Barnett, Fiona (2007) ***Psychobiological predictors of exercise behaviour in postmenopausal women.*** **PhD thesis, James Cook University.**

Psychobiological predictors of exercise behaviour in

postmenopausal women.

Thesis submitted by

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In November 2007

For the degree of Doctor of Philosophy in

The Institute of Sport and Exercise Science at

James Cook University

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Ethics Statement

The research presented in this thesis was conducted within the guidelines for research ethics outlined in the National Statement on ethics Conduct in Reasearch Involving Humans (1999), the Joint NHMRC/AVCC Statement and Guidelines on Research Practice (1997), the James Cook University Policy on Experimentation Ethics Standard Practices and Guidelines (2001), and the James Cook University Statement and Guidelines on Research Practice (2001). The research methodology received clearance from the James Cook University Human Research Ethics Committee (approval number H1836).

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Fiona Barnett

Abstract

Weight gain and the associated increased risk of obesity-related diseases are associated with the postmenopausal period. However, moderate intensity exercise may be protective for postmenopausal women through attenuation of weight gain. Despite this evidence, many postmenopausal women do not engage in regular exercise.

As exercise has a positive effect on body composition and the subsequent health of postmenopausal females, an understanding of why exercise levels decline in this population is needed. In particular, understanding the difference in exercise behaviour characteristics of exercising and non-exercising postmenopausal women may encourage more non-exercising postmenopausal women to obtain the health benefits of exercise. An understanding of the exercise behaviour characteristics of exercising and non-exercising postmenopausal women may also provide information for future health promotion policy directions for this population and allow for the formulation of guidelines for exercise professionals. It appears that the life event of menopause can become a barrier or an opportunity for postmenopausal women to exercise, depending on their exercise behaviour characteristics.

Postmenopausal women (N=101) resident in North Queensland volunteered for this study. A self-report questionnaire was utilised to determine the participants' recent exercise history. Participants completed two exercise behaviour scales. The Self-efficacy for Exercise Scale is a barrier-specific, thirteen-item instrument listing common reasons for preventing participation in exercise. The Health Belief Model

(HBM) scale required participants to indicate how much they agreed or disagreed with various statements relating to their individual health beliefs related to exercise and obesity.

Anthropometric assessments ascertained body mass index and waist-to-hip ratio. Resting heart rate and blood pressure were also measured. Participants then performed a six minute graded exercise test (GXT) to determine estimated maximum oxygen uptake ($\dot{V}O_{2max}$). A second visit required participants to perform a twenty minute moderate intensity exercise bout on a cycle ergometer while measures of pre, during and post-exercise affect were obtained using the Subjective Exercise Experience Scale (SEES).

Following data collection, participants were categorised as exercisers (n=53) or non-exercisers (n=48) based on whether they had performed a minimum of 150 minutes of accumulated moderate intensity exercise in the past 7 days. Univariate and multivariate statistical tests including discriminant function analysis (DFA) were utilised to determine whether significant between-group differences existed for the physiological and psychological variables.

The non-exercisers had obtained a lower level of education (U = 971.5, p = .03), were at a lower stage of exercise change (U = 308.0, p = .00), had higher resting diastolic blood pressure ($F_{1,99}$=7.57, p=0.01), BMI ($F_{1,99}$=33.63, p=0.00) and WHR ($F_{1,99}$=5.83, p=0.02) and lower cardiorespiratory fitness ($F_{1,99}$=21.57, p=0.00) and exercise self-efficacy ($F_{1,99}$=39.56, p=0.00) compared to the exercisers. Each of these variables may therefore represent barriers to exercise adoption for this sample of non-exercising postmenopausal women.

DFA determined that the postmenopausal women with higher exercise self-efficacy, lower BMI and higher cardiorespiratory fitness were more likely to be exercisers. DFA also found that the barrier to exercise items of perceived lack of time, difficulty getting to an exercise location and the weather provided the greatest discrimination between exercisers and non-exercisers.

Further analysis of exercise self-efficacy revealed that participants at different stages of change possessed different levels of exercise self-efficacy. Participants with the lowest exercise self-efficacy were in the precontemplation and contemplation stages of change, while participants with the highest exercise self-efficacy were in the action and maintenance stages.

DFA results for the HBM scale revealed that the non-exercising postmenopausal women had higher perceptions of susceptibility to developing an obesity-related disease, perceived a greater number of consequences from participating in regular exercise and felt they were less health motivated to control an obesity-related disease compared to the exercising women.

Separate mixed design repeated measures ANOVA found that no significant between-group differences occurred for positive well-being (SEESa) and fatigue (SEESc) during twenty minutes of moderate intensity exercise. However, follow-up univariate contrasts (Bonferroni) found that the acute exercise bout did have a beneficial effect for both groups across time, with higher SEESa scores postexercise compared to pre and during exercise. Additionally, SEESc scores for both groups were lower postexercise compared to during the latter stages of exercise.

Further research on postmenopausal women residing in Australian metropolitan cities is recommended for determining whether the differences found in this study are unique to postmenopausal women residing in regional North Queensland.

Key words: Postmenopausal women, exercise behaviour

Acknowledgements

To my supervisor, Associate Professor Warwick Spinks. Your expertise and guidance were indispensible. Thank you.

To Dr Melissa Crowe, Dr Joann Lukins and Dr Wade Knez. Thank you for your feedback and assistance.

To the Occupational Therapy staff, and in particular Professor Michele Clark. Thank you for your support and encouragement.

To the participants: thank you for your involvement in this study.

To my family and Oscar and Oliver. Thank you for your support and love.

Dedication

This thesis is dedicated to my late grandfather, Dr Arthur McMartin who will always be an inspiration to me.

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Chapter 1

Introduction

Obesity is a national health problem in Australia. In 1999-2000, more than seven million adult Australians aged 25 years and over were overweight (National Heart Foundation [NHF], 2001). Of these, more than two million, or 20 % of the adult population, were obese (NHF). This trend has increased dramatically since 1980. It has also been reported that 50% of all women in Australia over 45 years are overweight or obese (Campbell & Samaras, 2000). In the context of this thesis overweight and obesity are defined as excessive accumulation of body fat (Schairer, Levine, & Brawner, 2002) and equate to a body mass index (BMI) of $\geq$25 kg/m^2 and <30 kg/m^2 for overweight and a BMI of $\geq$30 kg/m^2 for obese.

Several chronic diseases have been linked to overweight and obesity. These include cardiovascular disease (CVD), non-insulin dependent diabetes mellitus (NIDDM), hypertension, breast, prostate and endometrial cancer, gallbladder disease, musculoskeletal disorders and respiratory problems (World Health Organisation [WHO], 2000). A strong relationship exists between body fat distribution and co-morbidities, with central obesity posing the greater health risk (Bouchard, 2000). Individuals with central or visceral obesity (excess body fat located in abdominal and trunk regions) possess elevated blood lipids, glucose and insulin (Bouchard, 2000). The strong relationship between visceral obesity and the risk factors associated with coronary artery disease (CAD) and NIDDM (hypertension, dyslipidemia and hyperglycaemia) are termed the metabolic syndrome (Meigs, 2003).

Factors affecting overweight and obesity

Genetic, metabolic and environmental or societal factors all influence overweight and obesity. Genetic factors are thought to account for 25-70% of the variability in body fat (Hill & Melanson, 1999). Studies on twins have shown high within-pair similarity in weight gain following overfeeding (Bouchard et al., 1990). Furthermore, genetic factors lower the threshold for developing the disease. Therefore, in a particular environment, the genetically susceptible individual will gain weight (Bouchard, 1997). Defective genes have been found in obese patients, resulting in the absence of leptin (Jackson et al., 1997). Leptin, a hormone secreted by adipose tissue, exerts its effects by decreasing food intake and therefore bodyweight (Jeanrenaud & Rohner-Jeanrenaud, 2001).

Metabolic factors, such as reduced metabolic rate, are the most common reasons provided for developing obesity (Goran & Weinsier, 2000). Resting metabolic rate has been found to be lower in both pre and postmenopausal women when compared to men (Arciero, Goran, & Poehlman, 1993; Carpenter, Poehlman, O'Connell, & Goran, 1995). Resting metabolic rate is associated with bodyweight changes due to its close correlation to fat free body mass (Byrne & Wilmore, 2001). It has been reported (Byrne & Wilmore, 2001) that exercise increased the metabolic rate and fat-free mass of previously sedentary, moderately obese women. However, resting metabolic rate was found to be unchanged following a 20 week endurance training program in male and female subjects, despite decreased body fat and increased fat free mass (Wilmore et al., 1998). Basal metabolic rate (BMR) appears to be lower in adults who reside in the tropics compared to more temperate climates (Henry &

Rees, 1992). However, this difference may be the result of reduced physical activity in hot and humid climates (Vallery-Masson, Bourliere, & Poitrenaud, 1980) as individuals of Asian origin living in temperate environments have higher metabolic rates compared to Asians living in the tropics (Henry, Piggot, & Emery, 1987).

Environmental or societal factors, such as extended time performing sedentary activities, are related to a greater prevalence of overweight and obesity in children (Harrell, Gansky, Bradley, & McMurray, 1997; Maffeis, Zaffanello, & Schutz, 1998) and adults (Brown, Miller, & Miller, 2003). Certainly, longer periods of television viewing are attributed to an increase in the rate of overweight and obese children (Robinson, 2001) and adults (Salmon, Bauman, Crawford, Timperio, & Owen, 2000). While overweight and obesity are multifactorial conditions (Martinez, Kearney, Kafatos, Paquet, & Martinez-Gonzalez, 1999), the principle cause is a decline in daily energy expenditure without a reduction in energy intake (Hill & Melanson, 1999), producing a positive energy balance.

Characteristics of the postmenopausal period

Weight gain is one of the physical factors associated with the postmenopausal period (Shangold & Sherman, 1998). Natural menopause is defined as 12 consecutive months of amenorrhea, while the postmenopausal period is the period of a woman's life following menopause (WHO, 1996). While many women report weight gain at this time, it has been suggested that BMI increases at a steady rate throughout life rather than accelerating in the perimenopausal period (Shangold & Sherman, 1998). The perimenopausal period refers to the period immediately before menopause (WHO, 1996). Historically, the redistribution of body fat to the abdominal region during the perimenopausal and postmenopausal periods has been attributed to the decline in oestrogen levels (Rebuffe-Scrive et al., 1987). However, a direct relationship has not been found between changes in fat distribution and climacteric changes (Blumel et al., 2001; Crawford, Casey, Avis, & McKinlay, 2000; Davies, Heaney, Recker, Barger-Lux, & Lappe, 2001; Singh, Haddad, Knutsen, & Fraser, 2001). The term climacteric refers to the years immediately before and after menopause (Shangold & Sherman, 1998). It appears that a reduction in physical activity at this time of life causes a decrease in muscle mass and a concomitant decrease in metabolic rate (Shangold & Sherman, 1998). Participation in regular exercise has been found to decline with age in women (Gallant & Dorn, 2001; Marcus, 1995; Sherwood & Jeffery, 2000). The level of both physical activity and exercise in the postmenopausal period is therefore a more significant predictor of abdominal fat compared to menopausal status or age (Kanaley et al., 2001).

Health risks associated with the postmenopausal period

The risk of CVD increases drastically in postmenopausal females due to adverse lipid and vascular changes induced by oestrogen deficiency (Shangold & Sherman, 1998). Decreased physical activity and dietary changes are also contributing factors (Gaspard, Buicu, & Creutz, 2001). In 1998, three women died every hour from CVD in Australia (NHF, 2000). More than 80% of women aged 55 years and over have at least one major modifiable risk factor for cardiovascular disease (NHF, 2000). Moderate intensity exercise however, may be cardioprotective in postmenopausal women (McKechnie, Rubenfire, & Mosca, 2001). Moreau et al., (2001) found that placing postmenopausal women on a 24-week walking program of 3 km/day was effective in reducing systolic blood pressure by 11 mmHg. Regular aerobic exercise has been found to have a positive effect on lipoprotein levels, namely increasing high-density lipoprotein (HDL) ratios (Taylor & Ward, 1993). A three year follow-up questionnaire found that women who reported regular exercise had a significantly reduced risk of death from CVDs (Kushi et al., 1997).

Health-related benefits of exercise for postmenopausal women

The physical and psychological health-related benefits of exercise for postmenopausal women are numerous. Exercise combined with an appropriate diet promotes a decrease in fat mass, an increase in lean body mass and metabolic rate (Gaspard et al., 2001) and improves muscle insulin sensitivity, thus lowering the risk of NIDDM (Campbell & Samaras, 2000). Regular exercise is associated with positive attitudes of social interaction, tension release (Rich & Rogers, 2001) and a better quality of life (Koltyn, 2001). Being physically active also lowers the risk of breast cancer (Thune, Brenn, Lund, & Gaard, 1997) and decreases the risk of early death (Grundy et al., 1999). Apart from the numerous physical health benefits (Asikainen, Kukkonen-Harjula, & Miilunpalo, 2004), regular exercise has also been found to have a positive effect on the psychological health of postmenopausal women (Pronk, Crouse, & Rohack, 1995).

Although a plethora of evidence is available regarding the health-related benefits of regular exercise for postmenopausal women (Campbell & Samaras, 2000; Gaspard et al., 2001; Campbell & Samaras, 2000; Wannamethee & Shaper, 2001), only 45.5% of Australian women aged 45-59 years are currently engaged in sufficient exercise for health (Armstrong, Bauman, & Davies, 2000). Sufficient exercise is defined as a minimum of 150 minutes of accumulated moderate-intensity activity per week (Department of Health and Aged Care [DHAC], 1999). Intervention programs have been offered to older adults (Svendsen, Hassager, & Christiansen, 1994; Treuth et al., 1995; Van Pelt et al., 1998), with exercise promoters focusing on physiological factors (eg. home-based versus gym-based programs, continuous versus intermittent activity, high-intensity versus low-intensity activity). However, despite these physiological interventions exercise adherence is poor. Exercise participation among Australians declined from 1997 to 1999, with 58% of Australians walking at least 3 times in the previous week compared to 54% in 1999 (Armstrong et al., 2000). Media campaigns focusing on educational factors have also fared poorly in increasing exercise adoption (Marcus, Selby, Niaura, & Rosi, 1992).

Over the past 20 years increasing importance has been placed on psychological factors associated with exercise adoption and adherence, particularly exercise self-efficacy (Sallis et al., 1986) and perceived barriers to exercise (Ball, Bauman, Leslie, & Owen, 2001). Understanding the psychological factors related to exercise participation and adherence is therefore necessary (Sheppard et al., 2003) for effective exercise programs aimed at improving postmenopausal womens' health (Nies & Kershaw, 2002).

Determinants and barriers to exercise for postmenopausal women

Promoting exercise in postmenopausal women should be a priority for the reduction of obesity-related diseases, however in order to succeed in achieving greater exercise levels in this population it is necessary to firstly understand the determinants of exercise behaviour. Determinants of exercise behaviour may influence exercise adoption in postmenopausal women and include personal characteristics, environmental factors, and psychological variables (Dishman, Sallis, & Orenstein, 1985; Marcus, 1995). A positive relationship exists between exercise levels and level of education (Bauman, Owen, & Rushworth, 1990; King et al., 1992; Marcus, 1995; Nies & Kershaw, 2002). Therefore, individuals with a higher education level are more likely to exercise. Body weight also has a strong association with exercise (Sherwood & Jeffery, 2000), whereby overweight and obese women are less likely to exercise compared to normal weight women (King et al., 1992). Women who perceive themselves as too fat are too shy and embarrassed to exercise (Ball, Crawford, & Owen, 2000).

Environmental factors include social support, discretionary time, exercise facility accessibility, cost of the exercise activity and safety (Marcus, 1995). Convenient facilities in pleasant and safe surroundings are important for both sexes (Ball et al., 2001). Social support is a strong determinant of exercise, particularly for women (Gallant & Dorn, 2001; Nies & Kershaw, 2002). Ball et al. (2001) reported that walking levels increased in women who walked in the company of a walking partner or pet. Women must have the support of their family to maintain an exercise program (Marcus, 1995), with greater adherence occurring if an individual undertakes exercise with their spouse (Wallace, Raglin, & Jastremski, 1995).

The type of exercise program can have a bearing on exercise adherence for postmenopausal women. Previous research is inconclusive as to whether home-based exercise programs are superior to supervised programs for enhancing exercise adherence. Comparable rates of participation have been found in home-based and group-based short-term exercise programs of less than one year (van der Bij, Laurant, & Wensing, 2002). However, higher exercise participation rates and adherence levels were found with obese women following 12 and 15 months of home-based exercise programs (Perri, Martin, Leermakers, Sears, & Notelovitz, 1997). Adherence rates were also better in home-based compared to group-based exercise programs among older adults (King et al., 1991).

Psychological variables including self-efficacy, self-motivation, perceived good health and benefits of exercise and exercise enjoyment, have been linked with higher levels of physical activity in women (Marcus, 1995). Exercise self-efficacy, or one's belief in successfully performing exercise, is thought to be the most consistent predictor of exercise behaviour and is important in the early stages of exercise (Sherwood & Jeffery, 2000). Self-efficacy influences the activities chosen, the effort expended and whether an individual will adhere to that activity (King et al., 1992). The activity chosen must be one that is enjoyable and easily mastered to ensure long-term adherence.

Similarly, prior exercise history can predict future exercise behaviour (Sherwood & Jeffery, 2000), such that negative experiences associated with prior exercise will reduce self-efficacy. How an individual responds to an acute exercise bout will have implications for future participation in that activity. Exercise-induced affect is influenced by many factors including individual physiological and psychological characteristics, the environment and the perceived attributes of the exercise bout (Ekkekakis & Petruzzello, 1999). Individuals with greater self-efficacy demonstrate more positive affective responses following an acute exercise bout (Bozoian, Rejeski, & McAuley, 1994; McAuley, Shaffer, & Rudolph, 1995; McAuley, Talbot, & Martinez, 1999).

Belief in the health benefits of exercise can affect the adoption of an exercise program for postmenopausal women (Dishman, Sallis & Orenstein, 1985; King et al., 1992). Individuals who perceive that they are in poor health will be more resistant to exercise participation (King et al., 1992). O'Brien Cousins (2000) found that sedentary postmenopausal women believed that exercise had the potential to do them harm. Furthermore, individuals who believe that exercise has little value for their health will exercise less or drop out earlier from exercise programs (Dishman et al., 1985). Yoshida, Allison and Osborn (1988) found women aged 40 years or more were less likely to exercise if they believed they did not need to. O'Brien Cousins (2001) also found that sedentary postmenopausal women believed exercise was not required if one was healthy.

A number of perceived barriers may prevent postmenopausal women from exercise participation. Environmental factors may play a part in exercise participation in the tropics. The nature of the tropical environment of North Queensland means that for a large percentage of the year it may be too hot and humid for some postmenopausal women to exercise outdoors (average temperature in winter is 25°C; average temperature in summer is 31°C (Townsville Enterprise, n.d.); average annual humidity is 75% (Australian Bureau of Meteorology, n.d.).

Heat balance in humans transpires from equal rates of heat production and heat loss. At rest in a thermoneutral environment, core temperature is maintained at approximately 37°C by alterations in skin bloodflow from vasomotor adjustments. During exercise however, vasomotor adjustments are accompanied by the initiation of other thermoregulatory effectors. Skin bloodflow increases from vasoconstriction inhibition and vasodilation activation to allow heat convection from the core to the skin for dissipation (Brooks et al., 1997). Earlier research has suggested that middle-aged (45-64 years) women are more heat-intolerant during exercise compared to younger women, however it is unclear whether this difference was age-related or due to other factors such as nutritional status, various disease states and medication effects (Pandolf, 1991). Indeed, heat-intolerance during exercise appears to be more related to lower cardiorespiratory fitness (Kenney, 1997). Cable and Green (1990) found sweat production rates were lower in middle-aged women compared to younger women during low-intensity exercise, however this age difference in sweat production rates is absent when women are matched for cardiorespiratory fitness (Drinkwater, Bedi, Louks, Roche, & Horvath, 1982).

It has also been found that Australian women are less likely to walk for exercise if the environment is less aesthetically pleasing (Ball et al., 2001). The external barrier of exercise facility accessibility may also reduce the likelihood of women engaging in walking (Ball et al., 2001). A 62% increase in the incidence of recreational walking occurred following environmental alterations to a municipal park in Queensland (Sly, Mummery, Humphries, & Reaburn, 1999). Alterations included upgrading of walking tracks, installation of water fountains, improved parking and street access. It is estimated that over 10,000 people visit the Strand, Townsville, every weekend since the foreshore was redeveloped in 1999 (Townsville City Council, n.d.). Amenities include a walkway, exercise stations, sea water pool, basketball court and open spaces suitable for active recreation. A study on the association between geographical proximity to the New South Wales coast and physical activity levels found that respondents were 27% more likely to report activity levels adequate for health if they lived in a coastal postcode. Fewer perceived barriers and greater exercise enjoyment were thought to increase exercise participation (Bauman, Smith, Stoker, Bellow, & Booth, 1999).

An additional barrier for postmenopausal women to adopt an exercise regime may be a lack of knowledge regarding the relationship between regular exercise and the reduction of obesity related diseases. Covington and Grisso (2001) found that obesity was more loosely defined by women when compared to standard height and weight guidelines. These women did not equate being ‘heavy’ with being fat.

