the follow up study participants are presented in Table 9.1.

Table 9:1: Demographic characteristics of participating employees

Demographic Factors	N=99*	N=32**
Mean age (SD) [years]	37.1 (±10.9)	36.0 (±10.8)
% Female	63.3%	63.3%
% born in Australia	86.1%	83.3%
% achieving year 12	82.3%	80.0%
% with trade or higher qualification	86.1%	86.7%
% with bachelor degree or higher	51.5%	57.6%
% fulltime employment	92.4%	90.0%
% with dependent children	49.4%	50.0%
% with chronic health problems	9.3%	15.6%
% whose health sometimes, often or very often limits physical activity	11.5%	13.3%
% Current smoker	10.6%	6.3%
% ex smokers	20%	21.9%
Mean BMI (SD) [kgs/m^2]	25.2 (4.7)	24.2 (3.9)
% wkly income >/= $1000 AUD	62.5%	59.2%

* All challenge Participants

** Participants who completed the baseline, Challenge and 6 month follow up.

9.4.3 Step Counts

The median average daily steps for participants involved in the Challenge are presented in Table 9.2. The second column in the table shows the median average daily step counts for the 79 participants who completed the baseline study. Of these, 69 participants went onto participate in the Challenge. Thirty six participants completed the six month follow up however four had not completed the baseline. Only 32 participants completed the baseline, Challenge and six month follow up and these are presented in the third column of Table 9.2.

Table 9:2: Median average daily steps for participants in the Challenge.

	Median average daily steps [IQR]* for participants who completed baseline, baseline and challenge, and six month follow up	Median average daily steps [IQR] of participants who completed the baseline, the Challenge and the six month follow up (n=32)
Baseline	9252[7169,11291] n=79 who completed the baseline	8766 [6847, 11252]
Challenge	10,600 [8318,13258] n= 69 who completed the Challenge and baseline	9666 [8084, 12935]
6-months follow-up	9608.5[7344.5,11362.5] n= 36 who completed the follow up	9609 [7644, 11637]

*IQR = Inter-quartile range

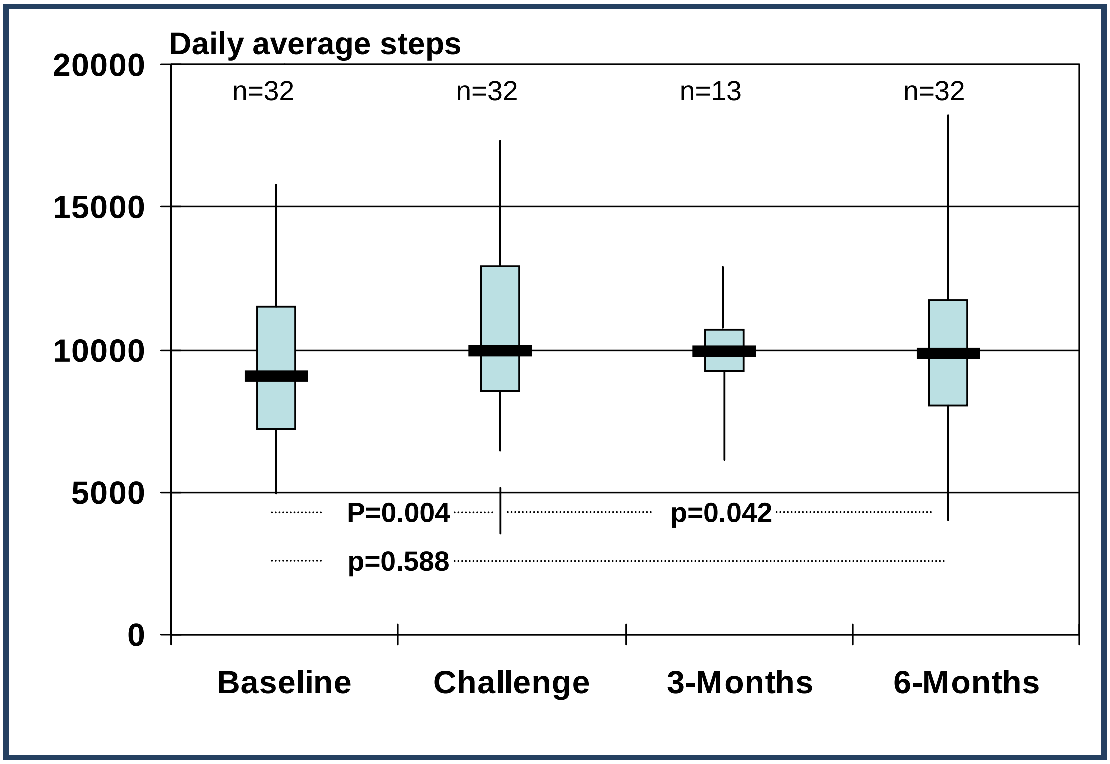
9.4.4 Differences in steps taken at baseline compared to the Challenge compared to six month follow up for the 32 people who completed everything

There was a significant difference when comparing the steps taken at baseline (median 8766; IQR= [6847, 11252]) compared to those taken during the Challenge, with people taking more steps during the Challenge (median 9666; IQR= [8084, 12935]; p = 0.004). During the challenge 23 people did more steps than in the baseline and nine people did less steps.

There was a significant difference when comparing the steps taken during the Challenge (median 9666; IQR= [8084, 12935]) compared to the six month follow up (median 9609; IQR= [7644, 11637]) with people taking more steps during the Challenge (p=0.042). At the six month follow up 22 people did less steps than during the Challenge and 10 people did more steps.

There was no significant difference found when comparing the steps taken at baseline (median 8766; IQR= [6847, 11252]) compared to the six month follow up (median 9609; IQR= [7644, 11637]; p=0.588). Fifteen people did less steps at follow up compared to the baseline and 17 people did more steps but it is not significantly different.

Table 9:3: Box-and-whisker plots to show differences in steps taken at baseline, compared to the Challenge, compared to six month follow up for the 32 people who completed all components.



9.4.5 Percentage of participants achieving different step counts

The percentage of participants who achieved <10,000 steps, 10,000-12,499 steps or > 12,500 steps are presented in Table 9.4. The first two rows are those 79 people who participated in the baseline and the 69 people from that group of 79 who then participated in the Challenge.

The bottom three rows show the percentage of the 32 participants who achieved <10,000 steps, 10,000–12,499 steps or > 12,500 steps who were involved in the baseline, the Challenge and the follow up.

At baseline, 62% of the 79 participants who participated were insufficiently active. 71.9% of the 32 participants who completed all parts of the study were insufficiently active. During the Challenge there was an increase in participants who were sufficiently or highly active. A lower percentage of the 32 participants who completed all parts of the study were insufficiently active but it was not significant.

Although a lower percentage of people were achieving < 10,000 steps at 6 month follow up compared to the baseline, it was not significantly different. There was an increase in the percentage of participants who were achieving 10,000-12,499 steps and >= 12,500 steps.

Table 9:4: Percentage of participants achieving different step counts.

	Not sufficiently active: <10,000 steps	Sufficiently active: 10,000 – 12499 steps	Highly active: ≥ 12,500 steps
Baseline (n=79)	62.0%	22.8%	15.2%
Challenge (n=69)	42.0%	26.1%	31.9%
Baseline (n=32)	71.9%	15.6%	12.5%
Challenge (n=32)	53.1%	18.8%	28.1%
6-months follow-up (n=32)	59.4%	18.8%	21.8%

9.5. Discussion

The Thuringowa City Council Workplace Challenge can be considered a success in that it engaged a total of 99 employees who averaged 10,803 steps per day throughout the duration of the Challenge which exceeded the target goal. This demonstrates that Challenges have the potential to motivate participants to achieve the daily number of steps that are recommended for sufficient levels of activity.

However, although this workplace Challenge was successful in getting participants to be more active during the Challenge, the follow up study shows that this does not translate into longer term sustained changes in physical activity levels. Similar to other studies (Chan et al., 2004; Croteau, 2004; Rogers et al., 2005; Thomas and Williams, 2006; Wyatt et al., 2004) participants' step counts did increase during the intervention compared to those at the baseline but there was no significant difference in the step counts of participants in this study at baseline compared to the six month follow up. Auweele, Boen, Schapendonk & Dornez, (2005) and Aldana, Greenlaw, Diehl, Salberg, Merrill & Ohmine, (2005) also reported a lack of sustainable change following workplace interventions. This may be due to the fact that during the Challenge participants have the motivation of wearing a pedometer, competing with others, having social support and are keeping daily log records of steps taken. However these conclusions must be viewed with caution in the current study due to the low number of participants who completed all parts of the study. In this study the follow up retention rate was slightly less to what is seen in other studies where retention rates are reported to be between 51%-63% (Marshall, 2004).

A further problem that has been identified with workplace physical activity interventions is that they are seen to attract employees who are already sufficiently active (Aittasalo, Miilunpalo, Suni 2004: Aldana et al., 2005; Badland and Schofield, 2005; Proper, Hildebrandt, Van der Beek, Twisk, Van Mechelen, 2003: McCarty and Scheuer, 2005; Marshall 2004). However in looking at the 79 participants who participated in the baseline of this study (62% were insufficiently active) and the 32 participants in this study who completed all three components, (71.9% were insufficiently active at the baseline) it would appear that this Challenge was successful in attracting a number of people who were not sufficiently active at the start. However, the challenge of how to sustain ongoing behaviour changes remains and this highlights the importance of undertaking socio-ecological approaches in workplace physical activity programs that are able to address multiple levels of influence. This includes broader policy and environmental approaches that will not only impact of those employees who participate in workplace programs but the entire workforce.

Limitations

While this workplace Challenge can be viewed as successful in terms of employees' participation and increased physical activity during the Challenge it does need to be acknowledged that obtaining sufficient data to be able to draw statistically confident conclusions about the effects of such interventions was difficult (only 36 people were recruited into the follow up study). Given how busy employees are, this is not surprising; however the small numbers that were involved in the follow up study has reduced the power to detect statistically significant relationships.

This study was also limited by the possible selection bias of the employees who completed the baseline, challenge and follow up due to the self-selection of participants into the study. This potentially limited the ability to generalize the results. However, baseline comparisons showed that participants who completed all three assessments (n=32) were not too different from the initial 99 participants (refer to Table 9.1). There was no use of step equivalents for non-ambulatory activities such as swimming and cycling and this means that some non-ambulatory activities have not been taken into account. The challenge was also of a short duration, running for only six weeks. There was also no external control group due to insufficient resources.

Although this study suffered from many of the issues that have been criticised in other workplace interventions including small sample sizes, self-selection of participants, poor follow up and lack of a control group, this should not be seen as a deterrent to the Council playing an ongoing role in physical activity participation for employees. It does however highlight the difficulties that workplaces encounter. While in an ideal world interventions would be designed and evaluated in a way that was rigorous enough to allow the findings to contribute to the evidence about what works in the workplace setting, this may not be achievable in all workplace settings. Issues around self-selection of employees into workplace programs will continue to be hard to avoid as it is not appropriate nor likely that programs would be made compulsory (Thomas and Williams, 2006). It is also difficult to generalize about the findings from one study and one workplace setting to other workplace settings due to the great diversity of workplaces and the nature of employees employed as well as the work undertaken (Thomas and Williams, 2006).

9.6. Conclusions

This study aimed to evaluate the 10,000 Steps Workplace Challenge at the Thuringowa City Council. The results show that competition based physical activity programs such as the 10,000 steps program may not be successful in achieving sustainable changes to the physical activity behaviours of employees and highlight the limitations of conducting one-off interventions. While Challenges have the potential to engage employees to be more physically active during the time of the Challenge, the lack of success in sustaining physical activity indicates that broader socio-ecological approaches are needed that create a supportive physical, social, organisational and policy environment to encourage physical activity in the workplace. By taking a broader socio-ecological approach to this problem, workplaces including local government organisations, are well placed to contribute positively to the health and well being of employees.

9.7. References

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Chapter 10. Overall Discussion and Recommendations

The research described in this thesis examined the impact of local government initiatives on physical activity, both at a community neighbourhood and workplace level. The intent of this final chapter is not to repeat what has already been discussed in previous chapters but rather to consider what the findings of the research mean in relation to current Australian policy and the latest evidence that exists about the built environment and physical activity, workplace physical activity, and the role of local government in these areas. The implications of the research findings and how they might influence policy and environmental initiatives at a local government level to address physical inactivity will be discussed.

This research was grounded within a socio-ecological model of health promotion that recognises multiple influences on health behaviours, including intrapersonal factors, interpersonal factors, institutional factors, community influences and policy (Sallis & Owen, 1997). Application of the socio-ecological model allowed exploration of the complex area of physical activity and the effects of community level environmental modifications and workplace initiatives conducted by a local government organisation. By applying a socio-ecological framework, the Riverway research focused attention on the environment and its influence on behaviour, as well as considering the relevance of intra and interpersonal factors. The workplace project enabled consideration of intrapersonal and interpersonal factors at an organisational level.

The conceptual framework for this research, presented in Figure 1.3 in Chapter One, postulated that local government could contribute to population based increases in physical activity through community environmental interventions and workplace interventions. The exploration of the complex interplay of individual, group, environmental and organizational factors that influence physical activity has provided findings to support future local government policy and initiatives. The implications of these findings will be discussed under the two separate areas of community (Riverway) and workplace.

The Riverway study used the unique advantage of a real life intervention or "natural experiment" and remains one of the only studies of this nature to be conducted and reported on in the literature. This is despite ongoing calls for such designs (Gebel, Bauman and Petticrew, 2007; Kaczynski and Henderson, 2007; Saelens and Handy, 2008).

The strength of the Riverway study was its quasi-experimental, pre post intervention and comparison design and clear definition of the intervention community (i.e. those who reside within 1.5km of a modified environment), which is reflective of what has been called for in the literature. While a strong design, the use of postal surveys introduced some limitations in relation to self-selection of study participants and self-reported responses. It is likely that the participants who completed the surveys were interested in the topic of physical activity and were already actively engaged in physical activity as evidenced by the fact that at baseline and follow up, greater than 66% of respondents were sufficiently active for health. This contrasts with population figures from 2000 which showed population levels of sufficient activity were only 56.8% (Bauman, Ford and Armstrong, 2001). Since that time population levels of physical activity in Australia have not been assessed using the same methodology, although data from New South Wales showed that physical activity in that state had increased from 47.6% in 1998, to 51.3% in 2005 (Chau, Smith, Chey, Merom and Bauman, 2005). The 10% discrepancy in physical activity levels between the Riverway participants and the wider population may reflect an inherent selection bias in using postal surveys for the Riverway research. It is worth noting that the use of computer assisted telephone interviews was initially considered but rejected following advice from the Council, who indicated that many residents did not have land lines. This selection bias is therefore likely to over-estimate the level of physical activity achieved by the local community. On the other hand, it is likely to under-estimate the association between the Riverway intervention and physical activity as it is more difficult to further increase physical activity in an already active sample.