A strong inverse relationship has been shown between education level and BMI among women (Molarius, Seidell, Sans, Tuomilehto, & Kuulasmaa, 2000; Nies & Kershaw, 2002). Individuals with a lower education level are more likely to have lower incomes (Bauman et al., 1990), and may therefore have limited access to information regarding overweight and obesity. A lack of knowledge regarding the frequency, intensity duration and mode of exercise required may also act as a barrier. It has been reported (Timperio, Cameron-Smith, Burns, Salmon, & Crawford, 2000) that women believed they should spend approximately 14 hours per week performing exercise. The authors also reported that women believed they should perform six walking sessions per week, as well as perform moderate-intensity activity (3.5 METS) and vigorous-intensity activity (9.0 METS) 5 times per week. This amount of activity would not be possible for most and could result in lower motivation for exercise. Strategies for promoting physical activity among postmenopausal women must therefore address these barriers in order to be successful (Bass & Crawford, 2000).

Exercise behaviour models

Various models exist to help predict exercise behaviour. Bandura’s (1977) Social Cognitive Theory of behaviour is based on one’s ability to regulate behaviour by setting goals, to monitor progress towards achieving these goals and to allow physical environments to support their goals. The theory proposes that one’s attitude towards a particular behaviour is gained from direct modelling through the observation of the behaviour within a social context and symbolic modelling through the observation of the behaviour portrayed in the media (Bandura, 1977). Self-efficacy, or one’s beliefs in his/her capabilities to execute a particular course of action to satisfy a situational demand, is the key construct within the social cognitive theory to explain behaviour. Outcome expectations, or the expected consequence of a successful behaviour performance, is another important construct within the social cognitive theory (Bandura, 1977). Factors said to influence self-efficacy and outcome expectancy include mastery experiences (behavioural), modelling (cognitive), verbal persuasion (social) and interpretation of emotional or psychological arousal (physiological) (Bandura, 1997).

Exercise self-efficacy is one's belief in their capabilities to successfully participate in exercise when faced with potential barriers (McAuley & Jacobson, 1991). Exercise self-efficacy is said to be influenced by past exercise experiences (McAuley, 1992b), generational circumstances (Branigan & O'Brien Cousins, 1995), instructor support (McAuley et al., 1999), the exercise environment (McAuley & Blissmer, 2000) and body weight (Sherwood & Jeffery, 2000). Exercise self-efficacy can be increased by developing interventions to enhance efficacy expectations, particularly that of performance mastery (Woodward & Berry, 2001).

The Transtheoretical (Stages of Change) Model (Prochaska & DiClemente, 1982) has also been used to understand exercise behaviour (Booth et al., 1993; Marcus et al., 1992; Rich & Rogers, 2001). The model proposes that individuals move through five stages of change sequentially when adopting a new behaviour (King et al., 1992). The stages consist of precontemplation, contemplation, preparation, action and maintenance (Baranowski, Cullen, Nicklas, Thompson, & Baranowski, 2003).

Researchers applying the Stages of Change Model to exercise describe the five stages as precontemplation (those not considering starting exercise); contemplation (considering initiating exercise in the next 6 months); preparation (taken steps to exercise but not regularly); action (those who are exercising regularly but only in the last 6 months) and maintenance (those who have been regularly exercising for longer than 6 months) (Marcus et al., 1992). Self-efficacy and decisional processes such as contingency management (adopting a healthy behaviour), helping relationships (interpersonal relationships that promote healthy behaviours), counter-conditioning (substitution of a healthy behaviour for an unhealthy behaviour) and stimulus control (removal of environmental cues that promote unhealthy behaviour) (Prochaska & Velicer, 1997) determine movement into the action and maintenance stages.

Cognitive and environmental intervention strategies must be tailored to each stage for increasing and maintaining physical activity (King et al., 1992). For example, Marcus et al., (1992) suggest that individuals in the precontemplation and contemplation stages may benefit from experiences designed to increase self-efficacy expectations. This approach has been successful in the adoption and adherence to a regular exercise program for older rural women in Australia (Rehor & McNeil, 1999).

The Health Belief Model (HBM) is another theoretical model that has been used to explain exercise behaviour. The HBM was originally developed in an attempt to explain and predict preventative health behaviours (Maiman & Becker, 1974). The primary constructs of the HBM are that four factors determine the likelihood an individual will take preventative action. These factors include perceived susceptibility (the degree to which an individual feels at risk of contracting a disease), perceived severity (the degree of threat the disease imposes), perceived benefits (of engaging in a particular behaviour) and perceived barriers (of engaging in a particular behaviour) (Baranowski, et al., 2003). Cues to action (external or internal triggers) and health motivation (a measure of one's desire to control the disease) were more recent additions to the HBM.

It is thought that individuals will have greater motivation to act if they perceive the threat of a disease and feel they are susceptible to a disease. They will also be more likely to act to reduce the threat of the disease if the perceived benefits outweigh the perceived costs of the health behaviour (Woodward & Berry, 2001). The HBM has been used to study various behaviours including smoking (Mullen, Hersey, & Iverson, 1987), diet (Humphries & Krummel, 1999), dental health (Ronis, 1992), HIV testing (Maguen, Armistead, & Kalichman, 2000) and breast self-examination (Champion, 1984).

The HBM has also been utilised to assess various aspects of exercise behaviour and proposes that adoption of exercise will be greater if an individual believes that the exercise will help prevent a perceived health threat (Woodward & Berry, 2001). Therefore, the model is seen to be more useful for those who view exercise as illness reducing (risk avoiding) rather than health-promoting (King et al., 1992). Perceived susceptibility and seriousness of contracting a disease, combined with the belief that the benefits will outweigh the costs (Rosenstock, 1974a), may not be enough to cause an individual to adopt an exercise regime. In order to change a sedentary individual's exercise beliefs, new factors or cues, must occur. A cue could be environmental, individual or personal. Examples of cues include a family member or friend starting an exercise regime, the opening of a fitness centre in the neighbourhood or an increase in leisure time (Uitenbroek, 1993b).

Affective responses to exercise are also thought to influence exercise behaviour. Psychological or mental health consists of both positive (psychological well-being) and negative (psychological distress) affective states (McAuley & Courneya, 1993). Exercise-induced affect literature (Gauvin & Brawley, 1993; Ekkekakis & Petruzzello, 2000) purports that an individual who partakes in an acute exercise bout producing enhanced positive affect and reduced negative affect would be more likely to adopt exercise practices in the future (Annesi, 2002).

The effect of moderate exercise bouts on improving psychological health has been well documented (Ekkekakis & Petruzzello, 1999). An acute exercise bout can reduce negative affective states such as anxiety, depression, anger and irritability (Leith & Taylor, 1990), and enhance positive outcomes such as psychological well-being (Cox, Thomas, Hinton & Donahue, 2006; Daley & Welch, 2004; McAuley et al., 1999) and positive engagement, revitalization and tranquillity (Annesi, 2002; Gauvin & Rejeski, 1993).

The Subjective Exercise Experiences Scale (SEES) (McAuley & Courneya, 1994) has been designed to measure the affective responses to an acute exercise bout. It is a 12-item, 3-dimensional scale measuring positive well-being, psychological distress and fatigue. Significant increases in positive well-being scores and decreases in psychological distress and fatigue scores were reported in younger (Daley & Welch, 2004) and middle-aged (McAuley & Courneya) women.

Increasing exercise participation rates in postmenopausal women

Despite numerous promotional campaigns, postmenopausal women's exercise participation rates remain low (Seefeldt, Malina & Clark, 2002; Wing, 1999), subsequently the question is whether exercise professionals are prescribing exercise strategies that are appropriate for this population. For postmenopausal women to maintain physically active lifestyles, intervention programs must be tailored to the individual (Van der Bij et al., 2002) accounting for level of fitness, allowing for personal control of both the activity and its outcomes, and providing social support (Seefeldt et al.). Intervention programs that reduce the barriers to exercise will in turn promote adherence and maintenance of better health practices (Seefeldt et al.; Woodard & Berry, 2001). A greater emphasis should be placed on easily achievable activities to overcome the embarrassment of participation (Ball et al., 2000) and to increase performance self-efficacy.

Intensity and mode of exercise must be considered when devising intervention programs (Sherwood & Jeffery, 2000). Establishing the appropriate mode and dose of exercise to elicit a positive affect for individuals may increase participation and adherence to exercise (Ekkekakis & Petruzzello, 1999). Lower intensity exercise is more commonly reported among women (Bauman et al., 1990; King et al., 1992), with walking the most popular mode of exercise (Sherwood & Jeffery, 2000). Walking is often promoted as a form of exercise for its convenience (Rippe & Hess, 1998) and cost effectiveness (Marcus, 1995). Recommending intermittent exercise, defined as multiple 10- to 15-minute bouts to accumulate 30-40 minutes per day (Jakicic et al., 2001), may encourage overweight postmenopausal women to participate in regular exercise. The recommendation of intermittent exercise may be particularly helpful for sedentary postmenopausal women who perceive barriers to participating in a continuous bout of exercise, defined as one long bout of exercise for a minimum of 20 minutes in one day (Jakicic et al., 2001). This strategy has been used with success in overweight women (Jakicic, Winters, Lang, & Wing, 1999).

Including behavioural strategies in an exercise intervention program improves long-term adherence (Jakicic et al., 2001). Intervention programs that incorporate self-regulatory skills help in the maintenance phase of a program (Woodward & Berry, 2001). These skills include self-monitoring of exercise behaviour, establishing exercise goals and developing supportive feedback systems (Woodward & Berry).

The decision to undertake regular exercise can be a difficult one for a previously sedentary postmenopausal woman, as behavioural changes are necessary for maintaining an active lifestyle. Knowledge of the exercise behavioural differences amongst postmenopausal women living in North Queensland may enable the development of strategies for exercise behavioural change in non-exercising postmenopausal women.

Statement of the research problem

As exercise has a positive effect on body composition and the subsequent health of postmenopausal females, an understanding of why exercise levels decline in this population is needed. In particular, understanding the difference in exercise behaviour characteristics of exercising and non-exercising postmenopausal women may encourage more non-exercising postmenopausal women to obtain the health benefits of exercise. An understanding of the exercise behaviour characteristics of exercising and non-exercising postmenopausal women may also provide information for future health promotion policy directions for this population and allow for the formulation of guidelines for exercise professionals. This study examined the exercise behaviour of postmenopausal women resident in North Queensland. Specifically, this study examined:

1. The personal characteristics of exercising and non-exercising postmenopausal women.
2. The exercise related physiological and psychological characteristics of exercising and non-exercising postmenopausal women.
3. The exercise self-efficacy of exercising and non-exercising postmenopausal women.
4. The barriers to exercise of exercising and non-exercising postmenopausal women.
5. The relationship between exercise self-efficacy and stages of exercise

change of postmenopausal women.

6. The health beliefs of exercising and non-exercising postmenopausal women.
7. The physiological and psychological responses of exercising and non-exercising postmenopausal women to an acute exercise bout.

Research hypotheses

For the purposes of this study it was hypothesised that:

1. Personal characteristics differ between exercising and non-exercising postmenopausal women.
2. Physiological and psychological characteristics discriminate between exercising and non-exercising postmenopausal women.
3. Non-exercising postmenopausal women have lower exercise self-efficacy compared to those who are exercisers.
4. Specific barriers to exercise discriminate between exercising and non-exercising postmenopausal women.
5. Postmenopausal women at different stages of change will differ in their level of exercise self-efficacy.
6. Individual health beliefs discriminate between exercising and non-exercising postmenopausal women.
7. The exercise behaviour of postmenopausal women will influence exercise induced affect.

Significance of the study

The life events of puberty and pregnancy have been identified for women as periods of increased risk of weight gain from hormonal and psychosocial changes.

Menopause is another significant life event with the subsequent postmenopausal period associated with weight gain and an increased incidence of cardiovascular disease. However exercise appears to be cardioprotective in postmenopausal women through attenuation of weight gain. Despite this evidence, many postmenopausal women do not engage in regular exercise. It appears that the life event of menopause can become a barrier or an opportunity for postmenopausal women to exercise, depending on their exercise behaviour characteristics.

There are numerous determinants of exercise, which may be viewed by some women as barriers to adopting exercise practices. Indeed, various barriers specific to postmenopausal women living in North Queensland may prohibit the initiation of a regular exercise regime. Exercise behaviour differences between exercising and non-exercising postmenopausal women have been previously investigated. However, whether these differences exist amongst postmenopausal women living in a North Queensland has yet to be determined. An understanding of exercise behaviour differences between exercising and non-exercising postmenopausal women may enable exercise professionals to incorporate strategies to encourage more postmenopausal women resident in North Queensland to undertake regular exercise.

The exercise self-efficacy, stage of exercise change, health beliefs and exercise-induced affective responses of postmenopausal women have been previously determined. Research on the psychological aspects of postmenopausal women in North Queensland however, remains largely unexplored. As exercise behaviour is multifaceted, a comprehensive perspective of exercise behaviour of this population is required.

Delimitations of the study

The findings of this research are delimited to:

1. The nature and location of the sample, namely postmenopausal women living in North Queensland.
2. The investigation of health beliefs and psychological characteristics of participants as they relate to exercise.
3. The specific exercise mode (cycle ergometer) and specific intensity (60% estimated VO_2max) for the measurement of exercise-induced affect.

Limitations of the study

Conclusions drawn from this research are limited by the following factors:

1. Non random selection of participants.
2. Self-reporting of exercise history.
3. Sample sizes.
4. Validity and reliability of measurement techniques.
5. Control of testing procedures.
6. The use of a recall questionnaire for the measurement of exercise behaviour.

Definition of terms

The following terms were relevant to this study:

1. Body mass index (BMI). An internationally accepted measurement for the classification of body weight, whereby weight in kilograms is divided by

height in metres squared.

2. Resting metabolic rate. The energy expended by an individual to maintain the integrated body systems and normal temperature at rest. This is typically taken in bed in the morning in a fasting state under comfortable, ambient conditions.
3. Postmenopausal period. The period of life for a woman following 12 months of amenorrhea.
4. Physical activity. Any bodily movement resulting in energy expenditure.
5. Exercise. Physical activity that is planned with the objective of enhancing physical fitness.
6. Regular exercise. Planned physical activity performed at an appropriate intensity and frequency to elicit improvements in physical fitness.
7. Moderate-intensity exercise. Planned physical activity performed at a level of 3-5 METS.
8. Lower-intensity exercise. Planned physical activity performed at the level of less than 3 METS
9. MET. A MET is the equivalent of resting energy expenditure, or 3.5ml/kg/min of oxygen consumption
10. Cardiovascular disease (CVD). A collective name encompassing a variety of chronic heart and blood vessel diseases.
11. Cardiovascular disease (CVD) risk factors. Certain behaviours, which increase the likelihood of suffering from CVD. Modifiable risk factors include smoking, overweight, physical inactivity and chronic hypertension.
12. Obesity-related disease. Chronic condition related to long term obesity.

Diseases include CVD, NIDDM, arthritis, breast cancer.

13. Metabolic syndrome. A combination of visceral or central obesity and the linked risk factors for coronary artery disease (CAD) and NIDDM (hypertension, dyslipidemia and hyperglycaemia).

14. Exercise behaviour. Behaviour characterised by participation in exercise.

15. Self-efficacy. An individual's belief in their capability to execute a course of action to satisfy situational demands.

16. Barriers to exercise. Objective and subjective obstacles thought to block exercise participation.

17. Exercise-induced affect. A psychological response, either positive or negative, to the stimulus of exercise.

18. Tropical environment. A geographical region with a mean temperature of 25ºC in winter and 31ºC in summer and a mean annual humidity range of 50-70%.

19. Exercise adoption. The initial stage of exercise when a sedentary individual begins an exercise regime.

20. Exercise adherence. Consistent performance of exercise over long periods of time.

21. Intermittent exercise. Short bouts of exercise performed at various times throughout one day. Typically these bouts consist of 10 minutes duration to accumulate a total of at least twenty minutes duration.

22. Continuous exercise. One long bout of exercise usually performed for at least 20 minutes in one day.

23. WHR. Waist to hip ratio is the waist measurement in centimetres divided by

the hip measurement in centimetres.

Summary

Physiological and psychological predictors have been used to explain exercise behaviour differences between exercising and non-exercising postmenopausal women. Whether these predictors apply to postmenopausal women living in North Queensland has not been considered.

The alarming levels of overweight and obesity in Australian postmenopausal women have been attributed to a decline in exercise participation rates. Obesity-related diseases such as CVD are particularly prevalent in postmenopausal women due to lipid and vascular changes associated with declining oestrogen levels.

However, participation in regular exercise can offer numerous health-related and psychological benefits for postmenopausal women. Despite these benefits, exercise participation rates in postmenopausal women remain poor. The determinants of exercise behaviour may act as barriers to non-exercising postmenopausal women living in North Queensland. Determinants include personal characteristics such as level of education, environmental factors such as climate, and psychological variables such as exercise self-efficacy.

The aim of this thesis was to investigate the exercise behaviour of postmenopausal women resident in the regional centres of North Queensland. Various models were utilised to help predict exercise behaviour differences in a sample of exercising and non-exercising postmenopausal women resident in North Queensland. Exercise behavioural models included the Social Cognitive theory of behaviour, the Health Belief Model, the Transtheoretical (Stages of Change) Model and Exercise-induced Affect.

Chapter 2

Literature review

Overweight and obesity

Prevalence of overweight and obesity

Overweight and obesity are defined as excessive accumulation of body fat (Schairer et al., 2002) and equate to a body mass index (BMI) of ≥ 25 kg/m^2 and <30 kg/m^2 for overweight and a BMI of ≥ 30 kg/m^2 for obese. Overweight and obesity affect over half of the adult population in industrialised countries, but is also rapidly increasing in developing countries (WHO, 2000). Prevalence of overweight and obesity vary according to gender, age, socio-economic status and race (Schairer, Levine, & Brawner, 2002). In Australia, almost two-thirds of the male and half of the female population are overweight or obese. These figures have increased significantly since 1989-90, with the prevalence increasing by 28% for overweight and 76% for obesity. Queensland has the highest rates of obesity in Australia with adults living in regional areas showing higher rates compared to those living in major cities (Australian Institute of Health and Welfare [AIHW], 2003).

The prevalence of obesity is greatest in the 50-60 year age group, with women more than twice as likely to be obese compared to women in the 20-24 year age group in 2001. Older Australians aged 55 year or more are approximately 6-7 kg heavier compared to the same age group 20 years ago. It has also been reported that Australians are continuing to gain weight well into their seventies (AIHW, 2003). A large study on Australian children and adolescents found that 19-23% were either overweight or obese. Cultural factors such as ethnicity influenced the results whereby more children of European or Middle Eastern background were overweight and obese compared to those of English-speaking or Asian background (Booth et al., 2001). Rates of overweight and obesity are also high amongst Aboriginal and Torres Straight Islander populations. Indigenous Australians living in non-remote areas exhibit double the rate of obesity compared to other non-indigenous Australians living in similar locations (AIHW, 2003).

An inverse relationship exists between socio-economic status and obesity, particularly for women. For example, the most disadvantaged women have double the rate of obesity compared to the most advantaged (AIHW, 2003). Women with higher education and resources have a greater chance of maintaining a healthy weight through cognitive efforts to manage bodyweight and appearance (Peters, Wyatt, Donahoo, & Hill, 2002).

Serious negative economic outcomes arise from overweight and obesity. Obese individuals are less likely to remain in the workforce and have higher health care costs (WHO, 2002). The financial costs of obesity and related diseases in Australia are estimated to be around $3.76 billion (Diabetes Australia, 2006). Australia is experiencing an accelerated aging of the population that is expected to continue for many decades. The number of older Australians aged 55 year or more was 4.2 million in 2001 and will reach 7.2 million in 2021. This trend coupled with the "obesity epidemic" has implications for medical and health care resources and the national health budget (AIHW, 2004).

Factors affecting overweight and obesity

The energy balance equation of energy stores equal energy intake minus energy expenditure has long been used to explain weight maintenance (Salbe & Ravussin, 2000). Significant weight gain occurs from a sustained imbalance between energy intake and energy expenditure, however energy balance is dynamic and can vary throughout a lifetime. Variability in energy balance is related to resting metabolic rate (RMR), thermogenesis and exercise. RMR is the amount of energy expended by an individual resting in bed in the morning in a fasting state and accounts for between 60-70% of daily energy expenditure. Thermogenesis is an increase in metabolic rate in response to various stimuli such as food intake, exposure to temperature extremes, psychological influences or from administration of drugs or hormones. The thermic effect of food accounts for approximately 5-15% of daily energy expenditure. Exercise is the most variable component of daily energy expenditure and in sedentary adults accounts for only 20-30% of total energy expenditure (Salbe & Ravussin). The causes of overweight and obesity are multifactorial and can affect the balance between energy intake and expenditure.

Factors affecting overweight and obesity can be broadly classified into metabolic, biological and behavioural. Metabolic factors include genetic, metabolic and endocrinal factors. Biological factors include race, gender, age and pregnancy status. Behavioural factors include exercise level, nutrition and socio-economic status. Genetic factors are thought to account for 25-70% of the variability in body fatness, although monozygotic twins show greater variability compared to the parent/child relationship (Hill & Melanson, 1999). High correlations have been found between BMIs of monozygotic twins reared apart and together (Stunkard, Harris, Pedersen, & McClearn, 1990). A strong relationship has also been found between the weight of adoptees and the BMIs of their biological parents (Stunkard et al., 1986). A study on 12 pairs of monozygotic twins found high within-pair similarity in weight gain following overfeeding (Bouchard et al., 1990). A genotype-environment effect exists whereby genetic factors lower the threshold for developing the disease. Consequently, the genetically susceptible individual will gain weight in a particular environment (Bouchard, 1997).