The Riverway intervention showed positive associations between environmental change and perceptions, as well as usage. In 2006 participants were significantly less likely to report that there was a lack of a pleasant environment in which to be active. Also in 2006, following the Riverway intervention, significantly more respondents from the intervention area reported using the paths along the river, walking to the paths and using the paths for walking compared to respondents in the comparison area. Residents using the Riverway complex lived closer than those who did not use the complex and those living closer the overall Riverway precinct were more likely to walk to the areas. Since this intervention, further research and publications have summarised the growing body of evidence for the built environment, including establishment of parks and playgrounds, and their role in shaping active lifestyles. Williams (2007) published a synthesis report that described the relationship between the built environment and physical activity and found consistent associations between access to parks and open spaces, proximity to destinations, walk-ability of the community (density, land use mix, street connectivity), availability of sidewalks, aesthetics of the community and physical activity. All of these aspects were created or enhanced with the Riverway project. A subsequent synthesis published by Active Living Research (2010) concluded that: “park proximity is associated with higher levels of park use and physical activity; that having parks and more park area within communities is associated with higher levels of physical activity; that within parks people tend to be more physically active on trails, at playgrounds and at sports facilities; and that perceived parks aesthetics, condition and safety may be associated with park visitation and physical activity levels within parks”. Bauman and Bull (2007) also describe proximity and walkable distance being associated with residential and utilitarian walking.

Some care does need to be taken when discussing the term “proximity” however, with varying definitions of proximity being used in the literature (Kaczynski & Henderson, 2007) and varying views on how far people will walk to destinations (Kent, Thompson & Jalaludin, 2011). In a study conducted by Burke and Brown (2007), the median distance that people walked from home to all other places was 1.45 kms (just under the 1.5 km distance used in the Riverway study). One recent study that used a similar measure of proximity to that used in the Riverway study was conducted by Sugiyama, Francis, Middleton, Owen, & Giles-Corti (2010). The results of this study showed that a shorter distance to attractive open spaces was associated with recreational walking and that adults with larger attractive open spaces within 1.6 km of their home were more likely to walk 150 minutes or more in a week. These findings are in contrast to the results of the Riverway study where no relationship was identified between proximity to paths or modified environments in relation to overall physical activity, those who were sufficiently active for health or those who walked for destination or recreation. It must be noted however that their study was not an intervention study and did not report on overall usage.

The Riverway research highlighted the role played by social support in relation to physical activity. The importance of social support was also highlighted in a recent pre-post study, which showed that walking groups conducted in a retrofitted urban area resulted in increased walking in group members (Krieger, Rabkin, Sharify & Song, 2009). Despite the study being conducted within the context of an improved environment, no assessment of the environmental factors was done, with the research focus solely on walking groups and participation.

In Chapter Two methodological issues that existed in studies that examined the physical environment and physical activity was discussed, particularly in relation to the use of cross sectional designs and self-report measures. These criticisms are still apparent in more recent literature (Gebel et al., 2007) although a review conducted by Saelens & Handy (2008) identified that studies were increasingly using objective measures of the physical and built environment, adding strength to the conclusions being made. A strength of the Riverway study was the use of Global Information System (GIS) methodology to explore objective proximity relationships with usage and physical activity.

While every attempt was made to design the Riverway study as rigorously as possible, it was not without its problems and a number of important evaluation methodology issues were identified that should be considered by researchers who work in these areas of research in the future. The use of self complete postal surveys resulted in a low response rate and significantly decreased the power of the study and the ability to draw convincing conclusions. Increasing the response rate would have been a costly exercise and this might be one reason that not many quasi-experimental designed, community environmental intervention studies, are conducted. The self selection of participants is difficult to avoid when using postal survey methodology and other data collection processes such as computer assisted telephone interviews (CATI) could address this issue to a degree. However recent research, which shows that there is increasing reliance on mobile phone technology particularly amongst younger consumers, means that CATI surveys will also be limited in who they are able to reach (Australian Communications and Media Authority, 2009). Many 18 to 24-year-olds do not have a fixed-line phone in their residence and in the 25 to 40 age group, it has been shown that increasingly a fixed-line service is used solely to provide broadband access, or as a backup to their mobile service, and that there is a shift away from fixed voice communications (Australian Communications and Media Authority, 2009).

While the Riverway study was not without its limitations it does have some strengths in its quasi-experimental design and the use of GIS measures that allowed for an objective measure of proximity. Very few studies of this nature have been conducted and this may highlight the difficulty in designing such studies. An intervention such as Riverway is a multi-million dollar initiative and researchers need to use such interventions opportunistically to undertake an evaluation of environmental change. The evaluation of the Riverway intervention has added to the limited intervention research that has been done in this area. In Chapter Four two quasi-experimental design studies conducted by Evenson, Herring & Huston (2005) and Brownson et al., (2004) were described and in Chapter Two a pre and post assessment of a campaign to promote a newly constructed 16.5 km long rail trail cycle way, which was designed to encourage people to use alternative means of transport was described (Merom, Bauman, Vita & Close (2003). However, given the continual call for prospectively designed studies to more clearly understand built environment features and physical activity, it is surprising to see that published literature using such designs is still largely lacking. Since the Riverway research began, the study that is most similar in design is one conducted in the United States of America by Fitzhugh, Bassett & Evans (2010). They undertook a quasi-experimental study using an intervention and two control neighbourhoods. The intervention consisted of retrofitting a neighbourhood with an urban greenway/trail to connect the pedestrian infrastructure with retail areas and schools nearby. Study participants included both children and adults. Pre and post construction observation assessment was conducted. At baseline there were no differences in physical activity counts in the experimental and control neighbourhoods but at follow up the counts of total physical activity was significantly higher in the experimental neighbourhood than in the control neighbourhoods. This significant increase was also seen in walkers and in cyclists. Unlike the Riverway study, this study did not assess whether there was an increase in people who were sufficiently active for health and although increases in sufficient levels of physical activity were not seen in the Riverway study, there was a self-reported increase in usage of Riverway after completion and people in the intervention area were more likely to walk there. GIS data also showed that the closer residents were to the Riverway complex or Riverway precinct, the more likely they were to use the areas or walk to them. While the Fitzhugh et al., (2010) study has been able to show that enhancing a neighbourhood's pedestrian infrastructure increases outdoor physical activity it does not capture the depth and breadth of the information in the Riverway study in relation to physical activity as well as individual, social and environmental attributes that influence physical activity.

The studies conducted as part of the workplace component of this thesis identified some important findings that can be used to inform future workplace physical activity research and interventions and that also highlight the importance of undertaking such work within a socio-ecological framework. Firstly the research showed that in this local government workplace there was both interest and support for worksite physical activity programs particularly for employees working in more inactive indoor roles. Having this commitment by employees is important and the World Health Organisation (WHO) highlight that developing interventions in a workplace setting should be a collaborative partnership, with active employee involvement in program planning and implementation of workplace interventions (WHO, 2009). In the current study, the Council employees readily participated in the qualitative research that was conducted at the commencement of the project and were actively involved in deciding what sort of interventions they would support in the workplace.

The research also demonstrated that employees do not always have a realistic understanding of their own physical activity levels. In this local government setting some outdoor employees felt that their engagement in workplace physical activity as a result of their active working practices negated the need for physical activity outside of work hours. The pedometer study confirmed that they were more active during their working day compared to those working indoors, but that it was not enough to preclude them from needing to do additional physical activity in leisure time, if they were to achieve sufficient levels of physical activity. Such findings can be promoted to outdoor employees so that their active working life does not lull them into a false sense of security and so that they understand the need for additional activity outside of work.

The workplace study also identified significant discrepancies between two different physical activity measurement methodologies. While the long version of the International Physical Activity Questionnaire (IPAQ) seemed ideal to use in the workplace due to its ability to identify the different domains of physical activity, including work time and leisure time physical activity, which was of particular interest in the research, it was clear that it did not provide a true representation of the level of physical activity of employees. Instead, the objective pedometer methodology appeared to provide a more realistic picture of what physical activity employees engage in. Most workplaces are well placed to use objective tools such as pedometers to measure employee physical activity levels or outcomes of physical activity initiatives due to the smaller number of participants that are likely to be in studies. Use of this objective measurement tool will provide a more realistic picture of employee physical activity levels.

A number of concerns have been highlighted in the literature about 10,000 step workplace pedometer interventions. One concern is the difficulty of engaging men (Saunders (2011) although in this current research 47.7% of participants in the pedometer study were male and 36.7% of participants in the 10,000 steps workforce challenge were male. Another concern with workplace interventions generally are the lack of sustainable long term changes as a result of interventions. While there is some evidence that support the implementation of workplace walking interventions using pedometers and diaries and self-monitoring (Dudgill, Brettle, Hulme, McClusky & Long, 2008), the sustainability of such approaches is unclear. In this 10,000 steps study, employees were enthusiastic during the program and achieved almost 10,000 steps per day however at six month follow up it was clear that the changes that had been achieved during the program were not sustained. This highlights the limitations of undertaking interventions in isolation and the need for ongoing workplace initiatives and support to be framed in a socio-ecological model that acknowledges that behaviours can be influenced through multiple levels of influence (Stokols, Pelletier and Fielding, 1996).

As discussed in Chapter Nine, the doctoral candidate was aware of the limitations of one-off interventions, however the intention of these early workplace research studies with the Council was to engage the Council and to develop a relationship and trust between the doctoral candidate and the Council management and employees. This was anticipated to form the basis for ongoing work that would enhance the overall Council environment to support physical activity through environmental, organisational and internal policy changes. The role of the environment in supporting physical activity within the workplace setting is likely to be just as important as the environment in the community setting.

At the time that the research was occurring this was being driven by a particular department within the Council who was working with Council manangement to develop environmental and policy initiatives to facilitate further opportunities for workplace physical activity. The James Cook University role (through the doctoral candidate) was to provide ongoing advice and support in regards to design and evaluation of programs. While ongoing involvement with workplace physical activity in this Council ceased due to the Council amalgamations, the reports that were generated from this research were available to the newly formed Council and interest has been expressed in future workplace physical activity initiatives. This provides opportunities for future engagement between the Council and the university who can support the Council in the design and evaluation of workplace initiatives thus contributing to evidence in the area. This is important as recent reviews of workplace physical activity continue to highlight the paucity of evidence in this area (Matson-Koffman, Brownstein, Neiner, Greaney, 2005; Bellew, 2008; Dugdill et al, 2008; Robroek, van Lenthe, van Empelen, Burdorf, 2009; Anderson et al., 2009; Conn, Hafdahl, Cooper, Brown, and Lusk, 2009; WHO, 2009). The excellent environmental initiatives that have been developed by local government in the Townsville area, such as the Riverway, also have indirect flow on effects to council employees who should also be seen as community members and as such as consumers of council interventions in their non-work time. Thus the complex interplay of multiple levels of influence in relation to physical activity behaviour is highlighted and the need to develop supportive environments across a range of settings including workplace and community settings is important if sustainable behaviour change is to be achieved. The importance of supportive workplace environments is gaining increasing attention in the literature as the evidence on the health effects of prolonged sitting at work grows, regardless of whether physical activity guidelines are being met (Owen, Bauman and Brown, 2009). Evidence on exactly how the workplace environment needs to change, particularly for employees such as indoor council workers who spend much of their day sitting in front of a computer, is evolving. The effectiveness of a range of environmental modifications such as sit-stand workstations and walking workstations are showing some promise (Levine and Miller, 2002;

Thompson, Foster, Eide and Levine, 2012) however more research in this area is required.

Since 2004 when this research began, the role of local government in creating neighbourhood infrastructure such as paths, trails, parks and other facilities has been increasingly acknowledged and reflected in government planning documents both within Australia and internationally.

In 2006, the WHO released a document titled “The Solid Facts: Promoting physical activity and active living in urban environments, the role of local governments” (Edwards & Tsouros, 2006). This document described the crucial role played by local governments in creating environments that enhance physical activity and active living opportunities and stated that local governments should “conserve and develop green spaces” that are accessible to residents (Edwards & Tsouros, 2006). Further they emphasised the importance of planning and designing for active living and providing recreation and sporting facilities, parks, paths and trails as well as “providing a clean and attractive environment that invites people to be active in their neighbourhoods” (Edwards & Tsouros, 2006). In the document, evidence to guide and support local government initiatives was provided in line with research that was discussed earlier in this thesis in Chapter Two in relation to environmental correlates and proximity. Recommendations for local governments included conserving, developing and enhancing green spaces, planning and designing for active living, placing playgrounds, sporting areas, trails, paths and parks within walking distance or wheeling distance of resident’s homes, providing well-maintained safe parks and play areas for children (such as playgrounds, wading pools, skateboard parks, sports fields and cycle lanes, tracks and paths) and providing free or subsidised access to swimming pools and other facilities for children and youth, older adults and people with disabilities (Edwards & Tsouros, 2006). The Riverway development, which was the focus of the current research and which provides a range of leisure and recreational areas, fits well within these recommendations and provides further evidence to support such initiatives.

In the Solid Facts document the workplace was also highlighted as a setting that local government can influence (Edwards & Tsouros, 2006). While the report highlighted the importance of governmental workplace settings more broadly, local government workplace settings can develop active living initiatives and policies in the community and in the workplace, thus creating an example and providing leadership for other workplaces.

In Australia, as a response to the growing concern regarding overweight and obesity and resulting chronic diseases, a National Partnership Agreement between the Federal, State and Territory governments was established (Council of Australian Governments [COAG], 2009). In this partnership the importance of healthy communities and healthy workers was clearly articulated (COAG, 2009). Furthermore, the importance of community and workplaces was emphasized in the key action areas of the National Preventive Health Taskforce Strategy for addressing obesity (National Preventive Health Taskforce, 2009). It was suggested that in order to reduce the growing burden of disease, multisectoral action is required and the role of local government was clearly described in these policy documents (COAG, 2009; National Preventive Health Taskforce, 2009). Local governments have opportunities to provide policies and legislation that support active living at a community level as well as being a role model for workplace physical activity initiatives (Edwards and Tsouros, 2006; Giles-Corti, 2006).

The first key action area in the Australian National Preventive Health Taskforce Strategy for addressing obesity is: "Drive environmental changes throughout the community that increase levels of physical activity and reduce sedentary behavior." Specific initiatives that have local government relevance were highlighted including urban design and land use, pathway continuity, aesthetic enhancements, access to places for physical activity (trails, facilities, parks). The Strategy stated that "local governments play a critical role in influencing the shape and design of the built environment and, ultimately, the health of their communities" (National Preventive Health Taskforce, 2009). The Riverway provides evidence that changing the built environment at a neighbourhood level does result in such areas being used by residents and, if in close proximity, they will walk to the areas.

The third key action area also has relevance to local governments: "Embed physical activity and healthy eating in everyday life". Under this action area, the notion of settings was described with a particular focus on workplaces (National Preventive Health Taskforce, 2009). Whilst local government was not clearly mentioned as being a workplace that should implement workplace physical activity programs, there is little doubt, that as a employer of a large number of indoor and outdoor employees, there is a great opportunity for a range of workers to be reached in the local government workplace setting. The current research supports that local government employees are interested in physical activity in the workplace and that both indoor and outdoor employees can benefit from being exposed to workplace based initiatives and to community environmental interventions that impact on their daily lives.

The tenth key action area in the National Preventive Health Taskforce Strategy for addressing obesity, “Build the evidence base, monitor and evaluate effectiveness of actions” emphasises the importance of undertaking research such as that conducted in this thesis, to add to the evidence base to support local government lead initiatives in the community and workplace. The Riverway research is some of the first intervention research that has been conducted in Australia to evaluate the impact of local government changes to the physical environment on usage and physical activity and has application for all local government organisations.

Not only do the above policies support local government initiatives like the Riverway project but a range of local government planning documents also provide direction for what councils can do. These include documents such as “Creating Active Communities: Physical Activity Guidelines for Local Councils” (New South Wales Department of Local Government, 2001) (revised 2006) and resources such as “Active, healthy communities: A resource package for Local Government to create supportive environments for physical activity and healthy eating” which was developed by the Heart Foundation and Local Government Association of Queensland specifically for Councils in Queensland. This resource provides practical guidance to councils on how to create supportive environments for physical activity and healthy eating. Queensland also has a Supportive Environments for Physical Activity and Healthy Eating Project, which is a joint initiative of the Heart Foundation, Queensland Health, Department of Local Government, Sport and Recreation, Maryborough Shire Council, Toowoomba City Council, Gold Coast City Council and Urban Research Centre at Griffith University (Pretorious, 2008). This project aims to guide and assist local governments across Queensland to create environments that are supportive of physical activity and improved nutrition (Pretorious, 2008). Other examples include websites that have been established to provide information and support for local government. For example on the “Be Active WA Physical Activity Taskforce” web site, there is a section titled

“Local Government” which provides information for local governments about why and how to prioritise physical activity as well as providing links to key resources and information to assist with the development of initiatives.

By framing the community based and workplace research presented in this thesis in an socio-ecological context, the complex interaction between individual, social and environmental factors that influence physical activity and the role that local government can play in contributing to population increases in physical activity through community and workplace based interventions has been described. Local government organisations are well placed to provide a range of physical and social environmental and policy initiatives that provide opportunities to enable neighbourhood residents and other people from the wider community, as well as employees, to develop healthier physical activity behaviours. This includes enhancing neighbourhood aesthetics and developing recreational areas such as paths, trails and parks and developing workplace opportunities for physical activity.

The increase in people using and walking to the Riverway complex and precinct demonstrate that redesigning the environment by renovating the existing paths, landscaping, building facilities, and enhancing aesthetics, is an effective local government environmental initiative. While the Riverway research failed to show a significant increase in the proportion of adults who were sufficiently active for health, the observed effects may have been attenuated as a result of the study limitations including a selection bias and a lack of statistical power due to the low response rates. There is a need for further prospective studies that rigorously evaluate modified environments similar to Riverway and allow causal relationships to be explored. The results of the Riverway study do provide direction for the design of future environmental intervention evaluation studies of a similar nature. Such findings are useful so that local government planners have evidence regarding neighbourhood features that influence physical activity, to inform the development of infrastructure and policy.

As a result of this research as well as other research that has been conducted since the study commenced in 2004, the following recommendations are made:

- Neighbourhood proximity is associated with physical activity and usage of recreational areas. Local governments are encouraged to develop policy initiatives at a local level that support community level physical activity including the development of infrastructure that provides opportunities for physical activity to become an easy choice for neighbourhood residents.
- Partnerships between local government and public health researchers are needed to allow for ongoing research evaluation of environmental modifications to allow a clearer understanding of causal relationships.
- Improved measures of physical activity and study methods are needed that reduce self selection and information bias and capture true neighbourhood participation. Postal surveys are discouraged, and despite an increased reliance on mobile phone technology, computer assisted telephone interviews are recommended.
- Physical activity utilisation of modified environments needs to be examined in relation to both recreation and transportation as it is likely that there are different environmental attributes that influence this and the findings will have relevance and application by local government policy makers.
- Local government should actively engage their own employees in identifying appropriate physical activity interventions that will be appealing and acceptable. The different requirements of indoor and outdoor employees should be identified and addressed through appropriate interventions.
- Workplace initiatives should be framed in a socio-ecological approach that acknowledges the multiple levels of influence that impact on physical activity and be rigorously evaluated to contribute to the evidence base about what works in a workplace setting. Emerging evidence on the role of modifying the workplace environment to reduce sedentary behaviour (such as sit-stand workstations and walking workstations) should be further researched. Evidence based approaches to workplace physical activity should be embedded into organisational policy to enhance sustainability.
- Use of pedometers rather than self-report surveys to measure workplace physical activity will allow for more objective assessment of physical activity and are feasible in a workplace setting.

Physical inactivity is a significant public health issue and developing supportive community and workplace environments that enhance opportunities and motivation for physical activity is a public health priority. The most important finding from this research is that neighbourhood proximity to recreational areas such as Riverway (parkland, walking trails and paths and other recreational facilities) is an important predictor of usage and walking, and local government should be encouraged to develop such areas within local neighbourhoods.

By supporting community members to be active, as well as providing opportunities for their own employees, local governments can provide an important contribution in enhancing overall population levels of physical activity and good health.

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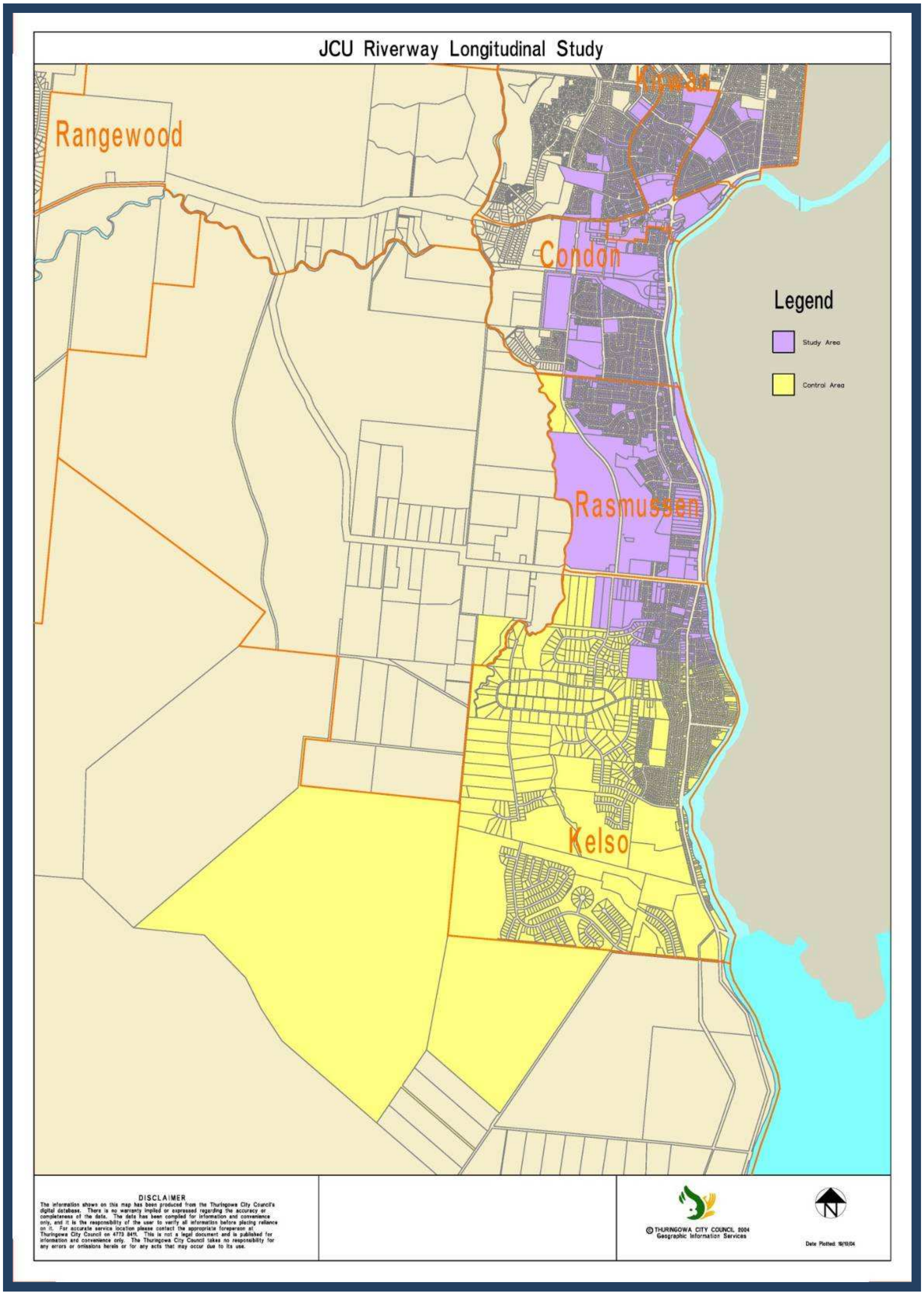
Appendix

Appendix 1.1 Riverway Study Area


JCU Riverway Longitudinal Study
Rangewood
Kirwan
Condon
Rasmussen
Kelso
Legend
Study Area
Control Area
DISCLAIMER
The information shown on this map has been produced from the Thuringowa City Council's digital database. There is no warranty implied or expressed regarding the accuracy or completeness of the data. The data has been compiled for information and convenience only, and it is the responsibility of the user to verify all information before placing reliance on it. For accurate service location please contact the appropriate foreperson at Thuringowa City Council on 4773 8411. This is not a legal document and is published for information and convenience only. The Thuringowa City Council takes no responsibility for any errors or omissions herein or for any acts that may occur due to its use.
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Appendix 2.1: Critical Appraisal Skills Programme (CASP)

CRITICAL APPRAISAL SKILLS PROGRAMME (CASP): Making Sense Of Evidence

10 Questions to Help You Make Sense of Reviews

How to Use This Appraisal Tool

- Three broad issues need to be considered when appraising the report of a systematic review:
  - Is the study valid?
  - What are the results?
  - Will the results help locally?
- The 10 questions on the following pages are designed to help you think about these issues systematically.
- The first two questions are screening questions and can be answered quickly. If the answer to both is "yes", it is worth proceeding with the remaining questions.
- You are asked to record a "yes", "no" or "can't tell" to most of the questions. A number of italicised prompts are given after each question.
- These are designed to remind you why the question is important. Record your reasons for your answers in the spaces provided.

Screening Questions

1. Did the review ask a clearly-focused question?

☐ Yes ☐ Can't Tell ☐ No

HINT: Consider if the question is 'focused' in terms of:
- the population studied
- the intervention given or exposure
- the outcomes considered

2. Did the review include the right type of study?

☐ Yes ☐ Can't Tell ☐ No

HINT: Consider if the included studies:
- address the review's question
- have an appropriate study design

Is it worth continuing?

Detailed Questions

3. Did the reviewers try to identify all relevant studies?

☐ Yes ☐ Can't Tell ☐ No

HINT: Consider:
- which bibliographic databases were used
- if there was follow-up from reference lists
- if there was personal contact with experts
- if the reviewers searched for unpublished studies
- if the reviewers searched for non-English-language studies

4. Did the reviewers assess the quality of the included studies?

☐ Yes ☐ Can't Tell ☐ No

HINT: Consider:
- if a clear, pre-determined strategy was used to determine which studies were included. Look for:
  - a scoring system
  - more than one assessor

5. If the results of the studies have been combined, was it reasonable to do so?

☐ Yes ☐ Can't Tell ☐ No

HINT: Consider whether:
- the results of each study are clearly displayed
- the results were similar from study to study (look for tests of heterogeneity)
- the reasons for any variations in results are discussed

6. How are the results presented and what is the main result?

HINT: Consider:
- how the results are expressed (e.g. odds ratio, relative risk, etc.)
- how large this size of result is and how meaningful it is
- how you would sum up the bottom-line result of the review in one sentence

7. How precise are these results?

HINT: Consider:
- if a confidence interval were reported. Would your decision about whether or not to use this intervention be the same at the upper confidence limit as at the lower confidence limit?
- if a p-value is reported where confidence intervals are unavailable

8. Can the results be applied to the local population?

☐ Yes ☐ Can't Tell ☐ No

HINT: Consider whether:
- the population sample covered by the review could be different from your population in ways that would produce different results
- your local setting differs much from that of the review
- you can provide the same intervention in your setting

9. Were all important outcomes considered?

☐ Yes ☐ Can't Tell ☐ No

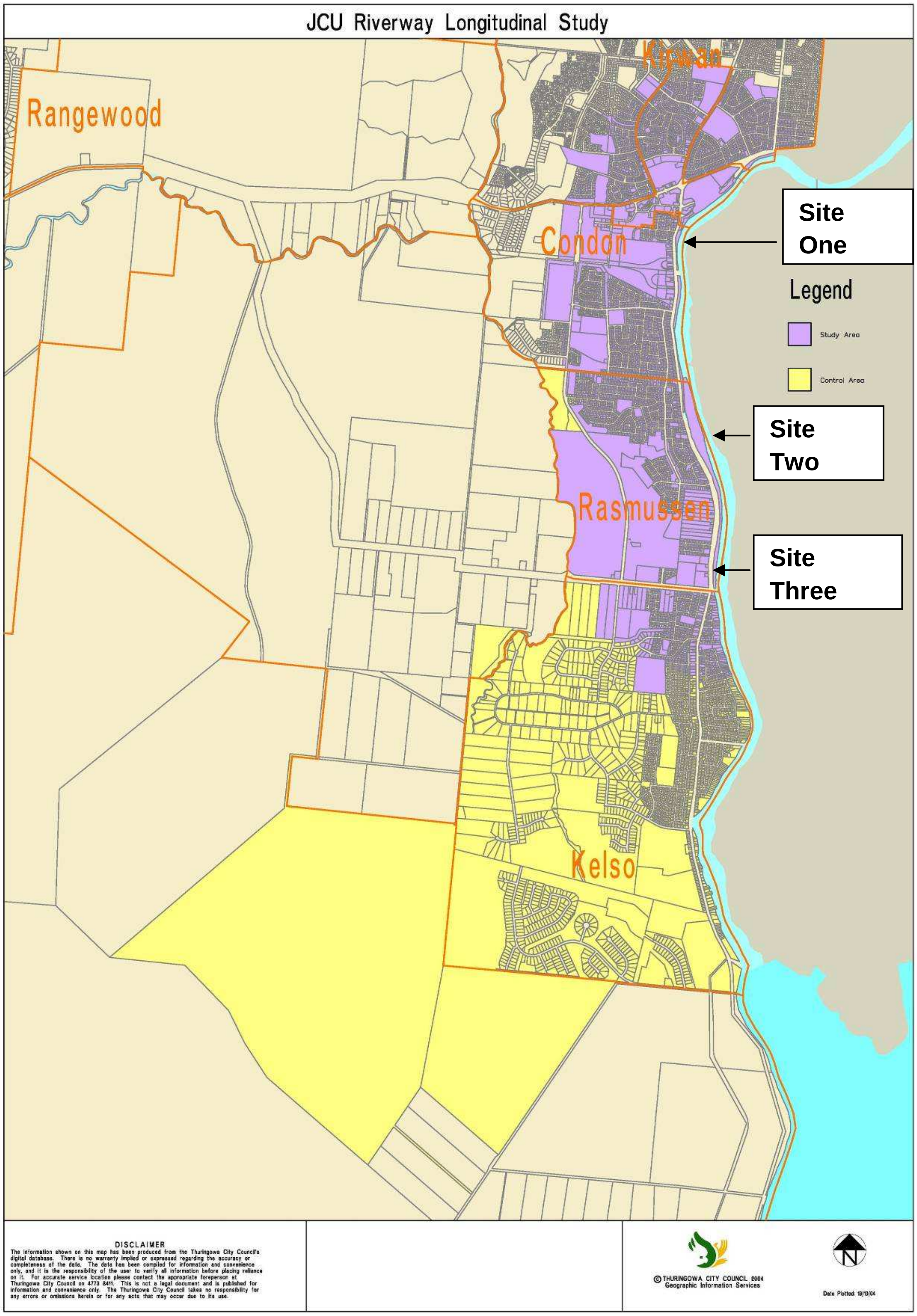
HINT: Consider outcomes from the point of view of the:
- individual
- policy makers and professionals
- family/carers
- wider community

10. Should policy or practice change as a result of the evidence contained in this review?

☐ Yes ☐ Can't Tell ☐ No

HINT: Consider:
- whether any benefit reported outweighs any harm and/or cost. If this information is not reported can it be filled in from elsewhere?