Obesity is associated with various genetic characteristics through their influence on metabolism. Defective genes have been found in obese patients resulting in the absence of leptin (Jackson et al., 1997). Leptin, a hormone secreted by adipose tissue, exerts its effects by decreasing food intake and bodyweight (Jeanrenaud & Rohner-Jeanrenaud, 2001). However, while plasma leptin concentrations have been found to be low in many groups, concentrations within the central nervous system (CNS) have remained stable, suggesting an obesity-related leptin resistance. This resistance may be from transport problems across the blood-brain barrier or with leptin-receptor sites in the CNS (Salbe & Ravussin, 2000).

Two CNS proteins, Neuropeptide Y (NPY) and Agouti Gene-Related Protein (AGRP), have been identified as modulators of food intake and energy expenditure in rats. Administration of NPY stimulates food intake and inhibits energy expenditure through its hypothalamic influence on the hormones insulin and corticosterone. Increased food intake also occurs in rats with AGRP administration.

AGRP exerts an antagonistic effect on α-melanocyte-stimulating hormone receptors in the hypothalamus and sympathetic nervous system (Jeanrenaud & Rohner-Jeanrenaud, 2001). These genetic defects in rats are thought to represent possible mechanisms for obesity in humans.

Alterations in lipid mobilisation and oxidation in skeletal muscle have been found in obese humans. Both long and medium-chain fatty acid oxidation is depressed in the skeletal muscle mitochondria of obese individuals (Kim, Hickner, Cortright, Dohm, and Houmard, 2000) and suggests a greater storage of intramuscular triglycerides. Lipid mobilisation is also thought to vary in the obese, depending on the site of adipose tissue (Horowitz, 2001). At rest, intra-abdominal adipocytes are sensitive to the stimulatory effect of catecholamines, while subcutaneous adipocytes in the abdominal and gluteal/femoral regions are sensitive to the antipolytic effect of insulin. Consequently, the release of fatty acids from intra-abdominal adipocytes into the bloodstream may be elevated as most fatty acids taken up by skeletal muscle for storage and oxidation are derived mainly from abdominal subcutaneous tissue (Horowitz, 2001).

Reduced metabolic rate is frequently offered as contributor to obesity (Goran & Weinsier, 2000), although previous studies have challenged this idea. For example, post-obese and never-obese postmenopausal women had similar resting metabolic rates (RMR), despite the post-obese women having regained the weight they had lost four years following the weight reduction program (Weinsier et al., 1995). In addition, an identical relationship between RMR and fat free mass has been shown to exist in genetically related people of West African origin living in very different environments (Luke et al., 2000). The results suggest that RMR is not influenced by environmental factors such as climate.

This result is in stark contrast to earlier studies on the RMR of people living in tropical and temperate regions. For example, the basal metabolic rate (BMR) of Asian individuals has been found to be lower in adults living in the tropics compared to those living in more temperate climates (Henry & Rees, 1992; Henry, Piggot, & Emery, 1987). This difference however, has been suggested as a result of reduced exercise in the hot and humid climates (Vallery-Masson, Bourliere, & Poitrenaud, 1980), particularly for those who were born in temperate climates but resided in a tropical region for an extended time.

Resting metabolic rate (RMR) has been found to be lower in both pre and postmenopausal women when compared to men (Arciero, Goran, & Poehlman, 1993; Carpenter, Poehlman, O'Connell, & Goran, 1995). However, while women have significantly lower metabolic rates compared to men on the basis of bodyweight, differences in metabolic rates are much smaller when BMR is adjusted for differences in fat-free mass (FFM) (Arciero et al., 1993; Ferraro et al., 1992). It seems that RMR is influenced more so by FFM of the body rather than from higher adiposity (Byrne & Wilmore, 2001). This view is supported by the literature (Carpenter et al., 1995; Goran & Weinsier, 2000; Luke et al., 2000).

The literature also differs on the relationship between metabolic rate (MR) and exercise. MR and free-fat mass increased following a resistance training exercise program in previously sedentary, moderately obese women (Byrne & Wilmore, 2001). However, no change in RMR was found following a 20 week endurance training program in male and female subjects, despite decreased body fat and increased fat free mass (Wilmore et al., 1998). Similarly, in a 4-year follow-up study Weinsier et al. (1995) found a significant difference in the amount of weight regained between post-obese and never-obese women with similar MRs. An average weight regain of 1.7 kg occurred in the never-obese women who had exercised regularly compared to the post-obese women who had not exercised regularly and who had regained an average of 10.9 kg. It was therefore suggested that physical inactivity was the predictor of greater weight regain (Weinsier et al., 1995).

Environmental or societal factors, such as extended time performing sedentary activities, have been blamed for the greater prevalence of overweight and obesity in a number of cohorts. Sedentary behaviours such as extended periods of television viewing are associated with overweight and obesity in women (Hu, Li, Colditz, Willett, & Manson, 2003), Australian adults (Salmon et al., 2000) and children (Robinson, 2001). Compared with other sedentary activities, television viewing results in a lower MR. In contrast, incidental activities such as performing household work and brisk walking are associated with a significantly lower risk of obesity. Mechanisms driving the positive association between television viewing and obesity levels include the displacement of exercise and the increase in energy intake whilst watching television (Hu et al., 2003).

Health risks associated with overweight and obesity

Overweight and obesity are associated with increased risk of death, morbidity and the accelerated effects of aging (Roth, Qiang, Marban, Redelt, & Lowell, 2004). Several chronic diseases including cardiovascular disease, non-insulin dependent diabetes mellitus (NIDDM), hypertension, breast, prostate and endometrial cancer, gallbladder disease, musculoskeletal disorders and respiratory problems have also been linked to overweight and obesity (WHO, 2000). A strong relationship exists between body fat distribution and co-morbidities, with central obesity posing the greater health risk (Bouchard, 2000). Central obesity increases insulin resistance (Bray, 2000), as adipocytes in this region are more sensitive to catecholamines. The resulting elevated levels of fatty-acid release from intra-abdominal adipose tissue is thought to be responsible for cardiovascular and metabolic disorders in the centrally obese (Horowitz, 2001). Hyperinsulinemia is also associated with obesity. As BMI increases, so to does the secretion of insulin. Hyperinsulinemia results in increased hepatic VLDL synthesis and secretion. In addition, an inverse relationship exists between BMI and HDL cholesterol (Bray, 2000). Dyslipidemia may therefore also play an important role in the relationship between BMI and heart disease.

The strong relationship between central obesity and the linked risk factors for coronary artery disease and NIDDM (hypertension, dyslipidemia and hyperglycaemia) is termed the metabolic syndrome (Meigs, 2003). Each of the components of the metabolic syndrome is a risk factor for cardiovascular disease however when combined, the risk is much greater (Alebiosu & Odusan, 2004). Central obesity is thought to be an important determinant of the metabolic syndrome (Carr et al., 2004).

Menopause and the postmenopausal period

Characteristics of the postmenopausal period

Natural menopause is defined as 12 consecutive months of amenorrhea (WHO, 1996). The postmenopausal period is therefore the period of a woman's life following menopause. Women approaching menopause will experience a gradual rise in serum follicle stimulating hormone and luteinizing hormone with a fall in oestrogen levels and subsequent diminishment in ovarian function. The climacteric is the 2-3 year interval following the final menstrual period and is characterised by endocrine symptoms such as intermittent hot flushes and bleeding irregularities and nervous system symptoms such as insomnia, fluctuation in mood and depression (Poehlman, 2002).

The average age at which menopause occurs is 50 years (Notelovitz, 1989). Average life expectancy for women in Queensland is 82 years (Australian Bureau of Statistics, 2003), which leaves a considerable time for individuals to spend living in the postmenopausal state. To ensure time spent in this period is free from various disabilities, women must adopt both a healthy premenopausal and postmenopausal lifestyle (Poehlman, 2002).

Weight gain is associated with the postmenopausal period (Shangold & Sherman, 1998). While many women report weight gain at this time, it has been suggested that BMI increases at a steady rate with age rather than accelerating in the perimenopausal period (Blumel, Castelo-Branco, Rocangliolo, Bifa, Tacla, & Mamani, 2001; Davies, Heaney, Recker, Barger-Lux, & Lappe, 2001; Shangold & Sherman, 1998). It appears that a reduction in activity at this time of life causes a decrease in muscle mass and a concomitant decrease in metabolic rate (Shangold & Sherman, 1998). Poehlman, Toth and Gardner (1995) conducted a longitudinal study on 35 premenopausal women over a 6-year period and during that time 18 of the premenopausal women became naturally postmenopausal. These women reported a decrease in exercise equivalent to 130 kcal per day compared to those age-matched women who had remained premenopausal. As participation in regular exercise has been found to decline with age in women (Gallant & Dorn, 2001; Marcus, 1995; Sherwood & Jeffery, 2000), the level of exercise in the postmenopausal period may be a more significant predictor of abdominal fat compared to menopausal status or age (Kanaley et al., 2001; Matthews et al., 2001).

Historically, the redistribution of body fat to the abdominal region during the perimenopausal and postmenopausal periods has been attributed to the decline in oestrogen levels (Rebuffe-Scrive et al., 1987). However, no direct relationship has been found between changes in fat distribution and climacteric changes (Bass & Crawford, 2000; Blumel et al., 2001; Davies et al., 2001; Singh, Haddad, Knutsen, & Fraser, 2001). It appears that oestrogen deficiency may be only partly responsible for inducing a central distribution of body fat. Rather, the level of exercise can account for the variability in central body fat in early postmenopausal women (Kanaley et al., 2001). High levels of exercise have been found to lower central fat levels in postmenopausal women (Astrup, 1999).

A belief exists among postmenopausal women that hormone replacement therapy (HRT) following menopause causes weight gain (Anderson et al., 2001; Espeland, et al., 1997; Simkin-Silverman & Wing, 2000), despite the evidence that weight gain is associated more with age-related changes (Blumel et al., 2001) and declining exercise levels (Crawford, Casey, Avis & McKinlay, 2000; Matthews et al., 2001). No differences in BMI, fat mass or WHR were found between postmenopausal women taking HRT and those who were not, however energy expenditure was lower in the older women (Anderson et al., 2001). Exercise was also more strongly associated with weight gain compared to HRT use in postmenopausal women participating in the Massachusetts Women's Health Study (Crawford et al., 2000), and sedentary postmenopausal women undertaking a 12-month resistance and aerobic exercise program (Figueroa et al., 2003).

Health risks associated with the postmenopausal period

The risk of coronary artery disease increases dramatically in postmenopausal women (Odgerel, Han, Yang, & Mao, 2007). In 1998, three women died every hour from cardiovascular disease in Australia (NHF, 2000), while more than 80% of women aged 55 years and over have at least one major modifiable risk factor for cardiovascular disease (NHF). Women who experienced natural menopause have a greater decline in high-density lipoproteins and greater increase in low-density lipoproteins and fasting triglycerides (Astrup, 1999; Hunter et al., 1996). As WHR increases during the transition from the premenopausal to postmenopausal periods, it has been suggested that these changes in concentration of plasma lipids are associated with metabolic syndrome risk factors that accompany central obesity (Poehlman, 2002).

Moderate intensity exercise however, may be cardioprotective in postmenopausal women (McKechnie, Rubenfire, & Mosca, 2001). Moreau et al., (2001) placed 24 postmenopausal women on a 24-week walking program of 3 km per day. Systolic blood pressure was reduced by 11 mmHg compared to postmenopausal women who did not partake in the program. Similarly, a 3-year follow-up questionnaire determined that women who reported engaging in regular exercise had a significantly reduced risk of death from cardiovascular diseases (Kushi et al., 1997). Regular aerobic exercise also has a positive effect on lipoprotein levels, namely increasing HDL ratios (Taylor & Ward, 1993). A 15-year longitudinal study found that daily exercise was positively related to HDL levels and inversely related to cholesterol levels, thereby enhancing cardiovascular health (Twisk, Kemper, & van Mechelen, 2000). More importantly, exercise is associated with lower levels of intra-abdominal fat in postmenopausal women (Astrup, 1999; Hunter et al., 1996; Van Pelt et al., 1998) thus reducing the health risk for this population (Ross & Katzmarzyk, 2003). Irwin et al. (2003) found that previously sedentary postmenopausal women who had performed a 12 month program of moderate-intensity exercise, 5 days per week had significantly reduced body weight, total body fat and intra-abdominal fat. The authors found that those women who exercised for more than 195 minutes per week lost 6.9% of intraabdominal fat, whilst the women who exercised 136-195 minutes per week lost 5.9% (Irwin et al., 2003).

Decreased RMR and fat-free mass coupled with declining levels of exercise results in a positive energy balance in postmenopausal women. This energy imbalance will increase body fat and may produce a decline in insulin sensitivity and subsequent increased risk of NIDDM (Poehlman, 2002). Postmenopausal women have been found to have reduced RMR and exercise levels and greater FFM, WHR and fasting insulin levels compared to premenopausal women (Poehlman, Toth, & Gardner, 1995).

The transition to the postmenopausal state is also marked by reduced lipid oxidation, which may also promote an increase in body fat. This reduced lipid oxidation is a result of decreased FFM (Poehlman, 2000). Exercise however has been shown to increase lipid oxidation in postmenopausal women (Poehlman, Gardner, Arciero, Goran, & Calles-Escandon, 1994) and insulin-like growth factor in older individuals (Poehlman, Rosen, & Copeland, 1994). Additionally, no differences have been found in body fat percentage and FFM between young female athletes aged 18-29 years and female athletes aged 50-69 years (Ryan, Nicklas, & Elahi, 1996). These findings would suggest that exercise should be an important component of a postmenopausal woman's life for the reduction of obesity-related comorbidities.

Exercise

Prevalence of exercise participation in Australia

Despite the plethora of evidence that exists on the benefits of exercise, many individuals do not participate in any form of regular exercise. An Australian Institute of Health and Welfare (2000) survey found that 75% of the population performed no moderate-intensity exercise in the previous week. The survey also found that less than half of adult women participated in exercise sufficient for their health. For example, only 36% of women performed five or more walking sessions in the previous week (AIHW). A New South Wales survey found 48% of women aged between 45-59 years did not walk for exercise of at least 10 minutes continuous duration over the previous two weeks. Similarly, 50% of women in the same age group did not participate in any moderate-intensity activity such as lawn bowls and gardening (Bauman, 1997).

The long standing exercise recommendation that adults should accumulate at least 30 minutes of moderate-intensity exercise on all or most days was issued by the American College of Sports Medicine (ACSM) and the Centres for Disease Control and Prevention (CDC) (Pate et al., 1995) to encourage greater exercise participation among North Americans. In 2007, the ACSM and the American Heart Association (AHA) issued an update of the 1995 recommendations (Haskell et al., 2007). It was recommended that moderate-intensity aerobic activity, equivalent to a brisk walk, should be performed five days per week for a minimum of 30 minutes. The 30 minutes of exercise can be accumulated by performing bouts of 10 minutes or more. The Surgeon General's (1996) report on exercise and health recommended that a moderate level of activity will produce demonstrated health benefits (U.S Department of Health and Human Services, 1996). In line with the ACSM recommendation, the National Exercise Guidelines for Australians (1999) recommended that a minimum of 150 minutes of accumulated moderate-intensity activity be performed per week (Department of Health and Aged Care [DHAC], 1999). Moderate-intensity activity equates to activity between 3-5 METS. A MET is 'the ratio of the associated metabolic rate for the specific activity divided by the resting metabolic rate' (Ainsworth et al., 1993, p. 72). One MET is equivalent to resting energy expenditure, or 3.5ml/kg/min of oxygen consumption (Welk, 2002).

Health-related benefits of exercise for postmenopausal women

The multiple benefits of engaging in regular exercise have been well documented. Regular exercise promotes decreased fat mass, increased lean body mass and metabolic rate (Gaspard et al., 2001) and improved muscle insulin sensitivity, thus lowering the risk of NIDDM (Campbell & Samaras, 2000). It is also associated with primary and secondary prevention of CHD and stroke (Wannamethee & Shaper, 2001). Svendsen, Hassager and Christiansen (1994) found that a reduction in weight and fat tissue mass and an increase in resting metabolic rate occurred in postmenopausal women following 6 months of combined aerobic and resistance exercise. Treuth et al. (1995) also found that a 16-week strength program produced significant reductions in intra-abdominal adipose tissue in older women. Additionally, Van Pelt et al., (1998) found that pre and postmenopausal runners who regularly engaged in vigorous endurance exercise did not gain body weight or a significant increase in central fat with age. However, moderate intensity exercise such as walking can result in similar reductions in weight loss as more vigorous exercise. Jakicic, Marcus, Gallagher, Napolitano & Lang (2003) randomly assigned premenopausal, overweight women to a vigorous intensity/high duration, moderate intensity/high duration, moderate intensity/ moderate duration or vigorous intensity/moderate duration exercise group for 12 months. While weight loss occurred in participants, no significant between-group differences were found. Cardiorespiratory fitness levels also increased (Jakicic et al., 2003).

In addition to weight loss, regular moderate intensity exercise has also been found to reduce coronary and total cardiovascular events in postmenopausal women (Manson et al., 2002). Similar reductions in cardiovascular events were seen in postmenopausal women who reported either walking or vigorous exercise (Manson et al.). Moderate intensity exercise can produce similar physiological responses in both pre- and postmenopausal women. Responses such as changes in body composition and cardiorespiratory endurance were seen in pre- and postmenopausal women during a progressive walking program (Cowan & Gregory, 1985).

Exercise increases muscle oxidative capacity thereby increasing lipid oxidation without increasing plasma FFA availability (Mittendorfer, Horowitz, & Klein, 2002). Exercise would therefore be beneficial for postmenopausal women as lipid oxidation is depressed in these individuals (Poehlman, 2000). During 90 minutes of moderate-intensity cycle ergometer exercise, premenopausal women had a greater contribution from plasma FFA to total fatty acid oxidation compared to men. This increase of plasma FA availability resulted in a greater rate of plasma FFA tissue uptake & oxidation in the female participants. The researchers concluded that adipose tissue triglyceride lipolysis is greater in women compared to men during moderate-intensity exercise (Mittendorfer et al.). During the 90-minute moderate-intensity exercise, plasma catecholamine concentrations increased while plasma insulin concentrations decreased. The performance of regular moderate-intensity exercise by postmenopausal women is therefore necessary to attenuate the process of reduced fat oxidation. Particularly as reduced fat oxidation is linked with central obesity and associated metabolic syndrome in postmenopausal women (Poehlman, 2002).

Previous researchers have found plasma fatty acid uptake and oxidation to be impaired in women with central obesity (Colberg, Simoneau, Thaete, & Kelley, 1995; Horowitz & Klein, 2000a). This impairment is thought to be due to a decreased response to catecholamines at rest. If catecholamine concentration is not blunted during exercise, it may increase triglyceride lipolysis of intra-abdominal adipocytes for uptake and oxidation by muscles. This finding is important, as elevated levels of fatty-acid released from intra-abdominal adipose tissue is associated with cardiovascular and metabolic disorders in the centrally obese (Horowitz, 2001).

Horowitz & Klein (2000b) found that centrally obese premenopausal women oxidised a greater amount of fat during moderate-intensity exercise compared to lean women. This increased fat oxidation was thought to result from an increase in the use of nonplasma fatty acids derived from lipolysis of intramuscular triglycerides (IMTG). It was proposed that as IMTG concentration was directly associated with insulin-resistant glucose metabolism, a decrease in IMTGs would enhance insulin sensitivity and decrease the risk of NIDDM for this population (Horowitz & Klein, 2000b). Therefore, it would appear that a major benefit of exercise for centrally obese women is increased FA oxidation from plasma and nonplasma triglycerides.

Being physically active also lowers the risk of breast cancer in postmenopausal women. Thune, Brenn, Lund and Gaard (1997) administered health surveys and exercise questionnaires to over 25,000 pre and postmenopausal Scandinavian women. An inverse dose-response relationship was found between exercise and the risk of breast cancer, whereby the relative risk of developing breast cancer decreased as the level of exercise increased. This finding was particularly so for younger postmenopausal women (Thune et al.).

Regular exercise can also assist in relieving the psychological symptoms of menopause. Dennerstein, Smith and Morse (1994) conducted interviews on Australian women aged 45-55 years to determine whether psychological well-being at mid-life was related to menopausal status. Exercise, rather than menopausal status, was found to be significantly related to well-being. The authors concluded that the psychological well-being of middle-aged Australian women was related to lifestyle factors such as exercise rather than endocrine changes. Elavsky and McAuley (2005) also found middle-aged exercising women to have higher psychological well-being and less severe vasomotor and general somatic menopausal symptoms. A significant relationship was also found between exercise and psychological symptoms, depression, anxiety and somatic symptoms in postmenopausal women who took part in the Queensland Midlife Women Health Study (Mirzaiinjmabadi, Anderson, & Barnes, 2006).