Appendix 3.1: Map of Study Area Showing Observation Sites



Appendix 3.2: Get Active Thuringowa Physical Activity Survey

Get Active Thuringowa: Thuringowa Physical Activity Survey

We need your help. The School of Public Health and Tropical Medicine at James Cook University together with the Thuringowa Council and Queensland Health, is conducting some research that looks at how your environment influences physical activity. In particular we are interested in finding out about what impact the Riverway development might have on the physical activity levels of people who live close to the Riverway. The Riverway project will redevelop the 11 km area along the Ross River from Black Weir to the Dam with special development at Pioneer Park, Loam Island and Apex Park. The aim of this exciting project is to open up the river area to greater access for community residents and tourists while protecting and enhancing the river's natural beauty.

Your address has been selected randomly and we do not know your name. Your name, address and phone number will only be recorded if you give your permission and will only be used in the event that you win one of the gift vouchers on offer. Provision of this information is totally voluntary. All information given to us will be stored securely and confidentiality will be maintained at all times. To complete this survey you need to be at least 18 years old.

We would greatly appreciate you completing this survey to allow us to gain a greater understanding of this area so that we can use the information to make your community a healthier and safer place to be.

Remember:

- We want to know what you think
- There are no right or wrong answers

If you have any questions please call the project coordinator, Sue Devine on 47816110 or email Sue at sue.devine@jcu.edu.au

This survey will take approximately 15-20 minutes to complete so we have included a tea bag for you – take a break, have a cup of tea and complete the survey. Please return the survey after you have completed it in the reply paid envelope included in the package that you received. Thank you for your participation in the Get Active Thuringowa Project.

PHYSICAL ACTIVITY

The following questions are about any physical activities that you have done in the LAST WEEK.

1. **IN THE LAST WEEK** how many times have you walked continuously, for at least 10 minutes, for recreation/exercise? _____ **times**

2. What do you estimate was the total time that you spent walking in this way **IN THE LAST WEEK?** _________ **hours** _________ **minutes**

3. **IN THE LAST WEEK** how many times have you walked continuously, for at least 10 minutes, to get to or from places like work, the bus stop, shops? _____ **times**

4. What do you estimate was the total time that you spent walking in this way **IN THE LAST WEEK?** _________ **hours** _________ **minutes**

5. **IN THE LAST WEEK** how many times did you do any vigorous gardening or heavy work around the yard which made you breathe harder or puff and pant? _________ **times**

6. What do you estimate was the total time that you spent doing vigorous gardening or heavy work around the yard **IN THE LAST WEEK?** _________ **hours** _________ **minutes**

The next question excludes household chores or gardening or yard work.

7. **IN THE LAST WEEK,** how many times did you do any vigorous physical activity which made you breathe harder or puff and pant? (e.g. jogging, cycling, aerobics, competitive tennis, etc.) _________ **times**

8. What do you estimate was the total time that you spent doing this vigorous physical activity **IN THE LAST WEEK?** _________ **hours** _________ **minutes**

The next question excludes household chores or gardening or yard work

9. **IN THE LAST WEEK** how many times did you do any other more moderate physical activity that you haven't already mentioned? (e.g. gentle swimming, social tennis, golf, etc.) _________ **times**

10. What do you estimate was the total time that you spent doing these activities **IN THE LAST WEEK?** _________ **hours** _________ **minutes**

11. Has your physical activity level over the last week been the same as in a usual week?
    - ☐ YES
    - ☐ NO

    If no please respond to the following questions?

    1. **IN A USUAL WEEK** how many times would you walk continuously, for at least 10 minutes, for recreation/exercise? _____ **times**

    2. What do you estimate was the total time that you would spend walking in this way **IN A USUAL WEEK?** _________ **hours** _________ **minutes**

    3. **IN A USUAL WEEK** how many times would you walk continuously, for at least 10 minutes, to get to or from places like work, the bus stop, shops? _____ **times**

4. What do you estimate was the total time that you would spend walking in this way **IN A USUAL WEEK** _________ **hours** _________ **minutes**

5. **IN A USUAL WEEK** how many times would you do any vigorous gardening or heavy work around the yard which would make you breathe harder or puff and pant? _________ **times**

6. What do you estimate was the total time that you would spend doing vigorous gardening or heavy work around the yard **IN A USUAL WEEK** _________ **hours** _________ **minutes**

The next question excludes household chores or gardening or yard work.

7. **IN A USUAL WEEK,** how many times would you do any vigorous physical activity which would make you breathe harder or puff and pant? (e.g. jogging, cycling, aerobics, competitive tennis, etc.) _________ **times**

8. What do you estimate was the total time that you would spend doing this vigorous physical activity **IN A USUAL WEEK?** _________ **hours** _________ **minutes**

The next question excludes household chores or gardening or yard work

9. **IN A USUAL WEEK** how many times would you do any other more moderate physical activity that you haven't already mentioned? (e.g. gentle swimming, social tennis, golf, etc.) _________ **times**

10. What do you estimate was the total time that you would spend doing these activities **IN A USUAL WEEK?** _________ **hours** _________ **minutes**

12. ***The next question is about your opinion of physical activity and health – you will be read a statement and you can strongly agree, agree, neither agree nor disagree, disagree or strongly disagree.***

	Strongly agree	Agree	Neither agree nor disagree	Disagree	Strongly disagree
Taking the stairs at work or generally being more active for at least 30 minutes each day is enough to improve your health					
Half an hour of brisk walking on most days is enough to improve your health					
To improve your health it is essential for you to do vigorous exercise for at least 20 minutes each time, 3 times a week					
Exercise doesn't have to be done all at one time—blocks of 10 minutes are okay					
Moderate exercise that increases your heart rate slightly can improve your health					

13. The following statements are about the amount of exercise you intend to do in the near future. Which one best describes how you feel at present? Please tick the box below the statement.

You intend to be less active than you have been over the last week	You will be as active as you have been over the last week	You intend to be more active in the NEXT MONTH than you have been over the last week	You intend to become more active sometime over the NEXT SIX MONTHS than you have been over the last week

BARRIERS TO REGULAR PHYSICAL ACTIVITY

We are interested in what might prevent you from participating in regular physical activity. That is participating in physical activity for at least 30 minutes on most if not all days of the week. Read the following statements and respond by saying that it never prevents you, rarely prevents you, sometimes prevents you, often prevents you or very often prevents you from participating in physical activity.

		Never	Rarely	Sometimes	Often	Very often
1.	Self conscious about my looks when I exercise					
2.	Lack of interest in exercise or physical activity					
3.	Lack of self-discipline					
4.	Lack of time					
5.	Lack of energy/too tired					
6.	Lack of company					
7.	Lack of enjoyment from exercise or physical activity					
8.	Discouragement from past attempts					
9.	Lack of equipment					
10.	Weather too hot or humid					
12.	Weather too cold					
13.	Lack of skills					
14.	Lack of facilities					
15.	Lack of knowledge on how to exercise					
16.	Lack of good health					
17.	Fear of injury					
18.	Lack of pleasant environment to be active in					
19.	Lack of safe place to be physically active					
20.	Lack of motivation to be physically active					
21.	No child care assistance					
22.	Lack of company					

Are there any other reasons not mentioned above that prevent you from participating in physical activity? If yes, please specify ____

SPECIFIC RIVERWAY QUESTIONS

We are interested to see if and how you use the river pathways around the proposed Riverway development. This extends for 5kms from Pioneer park to Apex Park in Rasmussen. We are also interested in how you feel about the impact of the Riverway development on physical activity.

1. In relation to the paths along the Ross River:

Do you currently use the paths along the Ross River

☐ YES

☐ NO

If yes how do you get to the paths along the Ross River?

☐ Walk

☐ Drive yourself

☐ Someone drives you

☐ Bicycle

☐ Bus

☐ Other ____

If yes for what purpose do you use the paths along the Ross River?

☐ Walking

☐ Jogging/running

☐ Cycling

☐ Other ____

2. Do you use the river for any other purposes?

☐ Canoeing

☐ Kayaking

☐ Rowing

☐ Skiing

☐ Other ____________________________

3. What impact do you think the Riverway development will have on the physical activity levels of residents living in close proximity to the development? Please tick the box below the statement.

No increase in physical activity levels	Slight increase in physical activity levels	Moderate increase in physical activity levels	Significant increase in physical activity levels	Very Significant increase in physical activity levels

4. What impact do you think the Riverway development will have on your own physical activity levels? Please tick the box below the statement.

No increase in physical activity levels	Slight increase in physical activity levels	Moderate increase in physical activity levels	Significant increase in physical activity levels	Very Significant increase in physical activity levels

SELF EFFICACY QUESTIONS

We would like to know how confident you feel that you could be physically active in each of the following situations. Please tell us if you are not at all confident, slightly confident, somewhat confident, confident or very confident. Please tick the box below the statement.

How confident are you that you feel you could be physically active:

1. Even when it's hot outside.

Not at all confident	Slightly confident	Somewhat confident	Confident	Very confident

2. When you don't have someone to exercise with.

Not at all confident	Slightly confident	Somewhat confident	Confident	Very confident

3. When you don't have any money.

Not at all confident	Slightly confident	Somewhat confident	Confiden t	Very confident

4. When you are tired.

Not at all confident	Slightly confident	Somewhat confident	Confiden t	Very confident

5. When you feel you don't have time.

Not at all confident	Slightly confident	Somewhat confident	Confiden t	Very confident

6. When activity takes a lot of effort.

Not at all confident	Slightly confident	Somewhat confident	Confiden t	Very confident

PERCEIVED PHYSICAL ENVIRONMENT/SAFETY QUESTIONS
The next few questions are about the neighbourhood that you live in. We are interested in what impact certain aspects of your environment have on physical activity. For each statement please tell us if you strongly disagree, disagree, are unsure, agree or strongly agree. Please tick the box below the statement.

1. It is safe to walk in your neighborhood

Strongly disagree	Disagree	Unsure	Agree	Strongly agree

2. Dogs frighten people who walk in your neighbourhood

Strongly disagree	Disagree	Unsure	Agree	Strongly agree

3. The neighbourhood is friendly

Strongly disagree	Disagree	Unsure	Agree	Strongly agree

4. Crime is high in the neighbourhood

Strongly disagree	Disagree	Unsure	Agree	Strongly agree

5. There are pleasant walks to do in your neighbourhood

Strongly disagree	Disagree	Unsure	Agree	Strongly agree

6. Shops and services are in walking distance in your neighbourhood

Strongly disagree	Disagree	Unsure	Agree	Strongly agree

7. You often see people out on walks in your neighbourhood

Strongly disagree	Disagree	Unsure	Agree	Strongly agree

8. Your neighbourhood is kept clean and tidy

Strongly disagree	Disagree	Unsure	Agree	Strongly agree

9. There are busy streets to cross when out on walks

Strongly disagree	Disagree	Unsure	Agree	Strongly agree

10. The footpaths are in good condition

Strongly disagree	Disagree	Unsure	Agree	Strongly agree

11. There is heavy traffic

Strongly disagree	Disagree	Unsure	Agree	Strongly agree

12. It is safe to cycle in your neighbourhood

Strongly disagree	Disagree	Unsure	Agree	Strongly agree

13. The streets are well lit

Strongly disagree	Disagree	Unsure	Agree	Strongly agree

14. There are open spaces (such as parks, ovals) for people to walk in or around my neighbourhood

Strongly disagree	Disagree	Unsure	Agree	Strongly agree

15. There are bicycle or walking paths/trails within walking distance of my home.

Strongly disagree	Disagree	Unsure	Agree	Strongly agree

SOCIAL ENVIRONMENT/CONNECTEDNESS QUESTION

The next questions are about other people in your life including those in your general neighbourhood, family, household members, friends or colleagues who may have an influence on how physically active you are. For these questions you can respond by using never, rarely, sometimes, often, very often. Please tick the box below the statement.

1. How often in the last three months have family, friends and colleagues encouraged you to perform physical activity?

Never	Rarely	Sometimes	Often	Very often

2. How often in the last three months have family, friends and colleagues done something to help you to be physically active?

Never	Rarely	Sometimes	Often	Very often

3. How often in the last three months have family, friends and colleagues made it difficult for you to be physically active?

Never	Rarely	Sometimes	Often	Very often

4. How often in the last three months have family, friends and colleagues offered to do physical activities with you?

Never	Rarely	Sometimes	Often	Very often

We are also interested in whether you think people in your neighbourhood are physically active. To this question you can respond using very physically active, somewhat physically active, not very physically active or not at all physically active. Please tick the box below the statement.

5. People in my neighbourhood are:

Very physically active	Somewhat physically active	Not very physically active	Not at all physically active

GENERAL AND DEMOGRAPHIC QUESTIONS

We would now like to ask you some general questions that give us a description of the people who participated in this survey. Please let me remind you that the information you give us is confidential.

1. How old are you? ______________________ years

2. What is your gender?
   - ☐ Male
   - ☐ Female

3. Where were you born?
   - ☐ Australia
   - ☐ New Zealand
   - ☐ United Kingdom
   - ☐ Europe
   - ☐ Asia
   - ☐ North America
   - ☐ Other (please specify) _______________________________________

4. How long have you been living in Australia?
   - ☐ All my life
   - ☐ _________ years

5. How long have you been living in the tropics?
   - ☐ All my life
   - ☐ _________ years

6. Are you of Aboriginal or Torres Strait Islander descent?
   - ☐ YES
   - ☐ NO

7. Are you a South Sea Islander?
   - ☐ YES
   - ☐ NO

8. What was your highest level of schooling?
   - ☐ Never attended school
   - ☐ Year 8 or below
   - ☐ Year 9 or equivalent
   - ☐ Year 10 or equivalent

- ☐ Year 11 or equivalent
- ☐ Year 12 or equivalent

9. Have you completed a trade certificate or any other qualification?
   - ☐ YES
   - ☐ NO

If yes, what is the highest qualification that you completed?

- ☐ Trade or business certificate
- ☐ Apprenticeship
- ☐ Associate Diploma
- ☐ Undergraduate Diploma
- ☐ Bachelor degree
- ☐ Post Graduate Diploma
- ☐ Masters degree
- ☐ Doctorate
- ☐ Other ____________________________________

10. What is your current employment?
    - ☐ Full time paid work in a job, business or profession
    - ☐ Part time paid work in a job, business or profession
    - ☐ Casual paid work in a job, business or profession
    - ☐ Work without pay in a family or other business
    - ☐ Home duties not looking for work
    - ☐ Unemployed looking for work
    - ☐ Retired
    - ☐ Permanently unable to work
    - ☐ Student
    - ☐ Other (specify) ____________________________________

11. Which one of the following best describes your living arrangement?
    - ☐ Single and living by yourself
    - ☐ Single and living with friends or relatives
    - ☐ Single parent living with one or more children
    - ☐ Couple (married or defacto) living with no children
    - ☐ Couple (married or defacto) living with one or more children
    - ☐ Other (please specify) ________________________________

12. Which of the following best describes your housing situation?

- ◻ A house
- ◻ A flat/unit/apartment
- ◻ Caravan/tent/cabin/houseboat/yacht
- ◻ Other (please specify) ___________________________________

13. At the place where you live are you:
    - ◻ An owner
    - ◻ A purchaser
    - ◻ A renter
    - ◻ Living rent free
    - ◻ A boarder

14. How many dependent children are currently living in your care? _________________

15. How many of these children are under the age of five? __________________________

16. Do you have a dog? (please tick one)
    - ◻ YES
    - ◻ NO

    If YES, do you take it for a walk regularly (i.e. for at least 30 minutes 5 or more times a week)
    - ◻ YES
    - ☐ NO

17. Have you ever been told by a doctor that you have any chronic or long term health problems?
    - ◻ YES
    - ◻ NO

    If yes, what would that be (you can choose more than one):
    - ◻ Diabetes (high blood sugar)
    - ◻ Heart Disease
    - ◻ High Blood Pressure
    - ◻ Stroke
    - ◻ Thrombosis (blood clot)
    - ◻ Arthritis
    - ◻ Emphysema
    - ◻ Osteoporosis
    - ◻ Breast Cancer
    - ◻ Colon Cancer
    - ◻ Skin Cancer
    - ◻ Other Cancer
    - ◻ Depression
    - ◻ Anxiety/Nervous Disorder

◻ Other (Specify) ______________________________

18. How much does your present health limit your physical activity? Please tick the box below the statement.

None of the time	A little bit of the time	Some of the time	Most of the time	All of the time

19. Do you currently smoke?

◻ YES

◻ NO

If yes approximately how many cigarettes do you smoke a day?

____

20. Are you an ex-smoker?

◻ YES

◻ NO

If yes approximately how long ago did you quit? ______________________________

21. How much do you currently weigh? (without clothes and shoes)

________kilograms or _______ stone and ______ pounds

22. What height are you? (without shoes)

__________centimeters or __________ feet and __________ inches

23. What is your approximate annual household income before taxes. Choose either per year or per week and place a tick next to the one that is relevant to you.

PER year OR	**PER week**
	Nil income
$1 - $2,079	$1- $39
$2,080 - $4,159	$40 – $79
$4,160 – $6,239	$80 - $119
$6,240 – $8,319	$120 $159
$8,320 – $10,399	$160 - $199
$10,400 – $15,599	$200 – $299
$15,600 – $20,799	$300 - $399
$20,800 – $25,999	$400 - $499
$26,000 - $31,199	$500 - $599
$31,200 – $36,399	$600 - $699
$36,400 – $41,599	$700 - $799
$41,600 - $51,999	$800 - $999
$52,000 – $77,999	$1,000 – $1,499
$78,000 or more	$1,500 or more

24. Have you heard of 10,000 Steps Townsville?

☐ YES

☐ NO

If yes, where did you hear about it from?

☐ Television

☐ Radio

☐ Newspaper

☐ Family/friend

☐ Other (please specify) ________________________________

25. We would like to involve community members in face to face discussion groups (focus groups) to explore their feelings about physical activity and the environment. Would you be interested in being involved in a focus group discussion?

☐ YES

☐ NO

If yes please provide your name and address and telephone number on the next page. This will be removed immediately from the survey to maintain confidentiality and ensure that your survey responses are anonymous.

Gift Vouchers

There are two gift vouchers worth $100.00 available to spend at Sportsco in the Nathan Plaza Shopping Centre. The first person to receive the survey will receive one and all remaining people who return the survey will go into a draw for a second $100.00 voucher. If you would like to be eligible for these vouchers we will need your name and address. Please provide your name and address and telephone number on the next page. This will be removed immediately from the survey to maintain confidentiality and ensure that your survey responses are anonymous.

CONCLUSION

That brings us to the end of our survey. Thank you for taking the time to answer our questions. If you would ever like any more information on this project please don't hesitate to call the project coordinator, Sue Devine on 07 47726515.

Contact details for:

☐ Focus Groups

☐ Vouchers

Name: ______________________________________

Address: ______________________________________

____

____

Telephone Number: __________________________

Appendix 3.3: Data record sheet for observation study

No	Sex		Approximate Age in years						Type of Activity				Being active with:					
	Male	Female	0-4	5-12	13-19	20-39	40-59	60+	Walking	Jogging	Cycling	Other	Male adult	Female adult	Male child	Female child	Dog on a leash	Dog off a leash

Appendix 3.4:Ethical Approval Notice for the Riverway Studay

JCU
JAMES COOK UNIVERSITY

JAMES COOK UNIVERSITY
Townsville Qld 4811 Australia

Tina Langford, Ethics Administrator, Research Office. Ph: 07 4781 4342; Fax: 07 4781 5521

ETHICS REVIEW COMMITTEE
Human Ethics Sub-Committee
APPROVAL FOR RESEARCH OR TEACHING INVOLVING HUMAN SUBJECTS

PRINCIPAL INVESTIGATOR	**Sue Devine**				
CO- INVESTIGATORS	Dr Petra Buttner, School of Public Health and Tropical Medicine; Professor Kerry Mummery, Central Queensland University				
SCHOOL	Public Health & Tropical Medicine				
PROJECT TITLE	**Get Active Thuringowa: the impact of recreational environmental modifications on physical activity levels of community members in the tropics**				
APPROVAL DATE	7 Oct 2004	**EXPIRY DATE**	31 Dec 2006	**CATEGORY**	1

This project has been allocated Ethics Approval Number **H 1911** with the **following conditions**:

1. All subsequent records and correspondence relating to this project must refer to this number.
2. That there is **NO** departure from the approved protocols unless prior approval has been sought from the Human Ethics Sub-Committee.
3. The Principal Investigator **must advise** the responsible Ethics Monitor appointed by the Ethics Review Committee:
   - periodically of the progress of the project;
   - when the project is completed, suspended or prematurely terminated for any reason;
   - if serious or adverse effects on participants occur; and if any
   - unforeseen events occur that might affect continued ethical acceptability of the project.
4. In compliance with the National Health and Medical Research Council (NHMRC) *"National Statement on Ethical Conduct in Research Involving Humans"* (1999), it is **MANDATORY** that you provide an annual report on the progress and conduct of your project. This report must detail compliance with approvals granted and any unexpected events or serious adverse effects that may have occurred during the study.

NAME OF RESPONSIBLE MONITOR	Leggat, Dr Peter
EMAIL ADDRESS:	peter.leggat@jcu.edu.au
ASSESSED AT MEETING	***Date:*** 29 Sep 2004
APPROVED **27 Oct 04: Amendment approved: Change in methodology to postal survey, additional site – Townsville area.**	***Date:*** 7 Oct 2004
[forwarded by email without signature] Tina Langford Ethics Administrator **Research Office** Tina.Langford@jcu.edu.au	Date: 29 October 2004

C:\Ethics\Templates\ApprovalFormHuman.doc

Appendix 4.1: Get Active Thuringowa Physical Activity Survey (follow up)

GET ACTIVE THURINGOWA
THURINGOWA PHYSICAL ACTIVITY SURVEY

HELP YOUR NEIGHBOURHOOD and WIN A PRIZE.

The School of Public Health, Tropical Medicine and Rehabilitation Sciences at James Cook University together with the Thuringowa Council and Queensland Health, is conducting research that will look at how your environment influences physical activity. In particular we are interested in finding out about what impact the Riverway development has had on the physical activity levels of people who live close to the Riverway.

The aim of the Riverway project is to open up the river area to greater access for community residents and tourists while protecting and enhancing the river's natural beauty. Stage One of this development was opened in July of this year.

Your address has been selected randomly and we do not know your name. Your name, address and phone number will only be recorded if you give your permission and will only be used in the event that you win one of the gift vouchers on offer. Provision of this information is totally voluntary. All information given to us will be stored securely and confidentiality will be maintained at all times. To complete this survey you need to be at least 18 years old.

We would greatly appreciate you completing this survey to allow us to gain a greater understanding of this area so that we can use the information to make your community a healthier and safer place to be.

Remember:

- We want to know what <u>you</u> think
- There are no right or wrong answers

If you have any questions please call the project coordinator, Sue Devine on 47816110 or email Sue at sue.devine@jcu.edu.au

This survey will take approximately 25 minutes to complete so we have included a tea bag for you – take a break, have a cup of tea and complete the survey. Please return the survey after you have completed it in the reply paid envelope included in the package that you received.

Thank you for your participation in the Get Active Thuringowa Project

PHYSICAL ACTIVITY DURING THE LAST WEEK

The following questions ask you to estimate the number and amount of time you have spent doing physical activities in the LAST WEEK.

WALKING

1. **IN THE LAST WEEK** how many times have you walked continuously, for at least 10 minutes, for recreation/exercise? _________ **times**

2. What do you estimate was the total time that you spent walking in this way **IN THE LAST WEEK?** _________ **hours** _________ **minutes**

3. **IN THE LAST WEEK** how many times have you walked continuously, for at least 10 minutes, to get to or from places like work, the bus stop, shops? _____ **times**

4. What do you estimate was the total time that you spent walking in this way **IN THE LAST WEEK?** _________ **hours** _________ **minutes**

GARDENING

5. **IN THE LAST WEEK** how many times did you do any vigorous gardening or heavy work around the yard which made you breathe harder or puff and pant? _________ **times**

6. What do you estimate was the total time that you spent doing vigorous gardening or heavy work around the yard **IN THE LAST WEEK?** _________ **hours** _________ **minutes**

EXERCISE

The next question excludes household chores or gardening or yard work.

7. **IN THE LAST WEEK,** how many times did you do any vigorous physical activity which made you breathe harder or puff and pant? (e.g. jogging, cycling, aerobics, competitive tennis, etc.) _________ **times**

8. What do you estimate was the total time that you spent doing this vigorous physical activity **IN THE LAST WEEK?** _________ **hours** _________ **minutes**

OTHER PHYSICAL ACTIVITY

The next question excludes household chores or gardening or yard work

9. **IN THE LAST WEEK** how many times did you do any other more moderate physical activity that you haven't already mentioned? (e.g. gentle swimming, social tennis, golf, etc.) _________ **times**

10. What do you estimate was the total time that you spent doing these activities **IN THE LAST WEEK?** _________ **hours** _________ **minutes**

BARRIERS TO REGULAR PHYSICAL ACTIVITY

We are interested in what might prevent you from participating in regular exercise or physical activity. By exercise or physical activity we mean doing some form of physical activity for at least 30 minutes on most if not all days of the week.

11. Below are a set of statements that we think might be barriers to regular physical activity. We would like to know whether you think these potential barriers either: never prevent you, rarely prevent you, sometimes prevent you, often prevent you or very often prevent you, from participating in physical activity.

		Never	Rarely	Sometimes	Often	Very often
a.	Self conscious about my looks when I exercise					
b.	Lack of interest in exercise or physical activity					
c.	Lack of self-discipline					
d.	Lack of time					
e.	Lack of energy/too tired					
f.	Lack of company					
g.	Lack of enjoyment from exercise or physical activity					
h.	Being discouraged (from past attempts)					
i.	Lack of equipment					
j.	Weather too hot or humid					
k.	Weather too cold					
l.	Lack of skills					
m.	Lack of facilities					
n.	Lack of knowledge on how to exercise					
o.	Lack of good health					
p.	Fear of injury					
q.	Lack of pleasant environment to be active in					
r.	Lack of safe place to be physically active					
s.	Lack of motivation to be physically active					
t.	No child care assistance					

12. Are there any other reasons not mentioned above that prevent you from participating in physical activity? If yes, please specify

____

SPECIFIC RIVERWAY QUESTIONS

We are interested to see if and how you use the river pathways around the Riverway development. This extends for 5kms from Pioneer Park to Apex Park in Rasmussen. We are also interested in how you feel about the impact of the Riverway development on physical activity.

In relation to the paths along the Ross River:

13. Do you currently use the paths along the Ross River
    - ☐ YES **if yes go to <u>question 14</u>**
    - ☐ NO, **if no go to <u>question 16</u>**

14. If you use the paths along the Ross River, how do you get to the paths along the Ross River?
    - ☐ Walk
    - ☐ Drive yourself
    - ☐ Someone drives you
    - ☐ Bicycle
    - ☐ Bus
    - ☐ Other ____

15. If you use the paths along the Ross River, for what purpose do you use the paths along the Ross River?
    - ☐ Walking
    - ☐ Jogging/running
    - ☐ Cycling
    - ☐ Other ____

16. Do you use the river for any other purposes?
    - ☐ Canoeing
    - ☐ Kayaking
    - ☐ Rowing
    - ☐ Skiing
    - ☐ Other _____________________________
    - ☐ No other use of the river

17. Do you currently use the new Riverway Complex/area
    - ☐ YES **if yes go to <u>question 18</u>**
    - ☐ NO, **if no go to <u>question 20</u>**

18. If you use the new Riverway Complex/area, how do you get to there?
    - ☐ Walk
    - ☐ Drive yourself
    - ☐ Someone drives you
    - ☐ Bicycle
    - ☐ Bus
    - ☐ Other ____

19. What facilities do you use?

☐ Swimming lagoons
☐ Restauarant
☐ Riverway and surrounding paths
☐ Riverway art centre and Pinnacles Gallery
☐ Other ____

20. Do you currently use the Loam Island area?

☐ YES **if yes go to <u>question 21</u>**
☐ NO, **if no go to <u>question 23</u>**

21. If you use the Loam Island area, how do you get to there?

☐ Walk
☐ Drive yourself
☐ Someone drives you
☐ Bicycle
☐ Bus
☐ Other ____

22. What facilities do you use?

☐ Scouts
☐ Rowing Club
☐ Waterski Club
☐ Paths and parkland
☐ Other ____

23. What impact do you think the Riverway development has had on the physical activity levels of residents living in close proximity to the development? Please tick the box below the statement.

No increase in physical activity levels	Slight increase in physical activity levels	Moderate increase in physical activity levels	Significant increase in physical activity levels	Very Significant increase in physical activity levels
☐	☐	☐	☐	☐

24. What impact do you think the Riverway development has had on your own physical activity levels? Please tick the box below the statement.

No increase in physical activity levels	Slight increase in physical activity levels	Moderate increase in physical activity levels	Significant increase in physical activity levels	Very Significant increase in physical activity levels
☐	☐	☐	☐	☐

SELF EFFICACY

In the following questions we would like to know how confident you feel in your ability to be physically active in each of the following situations. Please tell us if you are not at all confident, slightly confident, somewhat confident, confident or very confident. Please tick the box below the statement.

How confident are you that you feel you could be physically active:

25. Even when it's hot outside.

Not at all confident	Slightly confident	Somewhat confident	Confident	Very confident
☐	☐	☐	☐	☐

26. When you don't have someone to exercise with.

Not at all confident	Slightly confident	Somewhat confident	Confident	Very confident
☐	☐	☐	☐	☐

27. When you don't have any money (i.e. Can't afford the gym, shoes etc).

Not at all confident	Slightly confident	Somewhat confident	Confident	Very confident
☐	☐	☐	☐	☐

28. When you are tired.

Not at all confident	Slightly confident	Somewhat confident	Confident	Very confident
☐	☐	☐	☐	☐

29. When you are too busy (such as with work and/or family commitments)

Not at all confident	Slightly confident	Somewhat confident	Confident	Very confident
☐	☐	☐	☐	☐

30. When activity takes a lot of effort.

Not at all confident	Slightly confident	Somewhat confident	Confident	Very confident
☐	☐	☐	☐	☐

PERCEIVED PHYSICAL ENVIRONMENT/SAFETY

The next few questions are about the neighbourhood that you live in. We are interested in whether you agree or disagree about certain statements about your neighborhood, which may have an impact on physical activity. For each statement please tell us if you strongly disagree, disagree, are unsure, agree or strongly agree. Please tick the box below the statement.