Menopausal symptoms can also be relieved with an acute exercise bout. Vasomotor symptom reduction occurred in postmenopausal women immediately following participation in an aerobics class (Slaven & Lee, 1997). Menopausal symptoms can impact greatly on a woman's quality of life well into the postmenopausal years. Therefore, promotion of regular exercise for this population is recommended as a non-pharmacological intervention for alleviating the symptoms of menopause (Mirzaiinjmabadi et al., 2006).

Regular exercise also decreases the risk of early death through respiratory and cardiovascular causes (Kushi et al., 1997). In their review of 24 prospective studies, Blair and Brodney (1999) found that women with high cardiorespiratory fitness had lower all-cause mortality rates compared to unfit women in the BMI categories of normal weight and overweight. Furthermore, Grundy et al., (1999) conducted an evidence-based review of prospective studies on exercise and obesity. The review revealed similar results to Blair and Brodney (1999), whereby individuals who were physically active reduced the risk of developing obesity-related chronic diseases and the risk of early death. The authors also found that exercising postmenopausal women had lower central fat compared to non-exercising women. As central obesity poses a greater risk of early death for postmenopausal women due to its strong association with co-morbidities (Bouchard, 2000), it is imperative that this population participate in regular exercise.

A more recent study found that walking at least 2 hours per week produced a 39% lower all-cause mortality rate and a 34% lower cardiovascular mortality rate in adults with diabetes (Gregg, Gerzoff, Caspersen, Williamson, & Venkat Narayan, 2003). A study conducted on a large cohort of postmenopausal women also found that higher levels of exercise reduced the risk of death. Increasing the frequency of moderate-intensity activity such as walking and vigorous-intensity activity such as jogging decreased the risk of death. However, women who participated in only one moderate-intensity activity exercise session per week decreased their mortality risk. These associations were most relevant for cardiovascular diseases (Kushi et al., 1997).

Regular exercise pertains to positive attitudes of social interaction, tension release (Rich & Rogers, 2001) and a better quality of life (Koltyn, 2001). Middle-aged Australian women who exercised regularly have been found to have more positive moods, less somatic symptoms and memory-concentration difficulties following acute and chronic bouts of exercise (Slaven & Lee, 1997). Postmenopaual women were evaluated for the effect of exercise on quality of life following a 6-week sub-maximal exercise program (Teoman, Ozcan, & Acar, 2003). Significant decreases were found in Borg's (1970) Rating of Perceived Exertion (RPE) scale following a

6-minute walk test. Quality of life was evaluated using the Nottingham Health Profile (NHP) and included the sub-sections of physical mobility, pain, sleep, energy, social isolation and emotional reactions. Significant decreases in all items of the NHP indicated that quality of life had improved (Teoman et al., 2003).

Exercise has also been shown to have a positive effect on psychological illnesses such as reducing anxiety and depression (Arent, Landers, & Etnier, 2000; Ekkekakis & Petruzzello, 1999; Harris, Cronkite, & Moos, 2006) and in ameliorating the comorbidities prompted by chronic stress (Tsatsoulis & Fountoulakis, 2006). Brown et al., (2005) examined the relationship between exercise and depressive symptoms in middle-aged Australian women. Results revealed an inverse association between exercise and depressive symptoms, with women who had participated in 60 minutes or more of moderate-intensity exercise per week reporting less depressive symptoms.

Regular exercise can also improve mood (Arent et al., 2000) and enhance self-esteem (Rejeski, Focht, & Messier, 2002). Improvements in psychological well-being have also been found in postmenopausal women participating in moderate intensity exercise (Asbury, Chandrruangphen, & Collins, 2006; Brockie, 2006). Previously inactive postmenopausal women participated in a 6 week moderate-intensity walking program. The SF-36 and Hospital Anxiety and Depression Scale were completed prior to and following intervention. Psychological well-being and depression improved significantly following the program (Asbury et al.).

As the health-related benefits of regular exercise for postmenopausal women are numerous (Espeland et al., 1997; Treuth et al., 1995; Van Pelt et al., 1998), the question remains as to why postmenopausal women remain sedentary. A possible explanation could be the promotion of exercise participation as a mechanism for the prevention of disease, thus implying that exercise is an obligatory activity.

Exercise promotional campaigns in Australia have traditionally based exercise prescription on the physiological aspects of frequency, intensity, time and type. These campaigns suggest that exercise is perceived as an unpleasant experience only to be performed for gaining physical health benefits. It is little wonder that these campaigns have proved to be unsuccessful for sustaining exercise participation levels (Wankel, 1985). For example, the Australian Sports Commission conducted an exercise, recreation and sport survey in 2001 and found that 14.8% of females aged 45-54; 15.9% of 55-64 & 11.4% aged 65 years and over were participating in fitness, leisure or indoor sports centre activities. This was compared to 30.4% aged 15-24; 26.8% aged 25-34 & 21.2% aged 35-44 years (ASC, 2001). This reduction in participation levels may be due to the reluctance of older women to exercise under these conditions. An understanding of the psychological reasons why exercise participation levels are declining in older women is therefore needed.

Determinants and barriers to exercise for postmenopausal women

Several factors have been found to influence individual decisions to participate in exercise (Bauman, Owen, & Rushworth, 1990; Seefeldt, Malina, & Clark, 2002;

Woodard & Berry, 2001). Determinants of exercise behaviour can be categorized into personal characteristics, environmental factors, and psychological variables (Dishman et al., 1985; Marcus, 1995). These determinants can act as barriers to postmenopausal women contemplating exercise adoption. Indeed, sedentary older women have been found to perceive that exercise provides more risks than benefits (O'Brien Cousins, 2000).

Barriers constantly challenge individuals who adopt and maintain exercise as part of their lifestyle. Barriers include age, state of health, socio-economic status, geographical considerations and social and physical environments (Seefeldt et al., 2002). For intervention programs to prove successful, each of these barriers must be addressed. Within the barrier of age are obstacles such as illness, injury, physical disability (Seefeldt et al.) and salient elements (eg. perception of being strong, fit or an attractive body) (Fox & Corbin, 1989). Placing value or significance on the salient aspects of exercise, such as being perceived as fit or having an attractive body is thought to increase the likelihood of participation (Fox & Corbin). Negative self-presentation can be a barrier to exercise.

Older adults are sensitive to the health-related physical changes accompanying aging if these changes make them feel dependent and inept. The perception that only younger individuals participate in exercise can also act as an obstacle for the older adult (Seefeldt et al., 2002). This is particularly so for women with the proportion participating in regular exercise declining with age (King et al., 1992). The media reinforce these perceptions with depictions of slender young individuals participating in exercise (Dunlap & Barry, 1999). However it is important for this population to engage in regular exercise, as impaired function has been linked to inactivity in older women (Ensrud et al., 1994).

Socio-economic factors also influence exercise participation. Income level has been found to be an important determinant of exercise participation level, whereby those on lower incomes participate in less exercise in both the United States (Parks, Housemann & Brownson, 2003) and Australia (Bauman et al., 1990). Owen and Bauman (1992) found education level and income to be significant predictors of exercise levels in Australian adults. Participants who had not completed high school and were on lower incomes were less active compared to participants who had completed tertiary education (Owen & Bauman, 1992).

A strong inverse relationship between education level and BMI has been found for women (Molarius, Seidell, Sans, Tuomilehto, & Kuulasmaa, 2000; Nies & Kershaw, 2002). It has been suggested that women with higher education and socio-economic status will be able to maintain a healthy weight through cognitive efforts to manage physical appearance (Peters, Wyatt, Donahoo, & Hill, 2002). Savage, Bailey and O'Connell (2003) found a strong link existed between socio-economic status and health of people living in metropolitan, regional and rural settings in Australia. Six thousand participants from the Barwon and Otway regions of Victoria were surveyed on their level of community involvement and health status. The authors found that participants residing in cities or large country towns of more than 20,000 residents exercised more than participants residing in small country towns.

Similarly, an earlier study by Bauman et al. (1990) found that higher levels of exercise participation were reported by residents of Australian capital cities compared to towns of 10,000-50,000. Income level may therefore be linked with geographical location of residence. Therefore, residents living in metropolitan areas may have higher income levels and greater ability to afford access to commercial exercise facilities and information regarding exercise prescription. Indeed, research by Baum and associates (2000) indicated that Australians attending exercise classes or fitness centres had a higher educational and socioeconomic status. People living in smaller country towns may find the cost of supervised exercise prohibitive, thus denying access to instructional information on exercise prescription (Bauman et al.).

A lack of knowledge regarding the importance of regular exercise for the reduction of obesity related diseases may prevent postmenopausal women from exercise participation. Covington and Grisso (2001) found that obesity was more loosely defined by women when compared to standard height and weight guidelines. These women did not equate being heavy with being fat (Covington & Grisso). Similarly, no significant association was found between being too fat and poor health as barriers to exercise amongst Australian adults (Ball et al., 2000). If postmenopausal women are not aware that they are overweight and at risk of developing an obesity-related disease, it may not occur to them that regular exercise is necessary.

A lack of knowledge regarding the appropriate frequency, intensity, duration and mode of exercise may also act as a barrier to exercise. An Australian study explored the exercise beliefs of individuals attempting to lose weight (Timperio, Cameron-

Smith, Burns, Salmon, & Crawford, 2000). Female participants believed they should spend approximately 14 hours per week participating in exercise incorporating 6 walking sessions per week, 5 moderate-intensity activity (3.5 METS) and 5 high-intensity activity (9.0 METS) sessions per week. This amount of activity would not be possible for most women and could result in lower exercise motivation. Postmenopausal women may feel that high-intensity exercise is the only beneficial form of exercise and do not recognise the value of moderate-intensity exercise such as walking.

A higher education level may provide women with the skills needed to facilitate appropriate exercise prescription (Baum et al., 2000). Building awareness and knowledge of the value of exercise into structured environments such as schools, workplaces and community facilities would enable a greater opportunity for exercise to become an integral part of a postmenopausal woman's lifestyle (Peters et al., 2002; Swinburn & Egger, 2002).

Knowledge of the physiological and psychological aspects of exercise prescription may give postmenopausal women the confidence to exercise in an unsupervised setting. In a review of the effectiveness of 57 exercise interventions for older adults, Van der Bij, Laurant and Wensing (2002) found home-based exercise programs to have comparable participation rates with group-based exercise programs of 1 year duration when information on the benefits of exercise were given. Moreover, Perri and associates (1997) found higher exercise participation rates and adherence levels with obese women following 12 and 15 months of home-based exercise programs

(Perri, Martin, Leermakers, Sears, & Notelovitz, 1997). The authors cited greater convenience and flexibility of home-based programs as reasons for the higher participation rates in the women.

A national blueprint for increasing exercise levels in North American adults aged 50 years and older was designed in response to the growing body of evidence that exercise offers many health-related benefits (Sheppard et al., 2003). The blueprint recommended that community organisations were provided with evidence-based guidelines on the type and amount of exercise required for improved health and functional outcomes. The authors also recommended the development of effective partnerships among community groups, agencies and services for resource guides on culturally appropriate exercise information. Implementation of these strategies was thought to overcome some of the barriers to exercise experienced by middle-aged and older adults (Sheppard et al.). The strategies as outlined for middle-aged and older American adults could be equally applied to postmenopausal women residing in North Queensland.

The likelihood of exercise participation increases with the number of exercise facilities available for urban and rural women (Parks et al., 2003). The external barrier of exercise facility accessibility may reduce the likelihood of older women walking for exercise (Ball et al., 2001). A 62% increase in the incidence of recreational walking occurred following improved infrastructure to a municipal park in Queensland (Sly, Mummery, Humphries, & Reaburn, 1999). The alterations included upgrading of walking tracks, installation of water fountains, improved parking and street access. A study to determine the relationship between walking tracks and walking patterns of rural residents in the United States found that the introduction of walking tracks was particularly successful in increasing exercise participation in women (Brownson et al., 2000).

It is estimated that over 10,000 people visit the Strand, Townsville, every weekend since the foreshore was redeveloped in 1999 (Townsville City Council, n.d.). Upgraded amenities included a walkway, exercise stations, rock pool, open space and basketball court. Moreover, a strategic plan for the prevention of overweight and obesity has suggested providing a comprehensive system of bike paths in all towns in Australia (NHMRC, 1996).

While greater exercise facility accessibility has been associated with an increase in exercise participation, exercise facility aesthetics may also be a determinant for exercise in postmenopausal women. Environmental aesthetics have been shown to influence exercise in women. Australian women were less likely to walk for exercise if the environment was not aesthetically pleasing (Ball, Bauman, Leslie, & Owen, 2001). Interestingly, a study conducted on residents in Perth, Western Australia found that while residents living in low socio-economic status areas had greater spatial access to exercise facilities, they perceived that their neighbourhood was less attractive for walking (Giles-Corti & Donovan, 2002a).

The physical environment directly impacts on exercise adoption such that geographical considerations often create a barrier to exercise participation. Parks et al. (2003) found rural residents to be less likely to exercise in comparison to urban residents. The geographical effect of population density may therefore explain differences in exercise participation rates between urban and rural residents. For example, the presence of parks and retail outlets nearby and a safe neighbourhood environment (Ball et al., 2001) could determine whether a postmenopausal woman decides to walk for exercise.

A study was conducted on American adults aged 65 years and older to examine if a relationship existed between the built environment and rate of walking (Berke, Koepsell, Moudon, Hoskins, & Larson, 2007). Proximity to retail stores and restaurants, and higher residential density was associated with higher rates of walking. A similar study by King et al., (2005) found that living within walking distance of a post office or golf course increased the likelihood of exercise participation in postmenopausal women. An understanding of how business and facility proximity influences exercise participation will enable town planners to "…build more pedestrian-friendly communities, especially where postmenopausal women are a majority" (King et al., 2005, p. 467).

Geographical barriers to exercise may occur from an interaction between social support and the environment. Social support has been found to be a strong determinant of exercise, particularly for women (Gallant & Dorn, 2001; Nies & Kershaw, 2002). Participation in walking increased in women who had company to walk with, such as a partner or a pet (Ball et al., 2001). The social isolation experienced by rural women decreases their opportunity to exercise with others.

Women must have the support of their families to maintain an exercise program (Lee, 1993; Marcus, 1995), as greater exercise adherence occurs in women who participate in exercise with their spouse (Wallace, Raglin, & Jastremski, 1995). Social support is a more important factor for women than men (Gallant & Dorn, 2001) and can emanate from several sources such as spouses, intervention program staff and friends (King et al., 1992).

The proximity of exercise facilities will influence exercise adoption. Therefore, the greater the distance an individual has to travel to reach exercise facilities, the less likely they are to exercise (Giles-Corti & Donovan, 2002b; Sallis, Johnson, Calfas, Caparosa, & Nichols, 1997; Sallis et al., 1990). A study on the association between geographical proximity to the New South Wales coast and exercise levels found that respondents were 27% more likely to report activity levels adequate for health if they lived in a coastal postcode (Bauman, Smith, Stoker, Bellow, & Booth, 1999). Geographical location may also become a barrier if climatic conditions are adverse (Seefeldt et al., 2002). Previous research has found a pleasant climate to be associated with increased exercise participation (Uitenbroek, 1993a). Much of the research on the relationship between climate and exercise participation has centred on cold climates with exercise participation rates highest in the summer months (Hechler, Chau, Giesecke, & Vocks, 2004; Ma et al., 2006; Reilly & Peiser, 2006; Uitenbroek, 1993a). An Australian study that examined how changes in seasonal ambient temperature affected exercise participation rates also found a 20% decrease in exercise participation rates during winter (Hechler et al., 2004). However, the female participants were residents from Sydney, Australia, where the average summer temperature is 26°C with a mean humidity of 60%, while the average winter temperature is 17°C (Australian Bureau of Meteorology, n.d).

A similar study which examined the effect of seasonal changes in ambient temperature on walking rates was conducted on older Japanese adults (Togo, Watanabe, Park, Shephard, & Aoyagi, 2005). Walking rates were found to decrease as ambient temperature increased over a range of 17-29°C. While this study goes towards acknowledging that exercise participation rates decrease with higher ambient temperatures, the association between the tropical climate of North Queensland and exercise participation in postmenopausal women is as yet unknown. The nature of the tropical environment of North Queensland means that for a large percentage of the year it is too hot and humid to exercise outdoors. The wet season extends from January to April and the dry season from May to December. The average temperature in winter (June-August) is 25°C while the average temperature for summer (December-February) is 31°C (Townsville Enterprise, n.d.). The average humidity is 75% (Australian Bureau of Meteorology, n.d.). As the weather may be an important environmental barrier to exercise participation for postmenopausal women residing in North Queensland, the design of intervention strategies should consider seasonal and weather-related variations (Dasgupta et al., 2007).

During exercise, metabolic heat is produced via muscle contraction. This heat is dissipated to the environment by an increase in skin bloodflow (Kenney, 1997). Vasoconstriction inhibition and vasodilation activation allows heat convection from the core to the skin for dissipation (Brooks et al., 1997). Increased sweat production then dissipates the heat to the environment. The effect of age on the thermoregulatory responses to exercise in the heat in women is still unclear (Cable & Green, 1990).

Physically active Australian women aged 19-31 years and 38-48 years performed 4 bouts on a cycle ergometer for 20 minutes at a workload of 60 W (Cable & Green, 1990). Temperature was controlled at 22°C and 50% humidity for the duration of the test. Sweat production rates, as measured on the anterior surface of the forearm, were lower and began later in the middle-aged women compared to the younger women during low-intensity exercise. In contrast, postmenopausal and premenopausal women matched for anthropometric measurements and maximal oxygen consumption, exercised in a warm humid environment of 37°C and 60% humidity. No age-related differences were found between the two groups for sweat rate production (Kenney & Anderson, 1988). In an earlier study, Drinkwater and associates (1982) found no differences in sweat production rates when postmenopausal and premenopausal women were matched for cardiorespiratory fitness. The women rested for 2 hours in a 40°C and 20% humidity environment. The authors concluded that the sweating mechanism does not diminish with age in healthy, active older women (Drinkwater et al.).

Heat production during exercise is a function of absolute exercise intensity whereas heat loss mechanisms are dependent on relative exercise intensity (Saltin & Hermansen, 1966). Therefore, responses to exercise in the heat may be determined by cardiorespiratory fitness rather than age (Kenney, 1997). While the participants in the study conducted by Cable and Green (1990) were said to be physically active, there was no mention of whether the women were matched for cardiorespiratory fitness. Long-term exercise training results in enhanced cutaneous vasodilation and subsequent sweating response at a given level of core body temperature (Kuwahara et al., 2005). Therefore, postmenopausal women who participate in regular exercise in a tropical environment may find it less of a barrier to exercise in the heat.

Lack of time is another common barrier to exercise for middle-aged women. Women aged 45-50 years were surveyed for the Australian longitudinal study on women's health (RIGH, 1997). Sixty-eight percent of the women surveyed were employed either full or part-time, with 39% holding professional employment positions. Only 14% of the women surveyed performed a minimum of 100 minutes of moderate intensity exercise. Fifty-three percent thought they would like to spend more time in active leisure pursuits. The national exercise survey of Australians in 1999 found that the largest decline in exercise participation was amongst the middle-aged and well educated (AIHW, 2000). The authors suggested that pressures of longer working hours caused the decline in exercise participation, a notion supported by the absence of a decline in exercise amongst older retired Australians. A 2005-2006 survey (Australian Bureau of Statistics, 2007) had similar results, with insufficient time due to work commitments the most common reason for non-participation in exercise in middle-aged women.

Mutrie and Choi (2000) believe that women with less free time to exercise are more likely to live traditional lifestyles whereby family responsibilities afford a higher priority over taking time to exercise. Lack of time due to family responsibilities such as child care, cooking, cleaning and other household tasks has been cited as one of the most common barriers to exercise participation for women (Brownson, Baker, Housemann, Brennan, & Bacak, 2001, Bryan & Walsh, 2004; King et al., 2000). It therefore appears that finding the time to exercise is most difficult for a working woman who also may have many family responsibilities.

Time has also been the most frequently cited barrier to exercise for Australian men and women (Owen & Bauman, 1992; Booth et al., 1997) and Canadian (Yoshida, Allison, & Osborn, 1988; Bryan & Walsh, 2004) and North American (Johnson, Corrigan, Dubert, & Gramling, 1990; Brownson et al., 2001) women. Forty-five percent of Australian men and women aged 40-59 years claimed they did not have enough time to exercise (Booth et al., 1997). Fifty-three percent of the sample was insufficiently active, defined by the authors as less than 1.8 kcal·day·kg. In an earlier study by Owen and Bauman (1992), data from more than seventeen thousand participants in five population surveys in the mid-1980s were analysed. The most commonly cited barrier to exercise was lack of time, with participants aged 25-39 years and 40-54 years more likely to report this barrier compared to participants aged 55 years or more. Lack of time as a barrier was also more likely to be reported by participants with children. Surprisingly, this barrier was not related to gender or income, as it has been suggested that women with a higher education and socioeconomic status will be able to maintain a healthy weight (Peters et al., 2002) because they have the educational and material resources to exercise regularly.

Exercise behaviour models

Behavioural models form the basis for understanding exercise behaviour and may provide a framework for effective design and implementation of strategies for exercise behavioural change. The decision to exercise is influenced by many factors (Baranowski, Cullen, Nicklas, Thompson, & Baranowski, 2003). Environmental and biological factors have been previously considered in this chapter. The following exercise behavioural models focus on the psychological factors which influence exercise adoption.