31. It is safe to walk in your neighborhood

Strongly disagree	Disagree	Unsure	Agree	Strongly agree
☐	☐	☐	☐	☐

32. Dogs frighten people who walk in your neighbourhood

Strongly disagree	Disagree	Unsure	Agree	Strongly agree
☐	☐	☐	☐	☐

33. The neighbourhood is friendly

Strongly disagree	Disagree	Unsure	Agree	Strongly agree
☐	☐	☐	☐	☐

34. Crime is high in the neighbourhood

Strongly disagree	Disagree	Unsure	Agree	Strongly agree
☐	☐	☐	☐	☐

35. There are pleasant walks to do in your neighbourhood

Strongly disagree	Disagree	Unsure	Agree	Strongly agree
☐	☐	☐	☐	☐

36. Shops and services are in walking distance in your neighbourhood

Strongly disagree	Disagree	Unsure	Agree	Strongly agree
☐	☐	☐	☐	☐

37. You often see people out on walks in your neighbourhood

Strongly disagree	Disagree	Unsure	Agree	Strongly agree
☐	☐	☐	☐	☐

38. Your neighbourhood is kept clean and tidy

Strongly disagree	Disagree	Unsure	Agree	Strongly agree
☐	☐	☐	☐	☐

39. There are busy streets to cross when out on walks

Strongly disagree	Disagree	Unsure	Agree	Strongly agree
☐	☐	☐	☐	☐

40. The footpaths are in good condition

Strongly disagree	Disagree	Unsure	Agree	Strongly agree
☐	☐	☐	☐	☐

41. There is heavy traffic

Strongly disagree	Disagree	Unsure	Agree	Strongly agree
☐	☐	☐	☐	☐

42. It is safe to cycle in your neighbourhood

Strongly disagree	Disagree	Unsure	Agree	Strongly agree
☐	☐	☐	☐	☐

43. The streets are well lit

Strongly disagree	Disagree	Unsure	Agree	Strongly agree
☐	☐	☐	☐	☐

44. There are open spaces (such as parks, ovals) for people to walk in or around my neighbourhood

Strongly disagree	Disagree	Unsure	Agree	Strongly agree
☐	☐	☐	☐	☐

45. There are bicycle or walking paths/trails within walking distance of my home.

Strongly disagree	Disagree	Unsure	Agree	Strongly agree
☐	☐	☐	☐	☐

SOCIAL ENVIRONMENT

The next questions are about other people in your life including those in your general neighbourhood, family, household members, friends or colleagues who may have an influence on how physically active you are. For these questions you can respond by using never, rarely, sometimes, often, very often. Please tick the box below the statement.

46. How often in the last three months have family, friends and colleagues encouraged you to perform physical activity?

Never	Rarely	Sometimes	Often	Very often
☐	☐	☐	☐	☐

47. How often in the last three months have family, friends and colleagues done something to help you to be physically active?

Never	Rarely	Sometimes	Often	Very often
☐	☐	☐	☐	☐

48. How often in the last three months have family, friends and colleagues made it difficult for you to be physically active?

Never	Rarely	Sometimes	Often	Very often
☐	☐	☐	☐	☐

49. How often in the last three months have family, friends and colleagues offered to do physical activities with you?

Never	Rarely	Sometimes	Often	Very often
☐	☐	☐	☐	☐

We are also interested in whether you think people in your neighbourhood are physically active. To this question you can respond using very physically active, somewhat physically active, not very physically active or not at all physically active. Please tick the box below the statement.

50. People in my neighbourhood are:

Very physically active	Somewhat physically active	Not very physically active	Not at all physically active
☐	☐	☐	☐

GENERAL AND DEMOGRAPHIC QUESTIONS

We would now like to ask you some general questions that give us a description of the people who participated in this survey. Please let me remind you that the information you give us is confidential.

51. How old are you? ____________________ years

52. What is your gender?
- ☐ Male
- ☐ Female

53. Where were you born?
- ☐ Australia
- ☐ New Zealand
- ☐ United Kingdom
- ☐ Europe
- ☐ Asia
- ☐ North America
- ☐ Other (please specify) ___________________________________

54. How long have you been living in Australia?

- ☐ All my life
- ☐ _________ years

55. How long have you been living in the tropics?
    - ☐ All my life
    - ☐ _________ years

56. Are you of Aboriginal or Torres Strait Islander descent?
    - ☐ YES
    - ☐ NO

57. Are you a South Sea Islander?
    - ☐ YES
    - ☐ NO

58. What was your highest level of schooling?
    - ☐ Never attended school
    - ☐ Year 8 or below
    - ☐ Year 9 or equivalent
    - ☐ Year 10 or equivalent
    - ☐ Year 11 or equivalent
    - ☐ Year 12 or equivalent

59. Have you completed a trade certificate or any other qualification?
    - ☐ YES ***If yes, please go to question 60***
    - ☐ NO ***If no please go to question 61***

60. What is the highest qualification that you completed?
    - ☐ Trade or business certificate
    - ☐ Apprenticeship
    - ☐ Associate Diploma
    - ☐ Undergraduate Diploma
    - ☐ Bachelor degree
    - ☐ Post Graduate Diploma
    - ☐ Masters degree
    - ☐ Doctorate
    - ☐ Other ____________________________________

61. What is your current employment?

- ◻ Full time paid work in a job, business or profession
- ◻ Part time paid work in a job, business or profession
- ◻ Casual paid work in a job, business or profession
- ◻ Work without pay in a family or other business
- ◻ Home duties not looking for work
- ◻ Unemployed looking for work
- ◻ Retired
- ◻ Permanently unable to work
- ◻ Student
- ◻ Other (specify) ______________________________________

62. Which one of the following best describes your living arrangement?
- ◻ Single and living by yourself
- ◻ Single and living with friends or relatives
- ◻ Single parent living with one or more children
- ◻ Couple (married or defacto) living with no children
- ◻ Couple (married or defacto) living with one or more children
- ◻ Other (please specify) __________________________________

63. How many dependent children are currently living in your care? _________________

64. How many of these children are under the age of five? __________________________

65. Do you have a dog? (please tick one)
- ◻ YES ***If yes, please go to question 66.***
- ◻ NO ***If no, please go to question 67.***

66. Do you take it for a walk regularly (i.e. for at least 30 minutes 5 or more times a week)
- ◻ YES
- ◻ NO

67. Have you ever been told by a doctor that you have any chronic or long term health problems?
- ◻ YES ***If yes, please go to question 68***
- ◻ NO ***If no, please go to question 69.***

68. What would that chronic or long term health problems be (you can choose more than one):
- ◻ Diabetes (high blood sugar)
- ◻ Heart Disease

- ◻ High Blood Pressure
- ◻ Stroke
- ◻ Thrombosis (blood clot)
- ◻ Arthritis
- ◻ Emphysema
- ◻ Osteoporosis
- ◻ Breast Cancer
- ◻ Colon Cancer
- ◻ Skin Cancer
- ◻ Other Cancer
- ◻ Depression
- ◻ Anxiety/Nervous Disorder
- ◻ Other (Specify) ______________________________

69. How much does your present health limit your physical activity? Please tick the box below the statement.

None of the time	A little bit of the time	Some of the time	Most of the time	All of the time
☐	☐	☐	☐	☐

70. Do you currently smoke?

◻ YES

◻ NO

If yes approximately how many cigarettes do you smoke a day?

____

71. Are you an ex-smoker?

◻ YES

◻ NO

If yes approximately how long ago did you quit? ______________________________

72. How much do you currently weigh? (without clothes and shoes)

________kilograms **or** _______ stone and ______ pounds

73. What height are you? (without shoes)

__________centimeters **or** __________ feet and __________ inches

74. What is your approximate annual household income before taxes. Choose either per year or per week and place a tick next to the one that is relevant to you.

PER year **OR**	**PER week**

	Nil income
$1 - $2,079	$1- $39
$2,080 - $4,159	$40 – $79
$4,160 – $6,239	$80 - $119
$6,240 – $8,319	$120 $159
$8,320 – $10,399	$160 - $199
$10,400 – $15,599	$200 – $299
$15,600 – $20,799	$300 - $399
$20,800 – $25,999	$400 - $499
$26,000 - $31,199	$500 - $599
$31,200 – $36,399	$600 - $699
$36,400 – $41,599	$700 - $799
$41,600 - $51,999	$800 - $999
$52,000 – $77,999	$1,000 – $1,499
$78,000 or more	$1,500 or more

75. Have you heard of 10,000 Steps Townsville?

☐ YES

☐ NO

If yes, where did you hear about it from?

☐ Television

☐ Radio

☐ Newspaper

☐ Family/friend

☐ Other (please specify) ________________________________

CONCLUSION

Discussion Group

We would like to involve community members in face to face discussion groups (focus groups) to explore their feelings about physical activity and the environment. **Would you be interested in being involved in a focus group discussion**?

☐ YES

☐ NO

If yes please provide your name and address and telephone number on the next page. This will be removed immediately from the survey to maintain confidentiality and ensure that your survey responses are anonymous.

Gift Voucher

There are **four double movie gift vouchers available from the Reading Cinema**. The first person to return the survey will receive one and all remaining people who return the survey will go into a draw for the three remaining vouchers.

If you would like to be eligible for these vouchers we will need your name and address. **Please provide your name and address and telephone number on the next page.** This will be removed immediately from the survey to maintain confidentiality and ensure that your survey responses are anonymous.

That brings us to the end of our survey.

Thank you for taking the time to answer our questions.

If you would ever like any more information on this project please don't hesitate to call:
Sue Devine (project coordinator) on 07 4772 6515.

- - - - - ✂ - - - - - ✂ - - - - - ✂ - - - - - ✂ - - - - - ✂ - - - - - ✂ - - - - - ✂ - - - - - ✂ - - - - - ✂ - -

MY CONTACT DETAILS

I have provided my contacts below for the purpose of (*please tick as appropriate*):

- □ participating in the Project Focus Groups
- □ going into the draw for the movie vouchers

Name: ____

Address: ____

____

____

Telephone Number: ______________________________

Appendix 6.1: Critical Appraisal Skills Programme (CASP) 10 questions to help you make sense of reviews

CRITICAL APPRAISAL SKILLS PROGRAMME (CASP): Making Sense Of Evidence

10 Questions to Help You Make Sense of Reviews

How to Use This Appraisal Tool

- Three broad issues need to be considered when appraising the report of a systematic review:
  - Is the study valid?
  - What are the results?
  - Will the results help locally?
- The 10 questions on the following pages are designed to help you think about these issues systematically.
- The first two questions are screening questions and can be answered quickly. If the answer to both is "yes", it is worth proceeding with the remaining questions.
- You are asked to record a "yes", "no" or "can't tell" to most of the questions. A number of italicised prompts are given after each question.
- These are designed to remind you why the question is important. Record your reasons for your answers in the spaces provided.

Screening Questions

1. Did the review ask a clearly-focused question?

☐ Yes ☐ Can't Tell ☐ No

HINT: Consider if the question is 'focused' in terms of:
- the population studied
- the intervention given or exposure
- the outcomes considered

2. Did the review include the right type of study?

☐ Yes ☐ Can't Tell ☐ No

HINT: Consider if the included studies:
- address the review's question
- have an appropriate study design

Is it worth continuing?

Detailed Questions

3. Did the reviewers try to identify all relevant studies?

☐ Yes ☐ Can't Tell ☐ No

HINT: Consider:
- which bibliographic databases were used
- if there was follow-up from reference lists
- if there was personal contact with experts
- if the reviewers searched for unpublished studies
- if the reviewers searched for non-English-language studies

4. Did the reviewers assess the quality of the included studies?

☐ Yes ☐ Can't Tell ☐ No

HINT: Consider:
- if a clear, pre-determined strategy was used to determine which studies were included. Look for:
  - a scoring system
  - more than one assessor

5. If the results of the studies have been combined, was it reasonable to do so?

☐ Yes ☐ Can't Tell ☐ No

HINT: Consider whether:
- the results of each study are clearly displayed
- the results were similar from study to study (look for tests of heterogeneity)
- the reasons for any variations in results are discussed

6. How are the results presented and what is the main result?

HINT: Consider:
- how the results are expressed (e.g. odds ratio, relative risk, etc.)
- how large this size of result is and how meaningful it is
- how you would sum up the bottom-line result of the review in one sentence

7. How precise are these results?

HINT: Consider:
- if a confidence interval were reported. Would your decision about whether or not to use this intervention be the same at the upper confidence limit as at the lower confidence limit?
- if a p-value is reported where confidence intervals are unavailable

8. Can the results be applied to the local population?

☐ Yes ☐ Can't Tell ☐ No

HINT: Consider whether:
- the population sample covered by the review could be different from your population in ways that would produce different results
- your local setting differs much from that of the review
- you can provide the same intervention in your setting

9. Were all important outcomes considered?

☐ Yes ☐ Can't Tell ☐ No

HINT: Consider outcomes from the point of view of the:
- individual
- policy makers and professionals
- family/carers
- wider community

10. Should policy or practice change as a result of the evidence contained in this review?

☐ Yes ☐ Can't Tell ☐ No

HINT: Consider:
- whether any benefit reported outweighs any harm and/or cost. If this information is not reported can it be filled in from elsewhere?

Appendix 6.2: Critical Appraisal Skills programme (CASP) 10 questions to help you make sense of randomised control trials

CRITICAL APPRAISAL SKILLS PROGRAMME (CASP): Making Sense of Evidence

10 Questions to Help You Make Sense of Randomised Controlled Trials

How to Use This Appraisal Tool

- Three broad issues need to be considered when appraising the report of a randomised controlled trial:
  - Is the trial valid?
  - What are the results?
  - Will the results help locally?
- The 10 questions on the following pages are designed to help you think about these issues systematically.
- The first two questions are screening questions and can be answered quickly. If the answer to both is "yes", it is worth proceeding with the remaining questions.
- You are asked to record a "yes", "no" or "can't tell" to most of the questions.
- A number of hints are given after each question. These are designed to remind you why the question is important. There may not be time in the small groups to answer them all in detail!

A. Are the results of the study valid?

Screening Questions

1. Did the study ask a clearly-focused question?

☐ Yes ☐ Can't Tell ☐ No

HINT: Consider if the question is 'focused' in terms of:
- the population studied
- the intervention given
- the outcomes considered

2. Was this a randomised controlled trial (RCT) and was it appropriately so?

☐ Yes ☐ Can't Tell ☐ No

HINT: Consider:
- why this study was carried out as an RCT
- if this was the right research approach for the question being asked

Is it worth continuing?

Detailed Questions

3. Were participants appropriately allocated to intervention and control groups?

☐ Yes ☐ Can't Tell ☐ No

HINT: Consider:
- how participants were allocated to intervention and control groups. Was the process truly random?
- whether the method of allocation was described. Was a method used to balance the randomization, e.g. stratification?
- how the randomization schedule was generated and how a participant was allocated to a study group
- if the groups were well balanced. Are any differences between the groups at entry to the trial reported?
- if there were differences reported that might have explained any outcome(s) (confounding)

4. Were participants, staff and study personnel 'blind' to participants' study group?

☐ Yes ☐ Can't Tell ☐ No

HINT: Consider:
- the fact that blinding is not always possible
- if every effort was made to achieve blinding
- if you think it matters in this study
- the fact that we are looking for 'observer bias'

5. Were all of the participants who entered the trial accounted for at its conclusion?

☐ Yes ☐ Can't Tell ☐ No

HINT: Consider:
- if any intervention-group participants got a control-group option or vice versa
- if all participants were followed up in each study group (was there loss-to-follow-up?)
- if all the participants' outcomes were analysed by the groups to which they were originally allocated (intention-to-treat analysis)
- what additional information would you liked to have seen to make you feel better about this

6. Were the participants in all groups followed up and data collected in the same way?

☐ Yes ☐ Can't Tell ☐ No

HINT: Consider:
if, for example, they were reviewed at the same time intervals and if they received the same amount of attention from researchers and health workers. Any differences may introduce performance bias.

7. Did the study have enough participants to minimise the play of chance?

☐ Yes ☐ Can't Tell ☐ No

HINT: Consider:
if there is a power calculation. This will estimate how many participants are needed to be reasonably sure of finding something important (if it really exists and for a given level of uncertainty about the final result).

B. What are the results?

8. How are the results presented and what is the main result?

____

HINT: Consider:
- if, for example, the results are presented as a proportion of people experiencing an outcome, such as risks, or as a measurement, such as mean or median differences, or as survival curves and hazards
- how large this size of result is and how meaningful it is
- how you would sum up the bottom-line result of the trial in one sentence

9. How precise are these results?

____

HINT: Consider:
- if the result is precise enough to make a decision
- if a confidence interval were reported. Would your decision about whether or not to use this intervention be the same at the upper confidence limit as at the lower confidence limit?
- if a p-value is reported where confidence intervals are unavailable

10. Were all important outcomes considered so the results can be applied?

☐ Yes ☐ Can't Tell ☐ No

HINT: Consider whether:
- the people included in the trail could be different from your population in ways that would produce different results
- your local setting differs much from that of the trial
- you can provide the same treatment in your setting
- Consider outcomes from the point of view of the:
- individual
- policy maker and professionals
- family/carers – wider community
- Consider whether:
- any benefit reported outweighs any harm and/or cost. If this information is not reported can it be filled in from elsewhere?
- policy or practice should change as a result of the evidence contained in this trial

Appendix 7.1: Focus Group Questions and Script

A Qualitative Study examining Thuringowa Council Employee's perception of how to promote physical activity within the workplace.

Focus Group Questions

Good morning/ good afternoon and welcome. My name is …………….

And I will be conducting this focus group today. This is ………. who will be taking notes during this session.

Firstly we would like to thank everyone for attending and your willingness to participate.

The purpose of this focus group is to gain a better understanding of your view on physical activity in the workplace, and the benefits and barriers surrounding it.

Before we start there are a few house keeping rules to keep in mind

1. This meeting is confidential and no names will be used when we give feedback to
your employers.
2. This session will be tape recorded if you agree and feel comfortable with that and ………. will be taking notes so that we can recall the information easier at a later date. Taping the focus groups helps us make sure we don't miss anything.
3. To make sure that we can hear what you say on tape, it really helps if you speak clearly and one at a time.
4. If anyone would like to speak off the record please don't hesitate to ask, and the tape recorder will be turned off.

So if everyone is happy we might get started…

1. To get the ball rolling would anybody like to share their thoughts on what physical activity means to them?

Prompt: *Is being physically active something that is important to you?*
Why/why not?
What type of activities do you participate in?
What is good about them? - Why do you do them?

2. Who do you think is responsible to motivate or encourage you to participate in physical activity?

Prompt: *You're self, the workplace, family or friends.*
Could you expand on those thought for me?
ie: Why is it ?? responsibility

3. It has been suggested that the workplace is a setting that may incorporate physical activity.
What are your thoughts on/about this?

Prompt: *Would setting up physical activity programs work in your workplace? – Why/ why not?*
Can you see any benefits to PA in the workplace?
Are there any limitations to including PA in the workplace?

4. If a physical activity promoting program was to be set up in you workplace, what type of activities or approaches would you like to see incorporated?

Prompt: *Gym, walking groups or team sport, flexible working times, active transport (walking/biking) to work*
If these activities were set up, do you think you would actually use or participate in them

5. What would give Thuringowa Council employees further incentive or encouragement to participate in workplace physical activity activities?

Prompt: *What times during the work hours could be used for physical activity.?*
Longer lunchtimes
Seeing mangers taking part
Subsidised gym membership
Departmental sporting challenges
Corporate challenges

6. What might prevent Thuringowa Council employees participating in workplace physical activity programs?

Prompt: *Time, lack of interest, heat, lack of facilities (showers/bike racks etc)*

7. Is there anything else relevant to this topic that you would like to discuss?

Thank-you so much for your participation…

We will be analyzing all the information we gain, over the coming weeks. Our recommendations will then be reported back to the Council and they may choose to implement some of the suggestions in the future.

If you wish to find out anything more relating to the project, please don't hesitate in contacting Thuringowa City Council's Sport and Recreation Officer, and she will pass on the query to us.

Appendix 7.2 – Participant Information Sheet

PARTICIPANT INFORMATION SHEET

Physical Activity Programs in the Workplace – Employee Perceptions.
A Qualitative Study examining Thuringowa Council Employee's perception of how to promote physical activity within the workplace.

Physical activity is well recognised as an important risk factor for many diseases such as heart disease, diabetes and cancer. Research shows us that physical activity levels in Australia are decreasing which has important health implications. It is important that we fully understand what sort of approaches can be used to assist people in becoming more active.

There is quite a bit of discussion about the potential of workplaces to influence physical activity behaviour. Worksites are seen as important settings to influence physical activity as there is an opportunity to reach a "captive" group that spends a large period of time at work. Thuringowa City Council are keen to find out whether employees see physical activity as an important issue and if so, whether they are interested in the Council exploring ways to improve physical activity in the workplace setting. James Cook University will help them explore this.

Participation in this study is voluntary and you will not be disadvantaged in any way if you decide that you do not want to participate. Participation involves you participating in this focus group and answering those questions that you feel comfortable in answering. You are under no obligation to respond to all questions. The information provided by each person will not be identifiable by name. It is not our intention to judge you in any way. We just want to know in general some information on how you perceive the relationship between the workplace and physical activity. The focus group will take approximately 30 – 40 minutes and with your permission it will be tape recorded so that we can refer back to it later as a true interpretation of what was said.

We hope that you will be comfortable enough with the information we have given you to take part in this research. However, if you do have any hesitation or further questions, please feel free to discuss them with us in person.

INVESTIGATORS:

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HS3401 Occupational Therapy Students (under Supervision of Sue Devine)

Appendix 7.3 – Participant Informed Consent Form

PARTICIPANT INFORMED CONSENT FORM

Physical Activity Programs in the Workplace – Employee Perceptions.
A Qualitative Study examining Thuringowa Council Employee's perception of how to promote physical activity within the workplace.

INVESTIGATORS:

Reinhold Muller **Associate Professor** **School of Public Health and Tropical Medicine** **James Cook University** **Phone: 47 961750** **Email: reinhold.muller@jcu.edu.au**	**Sue Devine** **Lecturer and Principal Investigator** **School of Public Health and Tropical Medicine** **James Cook University** **Phone: 47 816110** **Email: sue.devine@jcu.edu.au**	**HS3401 Occupational Therapy Students (under Supervision of Sue Devine**

1. I have received an Information Sheet that explains the purpose of the study, the possible benefits, and the possible risks.

2. The nature and purpose of the research project has been explained to me on the information sheet. I understand it, and agree to take part.

3. I understand that I may not directly benefit from taking part in the survey.

4. I understand that, while information gained in the focus group may be published I will not be identified and my personal results will remain strictly confidential. However due to the nature of focus groups we cannot guarantee that that all information provided by you will be treated confidentially by other focus group members.

5. I consent to having my name recorded for consent and record of participation purposes only.

6. I consent to having the focus group interview audio taped.

7. I understand that I can withdraw from the study at any stage and that I can refuse to answer any questions.

NAME OF SUBJECT: ____________________

SIGNED: ____________________

WITNESSED: ____________________

DATED: ____________________

Appendix 8.1 – Questions from the Long IPAQ used to measure physical activity

Engaging local government employees in physical activity in the workplace – a pedometer study comparing physical activity between indoor and outdoor employees Physical Activity Survey

We need your help. The School of Public Health and Tropical Medicine at James Cook University together with the Thuringowa Council and Queensland Health, is conducting some research that looks at how much physical activity employees achieve during their time at work and in their leisure time.

Your participation is totally voluntary. All information given to us will be stored securely and confidentiality will be maintained at all times. To complete this survey you need to be at least 18 years old.

We would greatly appreciate you completing this survey to allow us to gain a greater understanding of this area so that we can use the information to consider the relevance of future workplace based physical activity programs.

Remember:

- We want to know what you think
- There are no right or wrong answers

If you have any questions please call the project coordinator, Sue Devine on 47816110 or email Sue at sue.devine@jcu.edu.au

This survey will take approximately 20-25 minutes to complete. You can either complete it as soon as you receive it or take it home and complete it overnight, returning it on the following day. Thank you for your participation in this Project.

Name: ___________________ **ID Number**: _____

Physical Activity Questions

We are interested in finding out about the kinds of physical activities that people do as part of their everyday lives. The questions will ask you about the time you spent being physically active in the **last 7 days**. Please answer each question even if you do not consider yourself to be an active person. Please think about the activities you do at work, as part of your house and yard work, to get from place to place, and in your spare time for recreation, exercise or sport.

Think about all the **vigorous** and **moderate** activities that you did in the **last 7 days**. **Vigorous** physical activities refer to activities that take hard physical effort and make you breathe much harder than normal. **Moderate** activities refer to activities that take moderate physical effort and make you breathe somewhat harder than normal.

PART 1: JOB-RELATED PHYSICAL ACTIVITY

The first section is about your work. This includes paid jobs, farming, volunteer work, course work, and any other unpaid work that you did outside your home. Do not include unpaid work you might do around your home, like housework, yard work, general maintenance, and caring for your family. These are asked in Part 3.

1. During the **last 7 days**, on how many days did you do **vigorous** physical activities like heavy lifting, digging, heavy construction, or climbing up stairs **as part of your work**? Think about only those physical activities that you did for at least 10 minutes at a time.

_____ **days per week**

☐ No vigorous job-related physical activity → ***Skip to question 3***

2. How much time did you usually spend on one of those days doing **vigorous** physical activities as part of your work?

_____ **hours per day**
_____ **minutes per day**

3. Again, think about only those physical activities that you did for at least 10 minutes at a time. During the **last 7 days**, on how many days did you do **moderate** physical activities like carrying light loads **as part of your work**? Please do not include walking.

_____ **days per week**

☐ No moderate job-related physical activity → ***Skip to question 5***

4. How much time did you usually spend on one of those days doing **moderate** physical activities as part of your work?

_____ **hours per day**
_____ **minutes per day**

5. During the **last 7 days**, on how many days did you **walk** for at least 10 minutes at a time **as part of your work**? Please do not count any walking you did to travel to or from work.

_____ **days per week**

☐ No job-related walking → ***Skip to PART 2: TRANSPORTATION***

6. How much time did you usually spend on one of those days **walking** as part of your work?

_____ **hours per day**
_____ **minutes per day**

PART 2: TRANSPORTATION PHYSICAL ACTIVITY

These questions are about how you traveled from place to place, including to places like work, stores, movies, and so on.

7. During the **last 7 days**, on how many days did you **travel in a motor vehicle** like a train, bus, car, or tram?

_____ **days per week**

☐ No traveling in a motor vehicle → ***Skip to question 9***

8. How much time did you usually spend on one of those days **traveling** in a train, bus, car, tram, or other kind of motor vehicle?

_____ **hours per day**
_____ **minutes per day**

Now think only about the **bicycling** and **walking** you might have done to travel to and from work, to do errands, or to go from place to place.

9. During the **last 7 days**, on how many days did you **bicycle** for at least 10 minutes at a time to go **from place to place**?

_____ **days per week**

☐ No bicycling from place to place → ***Skip to question 11***

10. How much time did you usually spend on one of those days to **bicycle** from place to place?

_____ **hours per day**
_____ **minutes per day**

11. During the **last 7 days**, on how many days did you **walk** for at least 10 minutes at a time to go **from place to place**?

_____ **days per week**

☐ No walking from place to place → ***Skip to PART 3: HOUSEWORK, HOUSE MAINTENANCE, AND CARING FOR FAMILY***

12. How much time did you usually spend on one of those days walking from place to place?

_____ **hours per day**
_____ **minutes per day**

PART 3: HOUSEWORK, HOUSE MAINTENANCE, AND CARING FOR FAMILY

This section is about some of the physical activities you might have done in the **last 7 days** in and around your home, like housework, gardening, yard work, general maintenance work, and caring for your family.

13. Think about only those physical activities that you did for at least 10 minutes at a time. During the **last 7 days**, on how many days did you do **vigorous** physical activities like heavy lifting, chopping wood, or digging **in the garden or yard**?

_____ **days per week**

☐ No vigorous activity in garden or yard → ***Skip to question 15***

14. How much time did you usually spend on one of those days doing **vigorous** physical activities in the garden or yard?

_____ **hours per day**
_____ **minutes per day**

15. Again, think about only those physical activities that you did for at least 10 minutes at a time. During the **last 7 days**, on how many days did you do **moderate** activities like carrying light loads, sweeping, washing windows, and raking **in the garden or yard**?

_____ **days per week**

☐ No moderate activity in garden or yard → ***Skip to question 17***

16. How much time did you usually spend on one of those days doing **moderate** physical activities in the garden or yard?

_____ **hours per day**

_____ **minutes per day**

17. Once again, think about only those physical activities that you did for at least 10 minutes at a time. During the **last 7 days**, on how many days did you do **moderate** activities like carrying light loads, washing windows, scrubbing floors and sweeping **inside your home**?

    _____ **days per week**

    ☐ No moderate activity inside home → ***Skip to PART 4: RECREATION, SPORT AND LEISURE-TIME PHYSICAL ACTIVITY***

18. How much time did you usually spend on one of those days doing **moderate** physical activities inside your home?

_____ **hours per day**
_____ **minutes per day**

PART 4: RECREATION, SPORT, AND LEISURE-TIME PHYSICAL ACTIVITY

This section is about all the physical activities that you did in the **last 7 days** solely for recreation, sport, exercise or leisure. Please do not include any activities you have already mentioned.

19. Not counting any walking you have already mentioned, during the **last 7 days**, on how many days did you **walk** for at least 10 minutes at a time **in your leisure time**?

    _____ **days per week**

    ☐ No walking in leisure time → ***Skip to question 21***

20. How much time did you usually spend on one of those days **walking** in your leisure time?

_____ **hours per day**
_____ **minutes per day**

21. Think about only those physical activities that you did for at least 10 minutes at a time. During the **last 7 days**, on how many days did you do **vigorous** physical activities like aerobics, running, fast bicycling, or fast swimming **in your leisure time**?

    _____ **days per week**

    ☐ No vigorous activity in leisure time → ***Skip to question 23***

22. How much time did you usually spend on one of those days doing **vigorous** physical activities in your leisure time?