Social Cognitive Theory - Self-efficacy

Self-efficacy is defined as one's beliefs in their capabilities to execute a particular course of action to satisfy a situational demand (Bandura, 1977), has long been identified as an important predictor of future exercise behaviour (Marcus, Selby, Niaura & Rossi, 1992; McAuley, 1992a; McAuley & Blissmer, 2000; McAuley, Lox & Duncan, 1993; Sallis & Hovell, 1990).

Social cognitive theory proposes that individuals gain attitudes from various sources. Direct modelling occurs when particular behaviours are observed within an individual's social network. Symbolic modelling occurs when individuals observe behaviours engaged by those in the media. Whether these observed behaviours lead to the individual engaging in the same behaviour however is a function of their beliefs about their own abilities and the consequences of engaging in the behaviour (Bandura, 1977).

Self-efficacy theory was first conceptualised by Bandura (1977) as the key construct within the social cognitive theory to explain behaviour through two factors: 1) one's self-efficacy, and 2) one's outcome expectations, or the expected consequence of a successful behaviour performance. Factors said to influence self-efficacy and outcome expectancy include mastery experiences (behavioural), modelling (cognitive), verbal persuasion (social) and interpretation of emotional or psychological arousal (physiological) (Bandura, 1997).

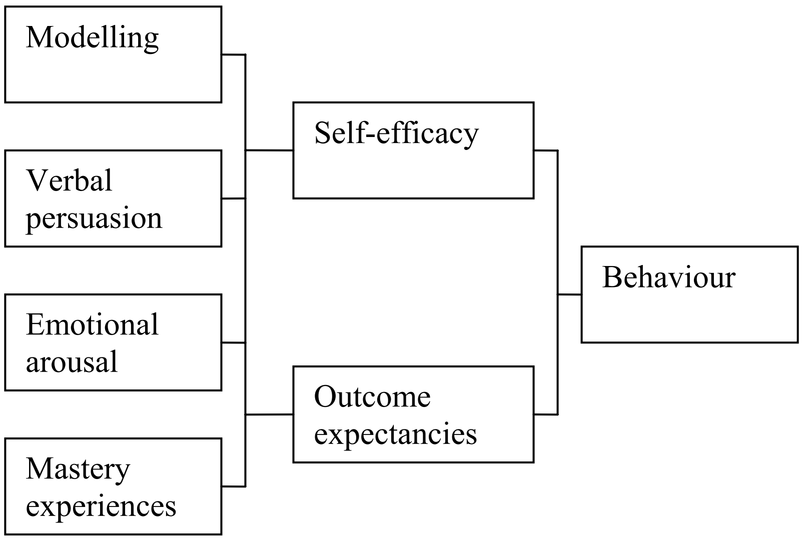

Figure 1. Bandura's Self-efficacy theory (Biddle & Nigg, 2000)

Efficacy beliefs should be assessed along three dimensions: level, strength and generality (Bandura, 1997). Level of self-efficacy means the number of tasks they can perform leading up to the target behaviour. Strength of self-efficacy is usually assessed on a 10-100-point scale at 10-point intervals from 0 ('Cannot do') to 100

(‘Certainly can do’) and determines the certainty an individual expects to successfully attain each of the component tasks or levels (Bandura, 1997). Summing the confidence ratings and dividing by the total number of items within the target behaviour determines overall strength of self-efficacy. Generality is the number of domains the individual considers themselves efficacious (McAuley, 1992a).

Self-efficacy scales generally measure how participants perceive their physical self-confidence (Ryckman, Robbins, Thornton, & Cantrell, 1982). Exercise-specific self-efficacy scales however have been developed to measure a respondent’s beliefs in their capabilities to successfully participate in exercise when faced with potential barriers (McAuley & Jacobson, 1991). These scales are typically composed of a number of items such as schedule conflicts and lack of support, to reflect these beliefs.

Exercise self-efficacy and environmental influences are reciprocal (McAuley, 1992b), whereby self-efficacy can act as a determinant and a consequence of exercise participation (McAuley & Blissmer, 2000). For example, failure to master an activity can lead to low self-efficacy (McAuley, 1992b). Therefore, women who attach negative experiences with past performance of exercise will be more likely not to participate as adults. Participation in sport when young has been found to be a predictor of exercise in women as adults (Adams-Campbell et al., 2000; Hirvensalo, Lintunen & Rantanen, 2000; Seefeldt et al., 2002). Exercise can be physiologically and psychologically reinforcing, whereby girls who perceive benefits during childhood may be more likely to remain active (Alfano, Klesges, Murray, Beech, & McClanahan, 2002).

Generational circumstances may influence the adoption of exercise. The lack of sport opportunities as girls coupled with the strong social commitment to their families may result in these women lacking the confidence to pursue an exercise regime at this time in their life (Branigan & O'Brien Cousins, 1995). Middle-aged women were raised under different conditions and viewed their primary role to be child rearing when young (Seefeldt et al., 2002). Women who received the advice of 'animals sweat, men perspire, women do neither' during the 1930's to 1950's would therefore lack the knowledge or skills to perform regular exercise (Dunlap & Barry, 1999). These women have now found themselves in a new cultural period whereby they are being told to perform exercise (O'Brien Cousins, 2000). Negative perceptions of exercise can therefore develop. However, allowing these women the opportunity to engage in a successful bout of exercise may increase self-efficacy levels and promote further exercise patterns. Vigorous activity at 50 year was also found to be a significant predictor for continued participation in older women of 65 year (Evenson et al., 2002). Exercise self-efficacy was measured amongst a group of older adults following a graded exercise bicycle test performed at the end of an exercise program and nine months following. Participants' efficacy levels were not maintained during the intervening nine months, however following performance of the second graded exercise test efficacy levels were the same as those for the initial test (McAuley et al., 1993). This large effect occurring after a single bout of exercise demonstrates that past experiences can shape an individual's self-efficacy.

Self-efficacy has been shown to play a more important role in the adoption of exercise with the more efficacious individual expected to adhere to an exercise program until it becomes habitual (McAuley, 1992a). This allows a greater opportunity to mediate through cognitive control compared to when exercise becomes more habituated (McAuley & Blissmer, 2000). Individuals who are in the early stages of exercise adoption may benefit from informational and motivational instruction to increase the appeal of exercise (Marcus et al., 1992). Early success at performing exercise enhances the self-efficacy to perform the activity, increasing the probability that exercise will be performed in the future (Baranowski et al., 2003).

Instructor support impacts on exercise adherence (McAuley & Jacobson, 1991). The implementation of individualised positive feedback on their performance has been found to enhance self-efficacy in women (McAuley, Talbot & Martinez, 1999). Following bouts of acute exercise, low-active women were given positive feedback regarding their performance. These women reported more positive well-being and less fatigue, and experienced lower levels of psychological distress compared to women who were given negative feedback (McAuley et al., 1999). Positive affective responses were also found among female undergraduate students following an acute exercise bout. Those students who exhibited higher exercise self-efficacy sustained a greater sense of energy during and felt more revitalised following the bout (Bozoian, Rejeski & McAuley, 1994).

Participation in a structured, facility-based exercise program may be beneficial to sedentary postmenopausal women during the adoption stage of exercise. Instructors would therefore be able to increase confidence by providing positive feedback on task-specific performance efficacy (Woodward & Berry, 2001). Efficacy beliefs which produce successes in short-term, structured exercise programs are different from those required for maintaining long-term exercise. Performance self-efficacy has been found to be more important during the adoption phase of exercise, while self-regulatory skills are more important in the maintenance phase. Building a base of success is essential for those women who will be expected to move from the adoption stage to the maintenance stage of exercise. Once the maintenance stage has been achieved, postmenopausal women should then be able to participate in home-based programs. To improve the likelihood of exercise maintenance, instructors should incorporate techniques to enhance self-regulatory capabilities (Woodward & Berry). Group-based programs incorporating an education intervention achieved greater activity levels in the short term amongst older adults (Van der Bij et al., 2002). At 12 and 15 months, home-based exercise programs produced higher participation rates and adherence compared to group-based exercise in obese women (Perri et al., 1997).

Exercise requires considerable effort in order to accrue any health benefits. This effort may prove to be particularly difficult for the sedentary and obese woman (McAuley, 1992b). By determining exercise self-efficacy issues in non-exercising women, environmental influences could be manipulated to ensure greater adherence when exercise is adopted. For example, self-presentational exercise such as exercising in front of a mirror produced lower efficacy in women and may act as a barrier for exercise (Katula, McAuley, Mihalko, & Bane, 1998). This type of environment can produce anxiety in these women and prove a demotivating influence (McAuley & Blissmer, 2000).

Incorporating cognitive strategies into intervention programs has proved successful for improving the exercise self-efficacy of previously sedentary women. Sedentary obese women who were taught about behavioural changes they could make to improve self-efficacy increased their participation in exercise during a 48-week program (Dallow & Anderson, 2003). Improved exercise self-efficacy was also found in obese women following a 12-week behaviour therapy program (Pinto, Clark, Cruess, Szymanski, & Pera, 1999). Cognitive strategies included training in problem solving, goal setting and facilitation of social support (Pinto et al., 1999). Self-efficacy predicted adherence to a resistance-training program for elderly women at three-month and six-month intervals (Rhodes, Martin, & Taunton, 2001). It was suggested that interventions focusing on improving older women's self-efficacy for overcoming the barriers of fatigue, lack of time and bad weather would result in increased exercise adherence.

A strong association may exist between exercise self-efficacy and body weight (Sherwood & Jeffery, 2000). Overweight and obese women are less likely to exercise compared to normal weight women (King et al., 1992). Ball, Crawford and Owen (2000) found women who perceived themselves as too fat were too shy and embarrassed to exercise however, no significant association between being too fat and poor health was found. Therefore, lower self-efficacy would be linked with their perceived appearance rather than poor health. Middle-aged female university employees were measured for self-efficacy to overcome barriers during weekly exercise program participation and total exercise participation (McAuley & Jacobson, 1991). Good and poor attendees differed significantly with body weight, however good and poor overall exercise participants did not. Heavier individuals may therefore prefer to exercise on their own rather than attend an exercise class.

Health belief model (HBM)

The HBM is one of the oldest conceptual models of behaviour (Sanderson, 2004) that can provide a framework for assessing the factors associated with prediction of exercise participation. It was first developed in the 1950's by Hochbaum and associates (as cited in Maiman & Becker, 1974) out of a concern for public health issues, and endeavoured to explain and predict preventative health behaviours. The HBM was influenced by Kurt Lewin, a prominent social psychologist, who believed that an individual is pulled by positive forces and repelled by negative forces (Rosenstock, 1974a). As disease represents a negative force, it would be expected that an individual would try to avoid or pull away from this force. The primary constructs of the HBM borne out of the Lewinian theory are that a number of factors help determine the likelihood of individuals taking preventative action. These factors include perceived susceptibility, perceived severity, perceived benefits, perceived barriers and cues to action (Rosenstock, 1974a). Perceived susceptibility refers to the degree to which an individual feels at risk of contracting a disease. Perceived severity is the degree of threat the disease is thought to impose on the individual (Allen, 1998). Individuals must believe that engaging in a particular behaviour will be beneficial in reducing the threat of a disease and that the benefits outweigh the barriers (Sanderson, 2004). Perceived benefits relates to the evaluation of a health action for its feasibility and efficaciousness, while perceived barriers is the perceived costs of the proposed health action (Maiman & Becker, 1974).

Although an individual is likely to take action if they have high perceived severity and susceptibility, the health behaviour may still not be adopted. An internal or external cue may therefore be required to trigger the action. The fifth factor, cues to action, is an external or internal stimulus to trigger an appropriate health action (Maiman & Becker, 1974). Certain cues to action must take place for sedentary individuals to reevaluate their exercise beliefs. These cues may be environmental, such as friends or family who start exercising or personal, such as gaining an increase in leisure time or income (Uitenbroek, 1993b). Cues can also increase awareness of the presence of a disease (Woodward & Berry, 2001) and take the form of media campaigns on cardiovascular disease, or powerful cues with a more personal reference such as a parent having a heart attack. Whether the cue of a perceived health threat will motivate an individual to engage in exercise depends largely on whether they believe that the benefits outweigh the costs (Allen, 1998).

The HBM proposed that motivation was necessary for action with motives determining an individual's perception of their environment (Maiman & Becker, 1974). The model was modified by Becker, Drachman and Kirscht (1974) to include a separate motivational factor. The general health motivation concept encompassed an individual's desire to attain or maintain good health and avoid disease (Maiman & Becker, 1974), their willingness to participate in general health activities and their willingness to comply with advice from health professionals believed to reduce the severity of, or susceptibility to, a disease (Champion, 1984).

It is proposed that each of the above factors contribute to an individual's decision to participate in a health behaviour. According to the HBM, an individual is more likely to participate in a preventative action if they believe:

1) themselves to be susceptible to a disease,
2) that contracting a disease would cause at least a moderately severe impact on their life,
3) that taking the action would reduce the individual's susceptibility to a disease, and
4) that taking the action did not require overcoming many barriers (Rosenstock, 1974b).

However, the main motivational factors thought to elicit change within the HBM are a combination of perceived seriousness and susceptibility (Baranowski et al., 2003). It is also thought the most important means for change in the HBM is self-efficacy, with those individuals who have higher levels of self-efficacy more likely to engage in, persist in and maintain a health behaviour (Baranowski et al.).

Modifying factors such as demographic, sociopsychological, and structural variables have also been included in the HBM for their indirect influence on behaviour. Demographic variables include age, gender and ethnic background, sociopsychological variables include personality traits, peer pressure and social class and structural variables include knowledge about a disease and/or prior contact with a disease (Caltabiano & Sarafino, 2002; Rosenstock, 1974a) (Figure 2).

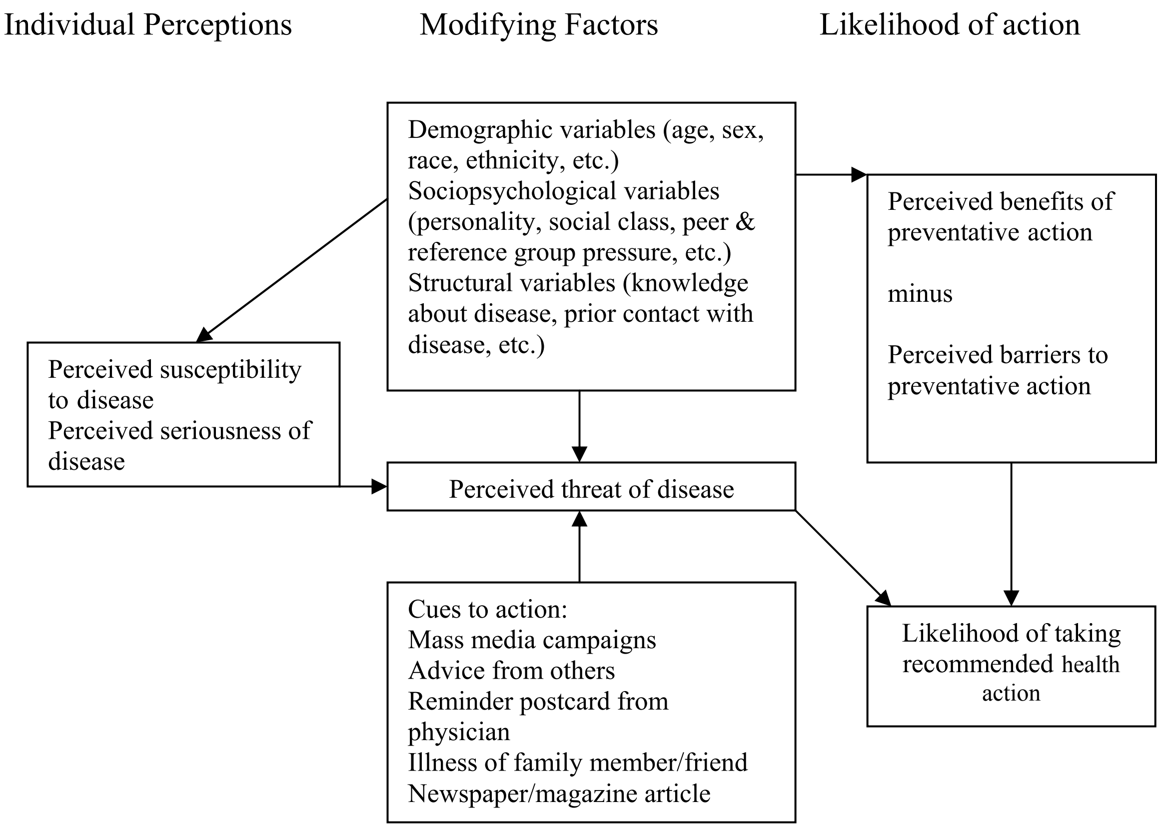

Figure 2. The Health Belief Model including modifying factors (Becker & Rosenstock, 1984)

The HBM has been used extensively for studying health-related behaviour and has been applied to such diverse behaviours as smoking (Mullen, Hersey, & Iverson, 1987), diet (Humphries & Krummel, 1999), dental health (Ronis, 1992), HIV testing (Maguen, Armistead, & Kalichman, 2000) and breast self-examination (Champion, 1984).

Despite the extensive use of the HBM, there have been methodological problems regarding the scale used to measure health beliefs. Two such criticisms have been that different HBM scales have been used to measure the presence or absence of the health beliefs (Rosenstock, 1974b) and many versions of the HBM scale were not tested for validity or reliability (Champion, 1984). In order to address these problems, Champion developed and tested an instrument to test the HBM constructs for validity, reliability and ultimately, transportability. Champion's instrument was originally designed for measuring the constructs of susceptibility, seriousness, benefits, barriers and health motivation of women related to breast self-examination and breast cancer. Reliability coefficients for each scale were found using Cronbach Alpha. Those items showing low correlations were removed until internal consistency coefficients reached .7 or above. The retained items within each construct were then used to calculate test-retest reliability. Correlation coefficients were also found to be above .7. Finally, construct validity was assessed by factor analysis and multiple regression. The constructs demonstrated strong evidence for both measurements of construct validity and were accepted. Champion recommended that future use of this validated scale could test different behaviours by substituting a word or phrase.

Transtheoretical model and Stages of Change

The Transtheoretical Model (TM) (Prochaska & DiClemente, 1982) was first introduced from an integration of clinical psychology theories and concepts, with a focus on promoting change in health-related behaviour (Baranowski et al., 2003).

The model involves 10 processes of change including consciousness raising, self-liberation, social liberation, self-reevaluation, environmental reevaluation, counterconditioning, stimulus control, reinforcement management, dramatic relief and helping relationships (Prochaska & DiClemente, 1983). Behavioural change is also said to occur in stages, the most common including precontemplation (not thinking about change or suppressing thoughts to change), contemplation (considering change but taking no action), preparation (anticipating making efforts to change and considering what behaviour one will do), action (engaging in efforts to change) and maintenance (expending effort to retain the changes made during action) (Baranowski et al., 2003). Individuals engaging in a new behaviour move in an orderly progression through these stages.

Prochaska and DiClemente (1983) propose that individuals at different stages of change differ in their attitudes, beliefs and motivations to their new behaviour. Different treatment approaches and health strategies may therefore be necessary for individuals across the different stages. For example, contemplators use the process of consciousness raising and would therefore be more likely to respond to feedback and education as sources of information about the new behaviour. Those in the action stage use the processes of self-reevaluation, self-liberation, reinforcement management and helping relationship. These individuals think more about themselves in relation to their behaviour and rely more on helping relationships for support. They also believe that they can change their behaviour if they want to.. This model has been applied to a variety of health behaviours including smoking cessation (Prochaska & DiClemente), colon cancer screening (Costanza et al., 2005), antihypertensive adherence (Johnson et al., 2006), calcium intake patterns (Zhang, Ojima, & Murata, 2007) and increasing fruit and vegetable consumption (Campbell et al., 1999).

The TM and Stages of Change have also been used to understand exercise behaviour (Booth et al., 1993; Marcus et al., 1992; Rich & Rogers, 2001; Spencer, Adams, Malone, Roy, & Yost, 2006). Attitudes towards exercise adoption have been categorised into five stages: precontemplation (those not considering starting exercise); contemplation (considering initiating exercise in the next 6 months); preparation (taken steps to exercise but not regularly); action (those who are exercising regularly but only in the last 6 months) and maintenance (those who have been regularly exercising for longer than 6 months) (Marcus et al., 1992). It is suggested that stage-matched interventions may lead to a progression into higher exercise stages (Spencer et al., 2006).

Rich and Rogers (2001) examined the relationship between exercise stage of change and attitudes towards exercise in older adults. Older adults in the action and maintenance stages were found to have more positive attitudes to exercise for health benefits compared to those in the precontemplation stage. Similarly, Lee (1993) examined the attitudes and behaviour related to exercise adoption among Australian middle-aged women. The author reported that women in the precontemplation stage to have less exercise knowledge and perceived less psychological benefits from exercise compared to women in the action and maintenance stages.

Booth and associates (1993) also obtained stage of change information and health benefits of exercise beliefs from Australian adults. The authors reported that the number of participants intending to perform more exercise decreased with age but increased with education level. Furthermore, participants who were in the higher stages of change held greater beliefs that exercise would help to prevent heart disease.

Rich and Rogers (2001) determined that if participants are to progress from the precontemplation stage into the action and maintenance stages of exercise, their beliefs in the advantages of making a behavioural change must increase. Interventions which include education to increase awareness on the health-related benefits of exercise were recommended (Rich & Rogers). This approach was also recommended by Jackson, Asimakopoulou and Scammell (2007) who determined if the TM could increase exercise participation in people with NIDDM. Forty participants were recruited into either an exercise consultation (EC) group or a control group. Both groups were given an exercise leaflet. In addition, EC participants also received a one-on-one interview with a dietician. A significant difference was found between groups for stage progression success rates, with eight EC group participants compared to one control group participant advancing their stage of change.

Apart from stage of change, other components of TM which are applied to exercise include processes of change, decisional balance, self-efficacy and temptation not to exercise (Spencer et al., 2006). Decisional balance refers to the pros and cons of adopting exercise, while processes of change are the behavioural and cognitive strategies that an individual utilises when moving from the precontemplation to the contemplation stage of exercise (Spencer et al.). The pros (benefits) and cons (costs) of adopting exercise are thought to be the motivational drive in TM. Therefore, an individual will change their behaviour to attain desired goals and avoid undesired goals through the use of self-efficacy and processes of change (Baranowski et al., 2003). Comparing the benefits with the costs of adopting exercise determines movement from the precontemplation into the contemplation stage, while self-efficacy determines movement into the action and maintenance stages (Baranowski et al.).

Individuals at various stages have also been found to have different degrees of exercise self-efficacy. Marcus and associates (1992) examined the relationship between stage of change and self-efficacy in government and hospital employees. The authors found that self-efficacy was significantly related to stage of change, whereby participants in the precontemplation stage scored the lowest self-efficacy scores and participants in the maintenance stage scored the highest self-efficacy scores. A more recent 6-week intervention study by Purath and Miller (2005) examined factors that predicted progression through the stages of change in previously sedentary women. Participants in the experimental group were given a tailored exercise intervention and a follow-up phone call two weeks later. Results revealed that women who had progressed into a higher stage of change had greater improvement in self-efficacy.

Marcus et al., (1992) suggested that exercise intervention strategies should differ in their focus on efficacy enhancement throughout the stages. For example, participants in the early stages of change may be more successful with a greater emphasis on increasing self-efficacy expectancies. This approach has proved successful in the adoption and adherence to a regular exercise program for older rural dwelling Australian women (Rehor & McNeil, 1999). Stage-specific cognitive behavioural strategies were provided to participants at the commencement and at 3 months of a 6-month intervention program. The results revealed that for every two participants who relapsed, there were five participants who progressed to the next stage. Additionally, 55% of the participants who progressed did so to the action and maintenance stages of change.

Exercise-induced affect

Various theories that have been used to explain exercise behaviour, including the Theory of Planned Behaviour (Ajzen & Fishbein, 1980) and Social Cognitive Theory (Bandura, 1977), involve an affective component. Psychological or mental health consists of both positive and negative affective states (McAuley & Courneya, 1993). Exercise-induced affect literature purports that an individual who partakes in an acute exercise bout producing enhanced positive affect and reduced negative affect would be more likely to adopt exercise practices in the future (Annesi, 2002). Psychological outcomes associated with an acute exercise bout may therefore influence exercise behaviour (McAuley et al., 1999) through tension release (Rich & Rogers, 2001), improvement of mood (Arent, Landers, & Etnier, 2000), enhancement of self-esteem (Rejeski, Focht, & Messier, 2002) and reduced anxiety and depression (Arent et al., 2000; Ekkekakis & Petruzzello, 1999; Harris, Cronkite, & Moos, 2006;). Negative affective responses to a single exercise bout may produce barriers to subsequent exercise participation. As exercise-induced affect influences exercise behaviour, an understanding of the mechanisms of exercise in producing these affective benefits is needed so that strategies can be developed to improve the experience for individuals (Gauvin & Brawley, 1993).

Positive and negative affective states experienced during and after exercise have been reported in the literature. For example, decreased negative affective post-exercise responses and increased positive responses have been found in older women (Pierce & Pate, 1994), middle-aged women (Pronk, Crouse, & Rohack, 1995) and college-aged students (McGowan, Talton, & Thompson, 1996) following a single bout of aerobic exercise. While many affects may be involved with exercise, the main dimension seems to be hedonic tone or pleasure and displeasure (Boutcher, 1993).

As previously stated, psychological health consists of both negative (psychological distress) and positive (psychological well-being) emotional or affective states (McAuley, 1994; McAuley & Courneya, 1994). However, most of the earlier literature that examined exercise focused on negative affective states such as anxiety, depression, anger and irritability (Leith & Taylor, 1990). One such measure which aimed to determine mood across several dimensions, was the commonly used Profile of Mood States (POMS) (McNair, Lorr, & Droppleman, 1971). The POMS was originally developed for clinical patients and student populations. This instrument has since been questioned for its emphasis on negative states and its inability to be used for those individuals beyond university age. Further, the length of the inventory makes the POMS not suitable for administration during exercise (McAuley & Courneya, 1994).

Most of the research on exercise-induced affect has been directed to postexercise responses. One two dimensional model developed to assess both positive and negative states during exercise was the 11 point single-item Feeling Scale (FS) (Rejeski, Best, Griffith, & Kenney, 1987). This measure has also been questioned as being too simplistic whereby affect is thought to be bipolar and one-dimensional (Watson, Clark, & Tellegen, 1988).

The Exercise-Induced Feeling Inventory (EFI) (Gauvin & Rejeski, 1993) measures the feeling dimensions of revitalisation, tranquillity, positive engagement and physical exhaustion. This model can be administered pre, during and postexercise. Improvement in the feeling state of revitalisation has been found following acute bouts of vigorous (Gauvin, Rejeski, & Norris, 1996) and moderate intensity activity (Annesi, 2002) in women.

A more recent measure that addresses the limitations of previous research is the Subjective Exercise Experiences Scale (SEES) (McAuley & Courneya, 1994). This measure was designed to assess the subjective experiences unique to exercise. The authors suggested that as the measure is brief it can be used with multiple administrations both during and following activity. The SEES consists of 12 items assessing positive well-being, psychological distress and fatigue. The 12 items came from an original pool of 367 items taken from POMS (McNair, Lorr, & Droppleman, 1971), the Positive and Negative Affect Schedule (PANAS) (Watson et al., 1988), Multiple Affective Adjective Check List (MAACL) (Zuckerman & Lubin, 1965) and the Affect Dictionary (Whissell, Fournier, Pelland, & Weir, 1986) which represented subjective responses and feeling states. The dimensions of positive well-being and psychological distress are thought to represent the positive and negative poles of overall psychological health and are also thought to occur in the exercise setting (McAuley & Courneya, 1994).

The third affective dimension of fatigue is related to psychological distress. It has been argued (Gauvin & Brawley, 1993) that exercise may give rise to subjective interpretations of physiological cues. For example, an individual's perception of the somatic state of fatigue can also be perceived as a subjective feeling state. Physiological cues are a part of exercise participation. Some psychological responses may therefore represent how an individual is feeling as a result of these cues. In fact, researchers believe that the SEES is more a measure of responsivity from which particular emotional states may arise from (McAuley & Courneya, 1994).

Exercise-induced affect is influenced by many factors including individual physiological and psychological differences, the environment and the perceived attributes of the exercise bout (Ekkekakis & Petruzzello, 1999). Individuals with greater self-efficacy demonstrate more positive affective responses following an acute exercise bout (Bozoian et al., 1994; McAuley, Shaffer & Rudolph, 1995; McAuley et al., 1999). Alternatively, affective responses can influence exercise self-effiacacy. A recent study found a reciprocal relationship with self-efficacy and fatigue with lower self-efficacy levels significantly related to feelings of fatigue in a group of older previously sedentary adults following an acute exercise bout (Focht, Knapp, Gavin, Raedeke, & Hickner, 2007). Social support has been shown to influence affect, whereby older adults with greater levels of support experience more positive affect during exercise bouts (McAuley, Jerome, Elavsky, Marquez, & Ramsey, 2003).

Assessment items

Exercise history recall questionnaires

Exercise has been assessed in various forms over the past 40 years or more. Assessment tools have included calorimetry (Conway, Seale, Jacobs, Irwin, & Ainsworth, 2002), diaries (Aadahl & Jorgensen, 2003; Conway et al., 2002; Elley, Kerse, Swinburn, Arroll, & Robinson, 2003), doubly labelled water (Conway et al., 2002), heart rate monitors (Bassett, 2000), pedometers (Elley, 2003; Freedson & Miller, 2000) and electronic motion sensors (Aadahl & Jorgensen, 2003; Bassett, 2000; Freedson & Miller, 2000; Stein, Rivera, & Pivarnik, 2003). However, the most popular method of assessment is the exercise questionnaire (Lamb & Brodie, 1990). Questionnaires can be either self-report or interviewer-administered (Lamb & Brodie, 1990). Many of the older questionnaires (1965-1978) were designed to assess habitual exercise. Therefore, both leisure-time and occupational activities were assessed. However with the growing importance of leisure activity for health benefits, questionnaires designed between 1979-1989 specifically assessed leisure-time exercise (Lamb & Brodie, 1990). However, a shift back to leisure-time and occupational activities assessment has occurred over the past decade due to the rise in levels of obesity in the community (Welk, 2002).

Questionnaires designed to examine dose response factors and historical activity patterns (Welk, 2002) include a specific time period for activities. This time period can range from twenty-four hours to one year (Booth, Owen, Bauman, & Gore, 1996). Frequency and duration of participation in each activity is also sought to enable an estimate of the amount of energy expended (Lamb & Brodie, 1990). This estimate is then compared to known energy costs of particular activities in multiples of the average resting metabolic rate (METS) (Welk, 2002). Activities are typically categorised into light, moderate, intense (vigorous/hard) or very intense (very vigorous/very hard) (Lamb & Brodie). An intensity scale of energy expenditure is therefore given to participants for each category as well as an overall score.

Reliable and valid measurement instruments can assist in the development of effective public health strategies (Aadahl & Jorgensen, 2003). Questionnaire reliability is performed to reduce errors thus enabling the questionnaire to deliver the same result on the second occasion (Shephard et al., 2003). Test-retest procedures are administered by the same observer (Shephard et al.) within a short timeframe following the initial test (Lamb & Brodie, 1990) and cover the same time period as the initial test (Sallis & Saelens, 2000).

Questionnaire validity has a number of components, including construct and content. Construct validity compares the recall questionnaire against other observations linked to exercise, such as exercise diaries and motion sensors (Shephard et al., 2003). Content validity looks at exercise dimensions such as type, frequency, intensity and duration (Welk, 2002).

The Tecumseh questionnaire was developed for use in a community health study (Reiff et al., 1967). It consisted of a self-administered questionnaire of 99 items followed by a home interview determining frequency and duration of activities. The questionnaire included items on occupational, leisure-time, sports, gardening and other activities performed during the preceding year. The categorisation of individuals in terms of their exercise was used to explain the heath status and health risks of a whole community. The questionnaire was validated during a study on mid-life women. Correlations were found to be significant ($r = 0.21$) between cardiorespiratory fitness and leisure time activity, but not for occupational activity (Wilbur, Holm, & Dan, 1993).

The Framingham exercise questionnaire was developed in 1979 to assess habitual activity during a longitudinal study on coronary heart disease incidence (Kannel & Sorlie, 1979). Respondents reported hours spent at rest, in work and in extracurricular activities. Five activity categories were determined based on oxygen consumption values and an exercise index calculated from the sum of hours spent in each category (Kannel & Sorlie). This questionnaire has had limited validity and poor reliability (Lamb & Brodie, 1990).

The Minnesota leisure-time questionnaire (Taylor et al., 1978) was developed as a shortened version of the Tecumseh questionnaire and has proved to be the most popular exercise questionnaire to date (Guthrie, 2002). It was designed to gather information on leisure-time activity only. More specifically, the questionnaire was designed to determine if cardiovascular type exercise served as a direct or indirect mechanism for coronary heart disease protection. Participants were asked to recall leisure-time activities performed over the previous year. An interview was also conducted to determine number of months, frequency within a month and duration of each activity performed (Taylor et al.). Overall energy expenditure was expressed as an Activity Metabolic Index and compared with known intensity codes from the literature. The categories light, moderate and heavy intensities were also used.

Guthrie (2002) administered a modified form of the Minnesota questionnaire together with an interviewer-administered questionnaire to Australian born women aged 45-55 year. The modified questionnaire was used in the Melbourne Women's Midlife Health Project (MWMHP) and focussed on activities more relevant to mid-life women living in Melbourne. Exercise over the previous twelve months was measured with intensity codes allocated to 35 activities from known oxygen consumption values. Participants indicated the type of activity, the number of months the activity was performed, average number of occasions in each month and average duration of each activity. Occupational physical activities and housework data were also recorded. Results were recorded as average total energy expenditure per week. The correlation between the two questionnaires was reported as being "reasonably high" ($r=0.53$) and significant at 0.01 (Guthrie).

Questionnaires with a shorter recall period for leisure-time exercise are more reliable due to the limitations of human memory (Shephard et al., 2003). The 7-day exercise questionnaire was developed for a 5-city community-based health education program in California during 1979 and 1980 (Sallis et al., 1985). Males and females between the ages of 20 and 74 year were asked to recall time spent during the past 7 days in activities from 3 lists. The lists corresponded to moderate (3-5 METS), hard (5.1 – 6.9 METS) and very hard (≥ 7 METS) activities. MET values were used to calculate energy expenditure. A high correlation was found between the questionnaire to a daily self-report log (Taylor et al., 1984) and a 7-day activity log (Dishman & Steinhardt, 1988) ($r = 0.81$; $p < 0.01$).

A 14-day recall questionnaire was administered to Australian males and females to determine the relationship between level of exercise participation and cardiovascular risk (Bauman & Owen, 1991). Participants were asked to recall how frequently they had participated in vigorous activities ('exercise which made you breathe harder or puff and pant'), moderate activities ('… exercise for recreation, sport or health-fitness purposes which did not make you breathe harder or puff and pant') and walking for exercise. Good reliability (ICC 0.86) for a continuous measure of energy expenditure was found when it was administered to a select population sample of South Australian adults for the same two-week period (Booth, Owen, Bauman, & Gore, 1996).

An important component of physical activity content validity is measuring the contexts within which individuals engage in exercise (Sallis & Saelens, 2000).

Questions regarding occupational and leisure-time activities should therefore be included in recall questionnaires for women. Those women who do not engage in any structured activity may perform many daily activities, which influence their metabolic output. For example, the Minnesota questionnaire focuses on team sports and high intensity activities, whereas older females may not participate in these activities (Guthrie, 2002). In order to choose a specific leisure-time exercise questionnaire the type of population and the relationships to be investigated must be considered (Lamb & Brodie, 1990).

Psychological Tools

Barrier specific exercise self-efficacy scale

Barrier specific exercise self-efficacy scales consist of items that measure self-efficacy expectations relating to the adoption or maintenance of exercise in the face of certain barriers. McAuley (1990) has developed a number of exercise self-efficacy scales which consist of barrier items initially determined from an attributional scale used to assess reasons for previous attrition from exercise programs (McAuley, Poag, Gleason, & Wraith, 1990). Reasons included lack of motivation, time constraints, injury, program termination, dissatisfaction, lack of social support, relocation/vacation, weather, personal stress, exercise of little value, inconvenience and financial constraints. Development of the exercise self-efficacy scales have also been in accordance with Bandura’s (1997) guidelines of level, strength and generality.

A scale developed by McAuley and Jacobson (1991) comprised seven barrier items that might prevent continuation in an exercise program in previously sedentary females. Construct validity was assessed by principal axis factor analysis and revealed two factors representing lack of progress (three items) and external commitments (two items) accounting for more than 50% of the total variation. Internal consistencies for these two factors were high. Participants completed the scale prior to commencement of the program. Participants also completed a six-item exercise self-efficacy scale post-program. Five of the six post-program barrier items produced one factor which accounted for 46.5 % of the variance.

Following the eight-week program, participants were classified as good or poor attendees based on their weekly attendance and good or poor overall exercise participants based on the total number of exercise bouts attended throughout the exercise period. Pre-program exercise self-efficacy did not differ significantly between good and poor attendees, but did post-program. Therefore, participants who exercised more regularly perceived themselves more capable of exercising when faced with barriers compared to poor overall exercise participants (McAuley & Jacobson, 1991).

A 10-item exercise-specific self-efficacy scale was designed by McAuley (1993) to determine previously sedentary middle-aged participants' perceived capabilities to exercise three times per week when faced with barriers. The measure was completed by participants at the end of a five-month exercise program. Aerobic capacity (estimated $\dot{V}O_{2max}$), body weight and bodyfat percentage were also assessed. Exercise behaviour was assessed from frequency (number of sessions) and intensity

(RPE) measures of exercise during the five-month program.

Four months following the program, participants were interviewed about their exercise participation since completing the program. Correlational analysis revealed that exercise self-efficacy was significantly correlated with exercise behaviour and aerobic capacity. Hierarchical regression equations were then performed on exercise self-efficacy, exercise behaviour and aerobic capacity to predict overall exercise behaviour from a combination of physiological and psychological variables. Exercise self-efficacy was found to predict exercise behaviour over a 4-month follow-up period when previous exercise participation and aerobic capacity were controlled. A combination of the physiological and psychological variables accounted for 30 % of the variance in exercise behaviour. As a result, the author suggested that future research should consider the joint contributions of physiological and psychological variables when predicting exercise behaviour (McAuley, 1993).

A more recent use of McAuley's (1990) 13-item scale measured exercise self-efficacy of previously sedentary older adults during a 6-month randomised controlled exercise program (McAuley, Jerome, Marquez, & Elavsky, 2003). The two treatment conditions were walking and stretching. Participants completed the scale at 2 weeks, 2 months, 4 months and the end of the program. Latent growth curve technology was employed using repeated measures to investigate growth of self-efficacy over the 6 months. Both treatment groups had similar exercise self-efficacy at 2 weeks. However, no significant growth in exercise self-efficacy occurred over the 6 months (McAuley et al., 2003).

Many of the exercise self-efficacy scales have measured exercise self-efficacy for the maintenance stage of exercise programs. However, as exercise self-efficacy has been shown to be important in exercise behaviour prediction during the adoption stage of exercise (McAuley & Blissmer, 2000), it would seem appropriate to measure exercise self-efficacy at this stage.

Resnick and Jenkins (2000) revised McAuley's (1990) thirteen barrier item scale to be more appropriate for older adults participating in a walking program. Participants identified four non-relevant items including when on vacation, getting to the exercise location, feeling self-conscious when exercising and lack of encouragement from an instructor. These questions were excluded from the scale. Two further items regarding interest in the activity were felt to be repetitive and were incorporated into one item. The revised scale was then tested for validity and reliability. Construct validity was evident through hypothesis testing. Criterion-related validity was tested with concurrent validity, such that exercise efficacy expectations would be significantly related to exercise activity. Validity was evident with efficacy expectations predicting exercise activity. Lambda X estimates of >.81 provided further validity. Reliability was also evident with an internal consistency of .92 and a squared multiple correlation coefficient of R^2 ranging from 0.38-0.76 (Resnick & Jenkins, 2000).

Health belief model scale

Champion’s HBM scale consists of a number of statements relating to each of the five constructs of perceived susceptibility, seriousness, benefits, barriers and health motivation. Participant responses are measured on a Likert scale (5 - strongly agree to 1 - strongly disagree). A number of studies (Lindsay-Reid & Osborn, 1980; Mirotznik, Feldman & Stein, 1995; O’Connell, Price, Roberts, Jurs, & McKinley, 1985; Oldridge & Streiner, 1990) have utilised the HBM to assess various aspects of exercise behaviour. Exercise adoption prediction was examined using the HBM in a group of firefighters (Lindsay-Reid & Osborn). Perceptions of susceptibility to coronary heart disease (CHD) and other illnesses, belief in the benefits of action to reduce the risks of CHD, and the effects of age were measured before and 6 months following an exercise program. Perceptions of susceptibility and benefits of activity were inversely associated with exercise adoption (Lindsay-Reid & Osborn).

Discriminant function analysis (DFA) was used to determine the predictive power of the HBM in relation to cardiac rehabilitation program compliance (Oldridge & Streiner, 1990). Questionnaires were completed on entering and at the end of the 6-month program. Participant responses increased the predictive power of the questionnaire by 10% with overall predictive power increasing to 74.4%. Responses also accounted for 21.1% of the variance between complier and dropout groups.

Adherence to a 6 month community-based supervised CHD program was assessed using the HBM (Mirotznik, Feldman & Stein, 1995). Participants were interviewed using the HBM variables of general health concern, engagement in special health behaviours, perceptions of susceptibility, severity, benefits and costs. The HBM accounted for 29% of the variance in exercise program attendance with the variables of engagement in special health behaviours, severity and benefits of exercise found to be significant to exercise session attendance. Contrary to the HBM however, it was a low perception of the benefits of exercise that was associated with program compliance. This result may be due to the retrospective nature of the study whereby participant beliefs were determined following completion of the program. Compliance may have therefore impacted on their beliefs (Mirotznik et al., 1995).

The HBM was also used to predict the exercise behaviour of obese and non-obese adolescents (O'Connell et al., 1985). Questionnaire items measured attitudes towards obesity and exercise, knowledge of obesity and exercise and beliefs and evaluations of obesity and exercise. DFA was utilised to determine how well the factors could predict obesity. The variable of cues to exercising was the most powerful health belief predictor of exercise behaviour for the obese adolescents, however no variable was significant in predicting exercise behaviour in non-obese adolescents.