_____ **hours per day**

_____ **minutes per day**

23. Again, think about only those physical activities that you did for at least 10 minutes at a time. During the **last 7 days**, on how many days did you do **moderate** physical activities like bicycling at a regular pace, swimming at a regular pace, and doubles tennis **in your leisure time**?

_____ **days per week**

☐ No moderate activity in leisure time → ***Skip to PART 5: TIME SPENT SITTING***

24. How much time did you usually spend on one of those days doing **moderate** physical activities in your leisure time?

_____ **hours per day**
_____ **minutes per day**

PART 5: TIME SPENT SITTING

The last questions are about the time you spend sitting while at work, at home, while doing course work and during leisure time. This may include time spent sitting at a desk, visiting friends, reading or sitting or lying down to watch television. Do not include any time spent sitting in a motor vehicle that you have already told me about.

25. During the **last 7 days**, how much time did you usually spend **sitting** on a **weekday**?

_____ **hours per day**
_____ **minutes per day**

26. During the **last 7 days**, how much time did you usually spend **sitting** on a **weekend day**?

_____ **hours per day**

_____ minutes per day

Appendix 8.2 – Information Sheet

PARTICIPANT INFORMATION SHEET

Engaging local government employees in physical activity in the workplace – a pedometer study comparing physical activity between indoor and outdoor employees

Physical inactivity is well recognised as an important risk factor for many diseases such as heart disease, type two diabetes and some cancers. Research shows us that physical activity levels in Australia are decreasing which has important health implications. The workplace is one area where physical activity can be encouraged. We know that physical activity can occur at varying degrees both within and outside of work hours and we are interested in finding out more about how much physical activity is done by indoor and outdoor employees both while they are at work and in their leisure time.

With the support of Thuringowa City Council and the Tropical Population Health Unit (Queensland Health), the School of Public Health and Tropical Medicine (James Cook University) would like to invite you to participate in a study in which we will assess your physical activity levels during and outside of work hours.

Participation involves you completing a survey at the beginning and end of a normal working week and wearing a pedometer so that we can measure how many steps you take each day over a 7 day period while you are at work and in your leisure time. A pedometer is a small motivational tool that you clip onto your waist band or pocket and it is used to count the number of steps you take each day. Pedometers can be used by individuals to monitor physical activity levels and to set goals.

Participation is voluntary and it is alright if you decide that you do not want to participate. The information provided by each person will not be identifiable by name but by an identification number that we will assign. It is not our intention to judge you in any way.

The findings of this study will assist us to understand the differences between indoor and outdoor employees in terms of achieving sufficient levels of physical activity and in what part of the day this is achieved.

Findings will be used to consider the relevance of future workplace based physical activity programs.

If you would like to take part we ask you to fill out a survey as best you can at the beginning and end of a one week period. The survey is totally anonymous and all information is confidential. While we are interested in your responses we do not need to know your name. There are no wrong answers to our questions. The survey will take approximately twenty minutes to complete. You will then be given a pedometer to wear for seven days and a log book to record the number of steps that you take each day during your work time and leisure time.

If you do have any hesitation or further questions, please contact Sue Devine or Petra Buttner on the numbers below. The Ethics Administrator, Tina Langford whose contact details are also below, can also be contacted should you have any complaints or enquiries about how this study is conducted.

INVESTIGATORS

Sue Devine
Lecturer and Principle Investigator
School of Public Health and Tropical Medicine
James Cook University
Phone: 47 816110
Email: sue.devine@jcu.edu.au

Petra Buttner
Senior Lecturer
School of Public Health and Tropical Medicine
James Cook University
Phone: 47 961750
Email: petra.buttner@jcu.edu.au

The ethics administrator can also be contacted should you have any complaints or further enquiries regarding the study.

Tina Langford (Ethics Administrator)
Research Office, James Cook University
Phone: 47814342: Fax: 07 47815521: Email: tina.langford@jcu.edu.au

Appendix 8.3 – Consent Form

INFORMED CONSENT FORM

PRINCIPAL INVESTIGATOR	Sue Devine
PROJECT TITLE:	Engaging local government employees in physical activity in the workplace – a pedometer study comparing physical activity between indoor and outdoor employees
SCHOOL	School of Public Health and Tropical Medicine
CONTACT DETAILS	Sue Devine, School of Public Health and Tropical Medicine, James Cook University Phone: 47816110

You are invited to participate in a study in which we will assess your physical activity levels during and outside of work hours. This will involve you completing a survey at the beginning and end of a normal working week and wearing a pedometer so that we can measure how many steps you take each day over a 7 day period while you are at work and whilst not at work.

The findings of this study will assist us to understand the differences between indoor and outdoor employees in terms of achieving sufficient levels of physical activity and in what part of the day this is achieved.

Findings will be used to consider the relevance of future workplace based physical activity programs. Confidentiality will be guaranteed at all times

The aims of this study have been clearly explained to me and I understand what is wanted of me. I know that taking part in this study is voluntary and I am aware that I can stop taking part in it at any time and may refuse to answer any questions.

I understand that any information I give will be kept strictly confidential and that no names will be used to identify me with this study without my approval.

I understand that no personal information will be available to Thuringowa City Council at any time.

Name: *(printed)*	
Signature:	**Date:**

Appendix 8.4 – Pedometer Log Sheet

PEDOMETER LOG BOOK

NAME (optional): ______________________________

ID NUMBER: ______________________________

WORK POSITION: ______________________________

You are to record how many steps you are walking each day on this sheet.

Measuring your step count

Get started using your pedometer with the following 6 easy steps.

1. Put your pedometer on first thing in the morning (it should be always on zero to start with).
2. Clip it to your belt/pants/skirt just above your hip (in line with your knee).
3. When you arrive at work write down your step count on the sheet below and reset your pedometer back to zero.
4. At the end of the working day write down your step count on the sheet below and reset your pedometer back to zero.
5. Before going to bed write down your step count on the sheet below and reset your pedometer back to zero.
6. Take the pedometer off last thing at night, just before going to bed.

Repeat the same process every day for seven days.

Day	Date	Working Day	Step count: Waking to commencement of work	Step count: Commencement of work – end of work	Step count: End of work until bedtime
Wednesday	**16.08.06**	**Yes/No**			
Thursday	**17.08.06**	**Yes/No**			
Friday	**18.08.06**	**Yes/No**			
Saturday	**19.08.06**	**Yes/No**			
Sunday	**20.08.06**	**Yes/No**			
Monday	**21.08.06**	**Yes/No**			
Tuesday	**22.08.06**	**Yes/No**			

Appendix 8.5: Ethical Approval Notice for pedometer study comparing physical activity between indoor and outdoor workers

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JAMES COOK UNIVERSITY
Townsville Qld 4811 Australia

Tina Langford, Ethics Administrator, Research Office. Ph: 07 4781 4342; Fax: 07 4781 5521

ETHICS REVIEW COMMITTEE
Human Ethics Committee
APPROVAL FOR RESEARCH OR TEACHING INVOLVING HUMAN SUBJECTS

PRINCIPAL INVESTIGATOR	**Sue Devine**				
CO- INVESTIGATORS	Dr Petra Buttner (Public Health, Tropical Medicine & Rehabilitation Sciences) & Kerry Mummery (Central Queensland University)				
SCHOOL	Public Health, Tropical Medicine & Rehabilitation Sciences				
PROJECT TITLE	**Engaging local government employees in physical activity in the workplace - a pedometer study comparing physical activity between indoor and outdoor workers**				
APPROVAL DATE	16 Jun 2006	**EXPIRY DATE**	1 Sep 2006	**CATEGORY**	1
This project has been allocated Ethics Approval Number with the **following conditions:**				**H**	**2331**

1. All subsequent records and correspondence relating to this project must refer to this number.
2. That there is **NO** departure from the approved protocols unless prior approval has been sought from the Human Ethics Committee.
3. The Principal Investigator **must advise** the responsible Ethics Monitor appointed by the Ethics Review Committee:
   - periodically of the progress of the project;
   - when the project is completed, suspended or prematurely terminated for any reason;
   - if serious or adverse effects on participants occur; and if any
   - unforeseen events occur that might affect continued ethical acceptability of the project.
4. In compliance with the National Health and Medical Research Council (NHMRC) *"National Statement on Ethical Conduct in Research Involving Humans"* (1999), it is **MANDATORY** that you provide an annual report on the progress and conduct of your project. This report must detail compliance with approvals granted and any unexpected events or serious adverse effects that may have occurred during the study.

NAME OF RESPONSIBLE MONITOR	Leggat, A/Prof Peter
EMAIL ADDRESS:	peter.leggat@jcu.edu.au
ASSESSED AT MEETING	***Date:*** 29 Mar 2006
APPROVED **Associate Professor Peter Leggat** **Chair, Human Ethics Committee**	***Date:*** 16 Jun 2006
Tina Langford Ethics Officer **Research Office** Tina.Langford@jcu.edu.au	Date: 21 June 2006

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Appendix 9.1: Participant Information Sheet

PARTICIPANT INFORMATION SHEET

Engaging local government employees in physical activity in the workplace – Evaluation of the Thuringowa City Council 10,000 Steps Workplace Challenge

With the support of Thuringowa City Council and the Tropical Population Health Unit (Queensland Health), the School of Public Health and Tropical Medicine (James Cook University) would like to invite you to participate in a study in which we will assess the long term impact of the 10,000 Steps Workplace Challenge on employee physical activity. The 10,000 Steps Workforce Challenge provides an opportunity for employees and employers to take positive steps towards better health.

The primary goal of the 10,000 Steps Workforce Challenge is to:
1) Increase individual's physical activity awareness,
2) Increase the overall physical activity levels among the workplace, and
3) Create awareness of the coincidental health benefits that can occur in the activities of daily living, including work.

Participation will involve you wearing a pedometer so that we can measure how many steps you take each day over a 7 day period before the Workplace Challenge. A pedometer is a small motivational tool that you clip onto your waist band or pocket and it is used to count the number of steps you take each day. Pedometers can be used by individuals to monitor physical activity levels and to set goals. During the Workplace Challenge you will wear a pedometer every day and record your daily step counts. Three and six months after the Challenge you will again be asked to complete a survey and wear a pedometer for a week.

Participation is voluntary and it is alright if you decide that you do not want to participate. The information provided by each person will not be identifiable by name but by an identification number that we will assign. It is not our intention to judge you in any way.

The findings of this study will assist us to understand how effective programs such as the 10,000 Steps Workplace Challenge are in achieving long term change to physical activity patterns.

If you would like to take part you will then be given a pedometer to wear for seven days and a log book to record the number of steps that you take each day during your work time and leisure time.

If you do have any hesitation or further questions, please contact Sue Devine or Petra Buttner on the numbers below. The Ethics Administrator, Tina Langford whose contact details are also below, can also be contacted should you have any complaints or enquiries about how this study is conducted.

INVESTIGATORS

Sue Devine Lecturer and Principle Investigator School of Public Health and Tropical Medicine James Cook University Phone: 47 816110 Email: sue.devine@jcu.edu.au	Petra Buttner Senior Lecturer School of Public Health and Tropical Medicine James Cook University Phone: 47 961750 Email: petra.buttner@jcu.edu.au	The ethics administrator can also be contacted should you have any complaints or further enquiries regarding the study. Tina Langford,Ethics, Administrator, Research Office, James Cook University Phone: 47814342 Email: tina.langford@jcu.edu.au

Appendix 9.2: Informed Consent Form

JAMES COOK UNIVERSITY

INFORMED CONSENT FORM

PRINCIPAL INVESTIGATOR	Sue Devine
PROJECT TITLE:	Engaging local government employees in physical activity in the workplace - Evaluation of the Thuringowa City Council 10,000 Steps Workplace Challenge
SCHOOL	School of Public Health and Tropical Medicine
CONTACT DETAILS	Sue Devine, School of Public Health and Tropical Medicine, James Cook University Phone: 47816110

You are invited to participate in a study in which we will assess the impact of the 10,000 Steps Workplace Challenge. This will involve you completing a survey at the beginning and end of a normal working week and wearing a pedometer so that we can measure how many steps you take each day over a 7 day period before the Workplace Challenge. During the Workplace Challenge you will wear a pedometer every day and record your daily step counts. 3 and 6 months after the Challenge you will again be asked to complete a survey and wear a pedometer for a week.

The findings of this study will assist us to understand how effective Workplace Challenges are in assisting employees to make long term changes to their physical activity patterns.

Findings will be used to consider the relevance of future workplace based physical activity programs. Confidentiality will be guaranteed at all times

The aims of this study have been clearly explained to me and I understand what is wanted of me. I know that taking part in this study is voluntary and I am aware that I can stop taking part in it at any time and may refuse to answer any questions.

I understand that any information I give will be kept strictly confidential and that no names will be used to identify me with this study without my approval.

I understand that no personal information will be available to Thuringowa City Council at any time.

Name: *(printed)*	
Signature:	**Date:**

Appendix 9.3: Personal Step Log

My Personal Step Log

Every Step Counts!

Name: ____________________________________

Team Name: ____________________________________

	MON	TUES	WED	THURS	FRI	SAT	SUN	Total Steps
WEEK								
Steps								

Please return your step log to your team captain every Monday morning

Appendix 9.4: Ethical Approval Notice for the Evaluation of the Thuringowa City Council 10,000 Steps Workplace Challenge

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JAMES COOK UNIVERSITY
Townsville Qld 4811 Australia

Tina Langford, Ethics Administrator, Research Office. Ph: 07 4781 4342, Fax: 07 4781 5521

ETHICS REVIEW COMMITTEE
Human Ethics Committee
APPROVAL FOR RESEARCH OR TEACHING INVOLVING HUMAN SUBJECTS

PRINCIPAL INVESTIGATOR	**Sue Devine**				
CO- INVESTIGATORS	Dr Petra Buttner (Public Health, Tropical Medicine & Rehabilitation Sciences) & Kerry Mummery (Central Queensland University)				
SCHOOL	Public Health, Tropical Medicine & Rehabilitation Sciences				
PROJECT TITLE	**Evaluation of the Thuringowa City Council 10,000 steps workplace challenge**				
APPROVAL DATE	16 Jun 2006	**EXPIRY DATE**	1 Sep 2006	**CATEGORY**	1

This project has been allocated Ethics Approval Number with the **following conditions**: **H 2330**

1. All subsequent records and correspondence relating to this project must refer to this number.
2. That there is **NO** departure from the approved protocols unless prior approval has been sought from the Human Ethics Committee.
3. The Principal Investigator **must advise** the responsible Ethics Monitor appointed by the Ethics Review Committee:
   - periodically of the progress of the project;
   - when the project is completed, suspended or prematurely terminated for any reason;
   - if serious or adverse effects on participants occur; and if any
   - unforeseen events occur that might affect continued ethical acceptability of the project.
4. In compliance with the National Health and Medical Research Council (NHMRC) *"National Statement on Ethical Conduct in Research Involving Humans"* (1999), it is **MANDATORY** that you provide an annual report on the progress and conduct of your project. This report must detail compliance with approvals granted and any unexpected events or serious adverse effects that may have occurred during the study.

NAME OF RESPONSIBLE MONITOR	Leggat, A/Prof Peter
EMAIL ADDRESS:	peter.leggat@jcu.edu.au
ASSESSED AT MEETING	***Date:*** 29 Mar 2006
APPROVED **Associate Professor Peter Leggat** **Chair, Human Ethics Committee**	***Date:*** 16 Jun 2006
Tina Langford Ethics Officer **Research Office** Tina.Langford@jcu.edu.au	Date: 21 June 2006

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