The exercise habits of employees in a fitness program were also examined using the HBM (Morgan, Shephard, Finucane, Schimmelfing, & Jazmaji, 1984). Employee health beliefs were measured at initial enrolment in the program and 20 months following. A higher level of perceived health and the belief in exercise were the stronger predictors at initial enrolment for women, there were no significant health belief predictors for exercise adoption.

A more recent qualitative study examined older Canadian womens' beliefs regarding the risks and benefits of exercise (O'Brien Cousins, 2000). Based on the HBM, participants were asked to respond to open-ended questions on their beliefs of the risks and benefits for participating in six different activities relevant to seniors' fitness programs. The results revealed that while the non-exercising older women believed there were benefits to participating in the activities, the perceived risks far outweighed the benefits.

While there has been some success utilising the HBM, these studies have involved predicting one-time behaviours. The results of studies predicting habitual behaviours however have been more varied. Sanderson (2004) suggested that the HBM may not be relevant for describing complex behaviours such as exercise. As the HBM was initially developed to predict isolated preventative behaviours such as attendance at clinics it may not be appropriate in its current form to predict the more complex behaviour of exercise adoption and adherence (Biddle & Mutrie, 2001). The motivations for adopting and adhering to exercise are diverse and may not contain illness-avoidance or health enhancement motives. Modifications of the HBM such as the use of selected parts of the instrument or the inclusion of self-efficacy beliefs may be more appropriate for predicting exercise behaviour (Biddle & Mutrie). More research utilising the HBM in the exercise behaviour setting is therefore needed.

Subjective exercise experiences scale

The subjective exercise experiences scale (SEES) (McAuley & Courneya, 1994) is a twelve-item, three-dimensional scale designed to measure affective responses to an exercise bout. A number of researchers have employed the SEES during the performance of a GXT on a cycle ergometer. McAuley and Courneya (1994) conducted a study to test the construct validity and reliability of the SEES. Middle-aged participants were assessed prior to and immediately following a GXT. Internal consistency was evident among all three subscales (.84 to .92). Confirmatory factor analysis on pre and postexercise data found all of the item loadings to be statistically significant. A significant decrease for psychological distress and a significant increase for positive well-being occurred from pre to postexercise. Fatigue also increased significantly, however participants were older adults completing a somewhat strenuous bout of exercise. Therefore, participants can feel simultaneously physically fatigued and very positive about the experience.

Fatigue is thought to be influenced by many factors including physical fitness, stage of exercise change and the exercise environment (McAuley & Courneya, 1994). Confirmatory factor analysis was also employed by Markland, Emerton and Tallon (1997) to further determine factorial and construct validity of the SEES. Participants were two groups of secondary school children who completed the SEES prior to and immediately following either a game of rounders or a twenty-metre multistage shuttle run. One psychological distress item (I feel awful) and one fatigue item (I feel drained) were found to have consistent patterns of relatively large residuals during model testing and assessment of fit. These two items were removed producing very good fit following reassessment. Factor loadings were then found to be moderate to strong and significant.

Internal consistency of the modified SEES was performed with all three subscales showing acceptable reliability both prior to and postexercise (.71-.87). Construct validity of the modified SEES was assessed by examining the effects of participation in exercise on feeling states on the same sample of children. It was hypothesised that the group of children playing rounders would experience an increase in positive well-being, a decrease in psychological distress and a moderate increase in fatigue. It was also hypothesised that children participating in the shuttle run would experience a decrease in positive well-being and increases in psychological distress and fatigue. The results revealed no significant changes in subscales for the group playing rounders, however a significant decrease in positive well-being and significant increases in psychological distress and fatigue occurred in the group performing the shuttle run. The diversity of results lead the researchers to conclude that there was no evidence for construct validity.

Watt and Spinks (1997) used the SEES to examine whether exercise behaviour influenced exercise-induced affect in young adults. Exercisers and non-exercisers performed 20 minutes of exercise on a cycle ergometer at 60% VO_{2max}. The authors hypothesised that the exercisers would demonstrate higher positive affect and lower negative affect during and postexercise compared to the non-exercisers. The results revealed that exercise behaviour had no significant influence on exercise-induced affect. Positive well-being was significantly higher and fatigue was significantly lower postexercise compared to during exercise for both groups. No significant effects for psychological distress were found for the two groups.

A more recent study investigated the positive and negative affect of women of different ages during an acute bout of aerobic exercise (Cox, Thomas, Hinton, & Donahue, 2006). The researchers hypothesised that older women would respond differently in terms of affect. The SEES was administered to two groups of participants aged 18-20 year and 35-45 year prior to, immediately following, and at 30, 60 and 90 minutes postexercise. Participants undertook three experimental sessions on separate days including no exercise, exercise on a treadmill for 33 minutes at 60% or 80% maximum oxygen uptake ($\dot{V}O_{2max}$). No significant main effects were found between the two age groups for all three SEES subscales (Cox et al., 2006).

Ratings of perceived exertion

The Borg (1970) rating of perceived exertion (RPE) scale is a popular method for measuring individual exercise tolerance. The 15 point scale ranging from 6-20 contains verbal anchors at every odd integer to assist participants to rate their perception of exercise intensity. RPE is often used in conjunction with a GXT and various tools for measuring the psychological response to an acute exercise bout (Daley & Welch, 2004; Parfitt & Eston, 1995; Pronk, Crouse, & Rohack, 1995; Reed, Berg, Latin, & La Voie, 1998). Researchers have found high correlations ($r = 0.97$) between RPE levels and heart rate (Borg & Kaijser, 2006). However, lower correlations ($r = 0.50$) can occur at lower RPE levels. Low correlations were found between RPE and $\%HR_{max}$ and %peak $\dot{V}O_2$ during a self-paced walk among adults over fifty years (Grant et al., 2002). A study comparing the exercise intensity and RPE of low impact and high impact aerobic dance sessions found a higher correlation (r = 0.84) between RPE and $\dot{V}O_2$ for the high impact session compared to the low impact session (r = 0.45) (Grant, Davidson, Aitchison, & Wilson, 1998). During the low impact session participants achieved a mean exercise intensity level of 52% $\dot{V}O_{2\ max}$ with a mean RPE of 10. As an RPE of 12-13 is equivalent to 50-74% $\dot{V}O_{2max}$ (ACSM, 1990), the participants underestimated their exercise intensity. It is therefore suggested that an RPE of 11 or more should be used when extrapolations are required (Borg & Kaijser, 2006).

Physiological tools

Graded exercise test

The graded exercise test (GXT) has long been utilised for measuring cardiorespiratory fitness or 'the ability to perform large muscle, dynamic, moderate-to-high intensity exercise for prolonged periods' (Franklin, 2000, p. 68). Direct measurement of maximal oxygen uptake ($\dot{V}O_{2max}$) is the accepted standard measure of cardiorespiratory fitness (Siconolfi et al., 1982) and is the product of maximal cardiac output (L/min) and arterial-venous oxygen difference (mL O_2/L). However, measurement of $\dot{V}O_{2max}$ is not suitable for women older than 55 years without physician supervision (Franklin, 2000). Submaximal exercise tests are therefore appropriate to predict $\dot{V}O_{2max}$ for this population in an unsupervised clinical setting. Submaximal testing aims to determine a HR response at various submaximal work rates and assumes that a steady-state HR is reached for each intensity level and that maximal HR is uniform for a given age (Franklin, 2000).

The most commonly used devices for testing cardiorespiratory fitness in a clinical setting are the treadmill and cycle ergometer (Franklin, 2000). Cycle ergometers offer a non-weight-bearing alternative whereby work rates can be easily adjusted in smaller increments and results in less anxiety in participants compared to treadmills (Franklin).

A popular test for predicting $\dot{V}O_{2max}$ is the Astrand-Ryhming cycle ergometer test (Astrand & Ryhming, 1954). This single-stage 6-minute test involves participants cycling at a rate of 50 rpm with an initial work rate of 50 watts for unconditioned females. An average measure of the HR at the 5th and 6th minutes is used to predict $\dot{V}O_{2max}$ from a nomogram. One problem with using the Astrand-Ryhming protocol is that the initial work rate of 50 rpm may be too high for unconditioned women. A modification of the Astrand-Ryhming test was therefore developed by Siconolfi et al. (1982) consisting of an initial work rate of 25 watts for women.

Summary

The postmenopausal period is defined as the period of a woman's life following 12 consecutive months of amenorrhea. Average life expectancy for women in Queensland is 82 years. As the average age at which menopause occurs is 50 years, this leaves a considerable time spent living in the postmenopausal state. Women must adopt a healthy premenopausal and postmenopausal lifestyle to ensure time spent in this period is free from various disabilities.

Queensland has the highest rates of obesity in Australia. Adults living in regional Queensland show higher rates of overweight compared to those living in major cities. Obesity is greatest in the 50-60 year age group with women more than twice as likely to be obese compared to 20-24 year olds. The health costs of obesity and related diseases in Australia are significant. Australia is experiencing an accelerated aging of the population that is expected to continue for many decades. This trend coupled with the obesity epidemic has implications for medical and health care resources and the national health budget. Various factors have been blamed for the greater prevalence of overweight and obesity in postmenopausal women including reduced metabolic rate and environmental or societal factors. Weight gain is associated with the postmenopausal period, however it has been suggested that BMI increases at a steady rate with age rather than accelerating in the perimenopausal period. A reduction in exercise participation rates in the postmenopausal period implies that the level of exercise in the postmenopausal period may be a more significant predictor of weight gain compared to menopausal status or age.

Overweight and obesity in postmenopausal women are associated with increased risk of death, morbidity and accelerated aging. Several chronic diseases including cardiovascular disease, NIDDM, hypertension and breast cancer are also linked to overweight and obesity. A strong relationship exists between body fat distribution and co-morbidities, with central obesity posing the greater health risk. The strong relationship between central obesity and the linked risk factors for coronary artery disease and NIDDM (hypertension, dyslipidemia and hyperglycaemia) is termed the metabolic syndrome. Therefore, central obesity is thought to be an important determinant of the metabolic syndrome. As central obesity poses a greater risk of early death for postmenopausal women due to its strong association with co-morbidities it is imperative that this population participate in regular exercise.

Moderate intensity exercise has been shown to be cardioprotective in postmenopausal women through its positive effect on increasing HDL ratios and lowering levels of intra-abdominal fat. Regular exercise promotes a decrease in fat mass, an increase in lean body mass and metabolic rate and improves muscle insulin sensitivity, thus lowering the risk of NIDDM. It is also associated with primary and secondary prevention of CHD and stroke and lowers the risk of breast cancer in postmenopausal women. Regular exercise can also assist in relieving the psychological symptoms of menopause, pertains to positive attitudes of social interaction, tension release and a better quality of life, reduces anxiety and depression, improves mood and enhances self-esteem.

Despite the numerous health-related benefits of exercise, many postmenopausal women do not participate in any form of regular exercise. A possible explanation for this phenomenon could be the promotion of exercise participation as a mechanism for the prevention of disease implying that exercise is an obligatory activity. Exercise promotional campaigns in Australia have traditionally based exercise prescription on the physiological aspects of frequency, intensity, time and type, suggesting that exercise is an unpleasant experience only to be performed for gaining physical health benefits. As exercise can offer many benefits to postmenopausal women in addition to physical health, an understanding of the psychological reasons why exercise participation levels are declining in older women is therefore needed.

Several determinants influence a postmenopausal woman's decision to participate in exercise. Determinants of exercise behaviour are categorized into personal characteristics, environmental factors, and psychological variables and can act as barriers to postmenopausal women contemplating exercise adoption. Each of these barriers must be addressed in order to increase exercise participation rates in postmenopausal women.

Personal characteristics include income and education level, perceived lack of time and knowledge of the physiological aspects of exercise prescription. Environmental factors include exercise facility accessibility and proximity, environmental aesthetics and climatic conditions. Psychological variables include self-efficacy, perceived good health and benefits of exercise and exercise enjoyment through mastery experiences.

Behavioural models such as Social Cognitive Theory, Health Belief Model, Transtheoretical Model and exercise-induced affect form the basis for understanding exercise behaviour and may provide a framework for effective design and implementation of strategies for exercise behavioural change. Various measures have been developed to test exercise behaviour including the Self-efficacy for Exercise Scale, Health Belief Model Scale, Stage of Exercise Change and Subjective Exercise Experiences Scale. Additionally, assessment tools used to measure the physiological aspects of exercise include calorimetry, diaries, heart rate monitors and pedometers. One of the most popular methods of assessment is the exercise questionnaire. The MWMHP questionnaire was developed to assess activities relevant to mid-life Australian women. The questionnaire focuses on exercise, occupational activities and housework.

Identifying the physiological and psychological reasons for why some postmenopausal women do not exercise may allow for the development of strategies to increase exercise adoption in this population. It is imperative that exercise participation rates increase in this population to ensure that the postmenopausal period is free from various disabilities.

Chapter 3

Methodology

Introduction

The aim of this research was to determine the psychobiological predictors of exercise behaviour in postmenopausal women resident in North Queensland. Specifically, the following research questions were addressed: (a) Do the personal characteristics of exercising and non-exercising postmenopausal women differ? (b) Do exercise related physiological and psychological characteristics of exercising and non-exercising postmenopausal women differ? (c) Does the exercise self-efficacy of postmenopausal women differ between exercisers and non-exercisers? (d) Do health beliefs discriminate between exercising and non-exercising postmenopausal women? (e) Do the physiological and psychological responses to a graded exercise test differ in exercising and non-exercising postmenopausal women? It was expected that for this sample of postmenopausal women, (a) personal characteristics would effectively discriminate between exercisers and non-exercisers, (b) physiological and psychological characteristics would effectively discriminate between exercisers and non-exercisers, (c) non-exercisers would have lower exercise self-efficacy compared to those who are exercisers, (d) health beliefs would effectively discriminate between exercisers and non-exercisers and, (e) exercise behaviour would influence exercise induced affect.

Participants

Postmenopausal women (N=124) resident in North and Far North Queensland volunteered and gave their written informed consent to participate in this study as approved by the James Cook University Human Subjects Research Sub-Committee (approval number 1836) (Appendix A). Participants were recruited through E-mail bulletin boards within the James Cook University community, advertisements in regional newspapers, community announcements on regional television and radio stations and on the community bulletin boards of local service clubs. This type of recruitment of participants was used as random sampling is typically not possible for group memberships such as exercisers and non-exercisers in research that investigates differences in trained versus untrained participants (Thomas & Nelson, 2001). Participants were eligible for the study if they had undergone at least 12 consecutive months of amenorrhea.

Table 1. Characteristics of participants

Characteristics	Mean ±SD	Minimum	Maximum
Age (yrs)	60.5±6.9	45	83
Height (cm)	162.1±6.0	146.7	179.2
Weight (kg)	70.5±12.3	41.1	113.6

Apparatus

A physical activity readiness questionnaire (PAR-Q) was used to determine the medical history and physical activity readiness (Appendix B) of the participants. A self-report measure of exercise history was obtained using a modified version of the instrument used for the MWMHP (Guthrie, 2002) (Appendix C). Questionnaire items included personal characteristics information such as age, place of birth, length of time resident in the greater Townsville and Cairns regions, marital status, highest level of schooling, employment status, menopausal status and use of hormone replacement therapy (HRT). Questionnaire items also sought to determine the extent of participant knowledge concerning current weight, heart disease risk factors, obesity-related diseases, and amount (number of hours) of exercise per week required to reduce body weight. Participants were required to indicate up to seven factors that may put an individual at risk of heart disease. Participants were also required to indicate up to seven obesity-related diseases and how much exercise was required each week to reduce body weight from a choice of six answers ranging from 1 hour per week to daily (Appendix C).

A five-item stage of change for exercise measure was included in the self-report questionnaire to determine participant current exercise behaviour. This measure was based on Prochaska and DiClemente's (1983) version regarding smoking cessation and was modified to describe exercise behaviour. The measure included precontemplation, contemplation, preparation, action and maintenance stages. Precontemplation was described as 'I currently do not exercise and do not intend to'. Contemplation was described as 'I currently do not exercise but am thinking to start'. The preparation stage was described as 'I currently exercise some, but not regularly'. The action stage was defined as 'I exercise regularly and have begun in the last six months' and the maintenance stage as 'I exercise regularly and have been doing so longer than six months'. Intertester reliability was found to be satisfactory (.78) (Marcus, et al., 1992). Information was also obtained on participant exercise history during their school years and whether the experience was positive, negative or neutral (Appendix C).

Thirty-six leisure-time activities were also included in the questionnaire to determine recent exercise history information. Participants were required to choose the activities they had performed in the past week along with the number of times the activity was performed and the approximate time spent in that activity per occasion. Participants were also asked if these activities were different from those performed in the past 12 months and the reason for changing. Finally, seven non-leisure time activities were included covering occupational and household daily activities.

Two scales were used to measure exercise and health behaviour. The first was a modified version of the self-efficacy for exercise scale (McAuley, 1992b) (Appendix D). This scale is a 13-item instrument listing common reasons for preventing participation in exercise. Participants were asked to indicate how confident they felt they could exercise in the event of each of the circumstances arising. A scale of 0% (not at all confident) to 100% (highly confident) was used to ascertain a barriers specific exercise self efficacy score. A total exercise self efficacy score was obtained by summing the confidence ratings and dividing by the 13 items in the scale. The original scale asked participants if they believed they could exercise 3 times per week. However, this was omitted for the current study as it was felt it was inappropriate for the non-exercising participants. The scale has previously been tested for reliability (alpha coefficient = .92) (McAuley et al., 1993) and validity, with exercise self efficacy found to be significantly correlated to participation in exercise (Lambda χ estimates >0.81) (Resnick & Jenkins, 2000).

The second measurement scale was a modified version of the Health Belief Model (HBM) constructed and tested by Champion (1984) who measured the constructs of susceptibility, seriousness, benefits, barriers and health motivation of women related to breast self-examination and breast cancer. The HBM version used for this study required participants to indicate how much they agreed or disagreed with various statements related to individual health beliefs related to exercise and obesity according to a seven point Likert scale (7 - strongly agree to 1 - strongly disagree) (Appendix E). Modification of the scale was achieved by replacing the words 'self-examination' and 'breast cancer' with 'exercise' and 'obesity-related disease' respectively. Champion's (1984) instrument was tested for consistency, reliability and validity with alpha coefficients of .7, correlation coefficients above .7 and satisfactory factor analysis and multiple regression results. The HBM scale used for the current study consisted of six categories of questions, including the perceived susceptibility of developing an obesity-related disease, the perceived seriousness of the disease, the perceived benefits of exercise to decrease the risk of the disease, the barriers to participating in regular exercise, the cues that may influence participation in exercise and how well respondents felt they could control the disease.

Measures of pre, during (5, 10, 15 and 20 minutes) and post-exercise affect were obtained using the Subjective Exercise Experience Scale (SEES) (McAuley & Courneya, 1994) (Appendix F). The SEES was designed to assess the subjective experiences unique to exercise, both during and following activity. The SEES consists of 12 items used to assess positive well-being (SEESa), psychological distress (SEESb) and fatigue (SEESc). Perceived exertion measures were determined using the Borg (1970) 15-point Rating of Perceived Exertion (RPE) scale (Appendix G).

HR both at rest and during exercise was measured by a HR monitor (model S610; Polar, Kempele, Finland). Resting blood pressure (BP_{rest}) was measured by auscultation using a stethoscope and an anaeroid sphygmomanometer (model 500-V ALP K2). Height was measured without shoes using a portable height scale (model PE87, Mentone, Victoria, Australia), and body weight was measured using portable scales (model EB6171, Camry, Guangdong, China). The body weight scales were calibrated prior to data collection and at regular intervals using a 4 kg mass. Waist and hip girth were obtained using a steel tape measure (model F10-02, KDS, Kyoto, Japan) Waist girth was determined as the minimum circumference, midway between the iliac crest and the lower costal border of the ribs, while hip girth was determined as the maximum circumference, with the participant standing in the anatomical position with the feet together and relaxed gluteal muscles (Norton & Olds, 2000).

A graded exercise test (GXT) conducted on a bicycle ergometer (Monark 828E, Varberg, Sweden) was used to obtain a submaximal estimation of $\dot{V}O_{2max.}$ A modified version of the 6 minute Astrand-Ryhming protocol (Astrand & Ryhming, 1954) was used for its suitability for older women (Siconolfi, Cullinane, Carleton & Thompson, 1982). Siconolfi et al., (1982) believed that the higher exercise rates of the original Astrand-Ryhming protocol can often prevent successful completion of the test by inactive older adults. The bicycle ergometer was also calibrated prior to testing and at regular intervals during the data collection period. Calibration was performed by detaching the brake belt from the balancing spring and fastening a 4 kg weight to the balancing spring while reading the corresponding weight from the pendulum.

Procedure

Prior to data collection, arrangements were made with the participant for the date and time of testing. It was also explained to them the need for no caffeine, eating, alcohol or tobacco products within 3 hours of participation in the test and to refrain from exercising on the day of the tests. Participants were also given suggestions regarding the appropriate clothing to wear & told to bring reading glasses if required.

Data collection was undertaken in the Human Performance Laboratories, Institute of Sport and Exercise Science, James Cook University, Townsville and Cairns campuses. On arrival at the laboratory, participants were fitted with the HR monitor chest strap and were provided with a participant information sheet, an informed consent form, and a PAR-Q. The consent form and PAR-Q were completed and all forms were signed. The participants were then required to complete the exercise history questionnaire in the presence of the tester so that clarification of items could be provided if required. The two behavioural measurement scales, barriers specific self-efficacy scale and HBM, were then administered.

Resting heart rate (HR_{rest}) was recorded following completion of the questionnaires so as to allow for several minutes of relaxed sitting. BP_{rest} was also obtained at this point along with the anthropometric measures of height, weight, waist and hip girth. From the HR_{rest} measurement, 70%HR_{max} was determined. Participants were then seated on the bicycle ergometer while a further explanation of the test was provided. Participants were also given additional assurance that they could terminate the test at any time for any reason. The correct seat height was ascertained by ensuring that the knee was only slightly flexed when the pedal was at the lowest position. The submaximal test commenced at a pedal rate of 50 rpm and a workload of 25 watts for the first 2 minutes. HR was recorded every minute. If the HR after the first 2 minutes was < 70%HR_{max}, the workload was increased by 25 watts for another 2 minutes and again at the next 2 minute stage if HR was still <70%HR_{max}. If the HR was ≥70%HR_{max}, workload remained at that stage. The average HR was taken between the 5th & 6th minute once steady state HR was achieved and if the difference between these exceeded 5 beats per minute (bpm), the test was prolonged for another 2 minutes. However, heart rate was not to exceed 170 bpm during the test.

Following recovery from the submaximal test, another appointment was made for the second visit to the laboratory. Participants were reminded to refrain from alcohol, caffeine, eating or tobacco products 3 hours prior to participation and to refrain from exercise prior to visiting the laboratory on the day of the second visit.

Prior to the second visit, the participants' cycling workload was established for 60% estimated $\dot{V}O_{2max}$ (Appendix G). On arrival, HR_{rest} was recorded and pre-exercise affect was determined. Participants were then instructed to pedal at 50 rpm for a duration of 20 minutes. HR was recorded every minute while affect and RPE were recorded every 5 minutes during the 20 minute exercise bout. HR and affect were also measured immediately post-exercise.

Reliability

Reliability testing was performed on the GXT, self-efficacy for exercise scale and HBM scale. Twelve postmenopausal women were asked to return to the laboratory on a further occasion to perform a second GXT. This appointment occurred within a week following their second visit, and at the same time of day as their initial appointment. The self-efficacy for exercise scale was mailed out to 18 participants to complete, while the HBM scale was mailed out to a further 17 participants. Turnaround time for return of the completed scales was 14 days. Response rate was 100%.

Data analysis

Of the 124 postmenopausal women who participated in the study, 15 were unable to complete the bicycle ergometer tests due to contraindications to exercise and the advent of cyclone Larry in Cairns. This incomplete data was excluded from the analysis. Following data collection, the participants were classified as exercisers (n = 59) or non exercisers (n = 50) on the basis of whether they had performed a minimum of 150 minutes of accumulated moderate intensity exercise in the past 7 days, as per the National Physical Activity Guidelines for Australians (DHAC, 1999).

Prior to data analysis, physiological and psychological variables were screened to ensure that the distributions and assumptions of univariate and multivariate analysis were met. Where analysis was conducted using the general linear model, testing for skewness, kurtosis, linearity and homoscedasticity was performed. Non-parametric tests were used if violation of these assumptions occurred. Outliers within data were detected through the examination of Z scores and boxplots.

Data collected in this study included ratio, nominal, ordinal and interval levels of measurement. A summary of the variables and their respective level of measurement are shown in Table 2.

Table 2. Study variables and level of measurement

Type of variable	Description of variable	Level of measurement
Personal characteristics	Age of participant	Ratio
	Menopausal status	Nominal
	HRT treatment	Nominal
	Employment status	Nominal
	Marital status	Nominal
	Occupation	Nominal
	Highest level of education obtained	Ordinal
	Stage of exercise change	Ordinal
	Past exercise history	Ordinal
	Quality of past exercise experience	Ordinal
	Reason why activities changed in last 12 months	Nominal
Correct knowledge responses	Cardiovascular risk factors	Nominal
	Obesity-related diseases	Nominal

	Exercise amount per week needed to lose weight	Nominal
	Current weight	Nominal
Physiological and psychological characteristics	HR_{rest}	Interval
	SBP_{rest}	Interval
	DBP_{rest}	Interval
	BMI	Interval
	WHR	Interval
	VO_{2max}	Interval
	Total exercise self-efficacy score	Interval
Barrier items	Weather was very bad	Interval
	I was bored by activity	Interval
	I was on vacation	Interval
	I was not interested in activity	Interval
	I felt pain/discomfort	Interval
	I had to exercise alone	Interval
	It was not fun/enjoyable	Interval
	Difficult to get to location	Interval
	I didn't like the activity	Interval
	Schedule conflicted	Interval
	I felt self-conscious	Interval
	Instructor didn't offer encouragement	Interval
	Under personal stress	Interval
Health beliefs	Perceived susceptibility to obesity-related diseases	Interval
	Perceived seriousness of developing an obesity-related disease	Interval
	Perceived benefits of exercise participation	Interval
	Perceived consequences of exercise participation	Interval
	Cues to influence exercise participation	Interval
	Health motivation	Interval
Exercise-induced affect	Positive well-being (SEESa)	Interval
	Psychological distress (SEESb)	Interval
	Fatigue (SEESc)	Interval
	Heart rate	Interval
	RPE	Interval

Statistical analysis included Analysis of Variance (ANOVA), Chi-square, Mann-Whitney U test, Tukey's HSD and Discriminant Function Analysis (DFA). Separate mixed design repeated measures ANOVAs were performed on the affect data. Follow-up univariate contrasts (Bonferroni) were performed on significant effects to determine the significance of pairwise comparisons (Vincent, 2005). ANOVA was used to determine group differences in the physiological and psychological characteristics, barrier items, exercise self-efficacy and stages of change and health beliefs. Chi-square analysis was used to determine the personal characteristics of age, menopausal status, HRT treatment, employment status, marital status and knowledge questions. Mann-Whitney U tests were used to determine the personal characteristics of education level, exercise history during school years and the quality of the exercise experience. Tukey's HSD test was used to determine if a significant difference existed between the stages of change in regards to participant exercise self-efficacy.

DFA was performed on the predictor variables HRrest, SBP_{rest}, BMI, predicted VO_{2max}, exercise self-efficacy, exercise barrier items and health beliefs. This technique was chosen to discriminate between exercising and non-exercising postmenopausal women based on the above variables. The technique has not been used extensively in this field

Discriminant analysis is a multivariate statistical technique used for two purposes. The first purpose is to identify variables that will effectively discriminate between two or more naturally occurring, mutually exclusive groups. This is achieved by descriptive discriminant analysis (DDA), a process similar to multivariate analysis of variance (MANOVA) (Stevens, 1996). The second purpose of discriminant analysis is to classify participants into groups according to a 'classification rule' (Krzanowski & Marriott, 1995). Predictive discriminant analysis (PDA) performs this function.

DDA interprets ways in which groups differ, thus allowing discrimination based on a set of characteristics, how well these characteristics discriminate and which of the characteristics are the most powerful (Klecka, 1980). MANOVA often precedes DDA to determine if group differences exist. If no group differences exist however, DDA would not be required (Joyner, 1992).

Several questions can be addressed by utilising DDA pertaining to variable selection, variable ordering and the underlying constructs in DDA. Variable selection attempts to determine a subset of variables that will separate the groups as effectively as the original set of variables. Stepwise discriminant analysis can be used for this purpose as it enters the independent variables into the discriminant function one at a time. The variable that offers the most separation between the groups is selected. This variable is then paired with each of the remaining variables to determine the combination which produces the greatest discrimination. The variable contributing to the best combination is then selected. The two variables are then combined with the other variables and this process is repeated until the remaining variables do not offer sufficient separation (Klecka, 1980). Stevens

(1996) however, argues that stepwise discriminant analysis capitalises on chance and warns that it should only be employed with caution.

Variable ordering in DDA attempts to identify variables that are most important for separating the groups. While previous researchers have thought that stepwise discriminant analysis fails to consider intercorrelations of the variables, the stepwise discriminant analysis program used in SPSS contains an F-to-remove statistic which overcomes the possibility of ignoring variables not yet in the analysis (Joyner, 1992).

If any group differences exist, it may be necessary to gain an interpretation of the underlying constructs of these differences. This can be achieved by using the standardised linear discrimminant function (LDF) weights and the correlation between the LDF and the structure correlations (Stevens, 1986). However, structure correlations have increasingly been utilised over LDF weights due to interpretation problems found with the latter (Hair, Anderson, Tatham & Black, 1998).

PDA uses mathematical equations, or discriminant functions, for the purpose of classification. The discriminant functions combine group characteristics so as to allow identification of the group to which a data case most closely resembles (Klecka, 1980).

A number of assumptions must be met when using DFA. These include the use of two or more groups with at least two cases per group. Groups drawn from the selected population should be normally distributed and the covariance matrices of the predictor variables must be homogenous across groups. Also, a linear relationship must exist between independent and dependent variables (Klecka, 1980). While these assumptions do exist, they are not essential to all of the statistical procedures of DFA. In addition, DFA is such a robust technique that it may tolerate minor violations of these assumptions, especially when using large groups of participants.

Intraclass correlational (ICC) analysis was performed on the test-retest reliability data. ICC reliability has been found to be a more appropriate indicator of test-retest reliability compared to Pearson's correlation coefficient (Vincent, 2005).

Data were analysed using the statistical software, Statistical Package for Social Sciences for Windows (SPSS version 12.0). An alpha level of .05 was adopted for this study. Where appropriate, results were reported as mean ±standard deviation.

Chapter 4

Results

Introduction

The results presented in this chapter detail sociodemographic data and statistical analysis of the physiological and psychological characteristics, exercise self-efficacy, health beliefs and exercise-induced affect of a sample of postmenopausal women resident in North and Far North Queensland.

Screening of data

Prior to statistical analysis, interval data was examined to ensure that the assumption of normality was met. Variables were examined for kurtosis and skewness. Normally distributed variables will have kurtosis values not exceeding three (Ferber, 1949) and skewness values not exceeding two (Vincent, 2005). Kurtosis and skewness values are presented in Appendix H. The results indicated that the majority of the variables were normally distributed. Mean perceived benefits of exercise (BE) exceeded the kurtosis value and was found to be slightly platykurtic on a normal probability plot. Psychological distress affective responses (SEESb) exceeded the acceptable kurtosis and skewness values and were found to be positively skewed for both exercisers and non-exercisers.

Data were also screened for outliers, missing values and input errors. Outliers were determined through consideration of Z scores and examination of boxplots for each variable. A summary of the Z scores for each variable is presented in Appendix I. Data outliers can be problematic depending on the context of analysis and therefore must be evaluated to determine whether data should be included in the analysis. For sample sizes larger than 80, Z score outlier threshold ranges are between three and four (Hair et al., 1998). The SEESb at each time measurement had Z scores greater than four. On examination of the boxplots SEESb was also found to have numerous outliers. SEESb was therefore excluded from further analysis.

Five other variables also had Z scores above the threshold range. On examination of boxplots, eight extreme outliers were found and excluded from the analysis. Upon re-examination of the Z scores, the variables of positive well-being (SEESapost) and mean perceived benefits of exercise (BE) were above the threshold.

Screening of data revealed that most interval variables met the assumption of normal distribution. As the variables SEESapost and BE did not meet the assumption of distribution normality, caution was exercised in interpretation of these results.

Personal characteristics of participants

Postmenopausal women resident in the Australian tropical regional centres of Townsville and Cairns participated in this study. Descriptive data for both groups of participants (exercisers and non-exercisers) are presented in Table 3. There was no significant between-group difference in mean age. Chi-square analysis revealed no significant between-group differences for menopausal status ($\chi^2 = 3.36$, $df = 1$, $p = 0.06$), HRT treatment ($\chi^2 = 0.27$, $df = 1$, $p = 0.60$), employment status ($\chi^2 = 3.19$, df

=1, p =0.07) or marital status (χ^2 =3.54, df =5, p =0.62). Frequency data for occupations of exercisers and non-exercisers are presented in Appendix J.

Data on the highest level of education obtained by participants, exercise history during their school years and whether the past exercise experience was regarded as positive, negative or neutral are presented in Table 4. The current stage of exercise change of participants is presented in Table 4. Mann-Whitney U tests were performed to determine whether significant differences existed between exercisers and non-exercisers for these variables.

Table 3. Mean ±SD values for participant age and frequency data for participant menopausal status, hormone replacement therapy treatment (HRT), employment status and marital status

	Exercisers (n=53)	Non-exercisers (n=48)	Total sample (N=101)
Mean age (years)	60.2 ± 7.8	59.6 ± 5.1	
Menopausal status			
Natural	40(75.5%)	28(58.3%)	68(67.3%)
Surgery	13(24.5%)	20(41.7%0	33(32.7%)
HRT			
Yes	11(20.8%)	8(16.7%)	19(18.8%)
No	42(79.2%)	40(83.3%)	81(81.2%)
Currently employed			
Yes	26(49.1%)	32(66.7%)	58(57.4%)
No	27(50.9%)	16(33.3%)	43(42.6%)
Marital status			
Married	34(64.2%)	29(60.4%)	63(62.4%)
Separated	2(3.8%)	4(8.3%)	6(5.9%)
Divorced	9(17.0%)	6(12.5%)	15(14.9%)
Widowed	5(9.4%)	4(8.3%)	9(8.9%)
Never married	0(0%)	2(4.2%)	2(2.0%)
De facto	3(5.7%)	3(6.3%)	6(5.9%)

Table 4. Frequency data for participant education level, exercise history during school years, quality of exercise experience during school years and stage of exercise change

	Exercisers (n=53)	**Non-exercisers (n=48)**	**Total sample (N=101)**
Educational level			
Primary/high school	17(32.1%)	25(52.1%)	42(41.6%)
Technical/trade	9(17.0%)	8(16.7%)	17(16.8%)
University/tertiary	27(50.9%)	15(31.3%)	42(41.6%)
Past exercise history during school years			
Very often	25(47.2%)	17(35.4%)	42(41.6%)
Often	14(26.4%)	19(39.6%)	33(32.7%)
Sometimes	6(11.3%)	9(18.8%)	15(14.9%)
Not often/never	8(15.1%)	3(6.3%)	11(10.9%)
Quality of past exercise experience			
Positive	41(77.4%)	39(81.3%)	80(79.2%)
Negative	6(11.3%)	1(2.1%)	7(6.9%)
Neutral	6(11.3%)	8(16.7%)	14(13.9%)
Stage of exercise change			
Do not ex & don't intend to	0(0%)	5(10.4%)	5(5.0%)
Do not ex & thinking to start	0(0%)	9(18.8%)	9(8.9%)
Ex some but not regularly	4(7.5%)	23(47.9%)	27(26.7%)
Ex reg & begun in last 6mths	4(7.5%)	3(6.3%)	7(6.9%)
Ex reg & longer than 6mths	45(84.9%)	8(16.7%)	53(52.5%)

Significant between-group differences were found for highest level of education (U = 971.5, p =0 .03) and for stage of exercise change (U = 308.0, p = 0.00). Exercisers had achieved a higher level of education and were at a higher level of stage of exercise change compared to the non-exercisers. However, there were no significant between-group differences for exercise history during school years (U = 1197.5, p = 0.59) or the quality of the exercise history experience (U = 1243.5, p = 0.78). Data were collected on whether the participants had performed leisure-time activities over the past 12 months which were different to the activities they had participated in the past 7 days. Participants were also asked to list reasons why they had not performed these activities in the past 7 days. Frequency data on the reasons for a change in activities is presented in Appendix K.

Data were also collected regarding the depth of participant knowledge of cardiovascular risk factors, obesity-related diseases, the amount of exercise required per week to lose weight and current body weight. Chi-square analysis revealed no significant between-group differences for all knowledge responses (Table 5).

In summary, a significant between-group difference was found for highest level of education achieved and stage of exercise change. No significant between-group differences were found for age, employment status, marital status, exercise history during school years or the quality of the exercise history experience and the depth of participant knowledge concerning heart-disease risk factors, obesity-related diseases, the amount of exercise required per week to lose weight and current body weight. Therefore, the hypothesis that personal characteristics will differ between exercising and non-exercising postmenopausal women was not fully supported.

Table 5. Crosstabulations of correct knowledge responses for cardiovascular risk factors, obesity-related diseases, exercise amount required per week to lose weight and current weight

	Exercisers (n=53)	Non-exercisers (n=48)	Total sample (N=101)
Cardiovascular risk factors			
Smoking	51(96.2%)	44(91.7%)	95(94.1%)
High fat diet	48(90.6%)	43(89.6%)	91(90.1%)
Low levels of act	47(88.7%)	38(79.2%)	85(84.2%)
Family history	52(98.1%)	46(95.8%)	98(97.0%)
Obesity	52(98.1%)	47(97.9%)	99(98.0%)
Obesity-related diseases			
Heart attack	53(100.0%)	47(97.9%)	100(99.0%)
Arthritis	25(47.2%)	22(45.8%)	47(46.5%)
Stroke	43(81.1%)	42(87.5%)	85(84.2%)
Atherosclerosis	40(75.5%)	38(79.2%)	78(77.2%)
Diabetes	47(88.7%)	44(91.7%)	91(90.1%)
Angina	42(79.2%)	35(72.9%)	77(76.2%)
Breast cancer	9(17.0%)	5(10.4%)	14(13.9%)
Exercise amount			
1-3 hr/wk	8(15.1%)	13(27.1%)	21(20.8%)
4-5 hr/wk	9(17.0%)	7(14.6%)	16(15.8%)
Daily	36(67.9%)	28(58.3%)	64(63.4%)
Current weight	21(39.6%)	20(41.7%)	41(40.6%)

Physiological and psychological characteristics

Participant anthropometric, physiological and psychological characteristics were measured and one-way ANOVA was utilised to determine if significant between-group differences occurred for each of the variables (Table 6). Mean DBP_{rest} ($F_{1,99}$=7.57, p=0.01), BMI ($F_{1,99}$=33.63, p=0.00) and WHR ($F_{1,99}$=5.83, p=0.02) were all found to be significantly higher in non-exercisers. Mean $\dot{V}O_{2max}$ ($F_{1,99}$=21.57, p=0.00) and total exercise self-efficacy score ($F_{1,99}$=39.56, p=0.00) were significantly lower in non-exercisers. There were no significant between-group differences for HR_{rest} ($F_{1,99}$=3.58, p=0.06) or SBP_{rest} ($F_{1,99}$=.182, p=0.67). Frequency data for waist circumference is presented in Appendix L.

Table 6. Mean ±SD values for resting heart rate (HR_{rest}), resting systolic blood pressure (SBP_{rest}), resting diastolic blood pressure (DBP_{rest}), body mass index (BMI), waist-to-hip ratio (WHR), cardiorespiratory fitness ($\dot{V}O_{2max}$) and exercise self-efficacy score

Characteristics	Exercisers (n=53)	Non-exercisers (n=48)
HR_{rest}	69.86 ±9.70	73.35 ±8.69
SBP_{rest}	124.56 ±16.40	125.87 ±14.18
DBP_{rest}	69.2 ±1.25	73.95 ±1.17*
BMI	24.4 ±3.05	28.92 ±4.65*
WHR	.76 ±.005	.78 ±.008*
$\dot{V}O_{2max}$	26.06 ±4.81	21.77 ±4.42*
Exercise self-efficacy score	62.56 ±19.9	37.19 ±20.60*

* $p < .05$

DFA was used to determine the extent to which a combination of the physiological and psychological variables discriminate between exercisers and non-exercisers**.** DFA is considered a highly robust statistical technique, able to withstand most minor violations of the assumptions underlying this statistical procedure (Klecka, 1980). Nonetheless, assumptions including multivariate normality, outliers, linearity, homogeneity of variance-covariance matrices, multicollinearity and singularity, were assessed. Following screening, 101 cases were included in this direct entry DFA procedure. The independent variables used included HR_{rest},

SBP_{rest}, DBP_{rest} BMI, WHR, $\dot{V}O_{2max}$ and exercise self-efficacy score. The dependent variable was exercise behaviour.

DFA can utilise either a stepwise or direct entry procedure during analysis. The stepwise procedure involves the elimination of variables when they are found to be irrelevant. As the sample size to independent variable ratio is reduced, results become more generalisable and less stable (Hair et al., 1989). To avoid this problem, the direct entry procedure of DFA was chosen as this procedure enters all variables at the same time.

Participants were classified into two groups according to whether they had performed a minimum of 150 minutes of accumulated moderate intensity exercise in the past 7 days (DHAC, 1999). The two groups included exercisers (n=53) and non-exercisers (n=48). Consideration should be given to the unequal size of the two groups on interpretation of results. Klecka (1980) however, believes that due to the robust nature of DFA, some deviation from the assumptions of normality is allowed. In particular, significance tests remain useful, "… when the main interest is in a mathematical model that predicts well, or serves as a reasonable description of, the real world" (Smith & Spinks, 1995, p.384). Similarly, greater care should be taken in satisfying the assumptions of DFA with small sample sizes (Klecka, 1980). Tabachnick and Fidell (1996) suggest that robustness is expected if there are at least 20 cases in the smallest group. For the current study, the small difference in group size was not thought to be problematic, especially as sample sizes were relatively large.

Appropriate overall sample size guidelines vary from the number of cases exceeding the number of variables by more than two (Klecka, 1980), to at least 20 cases per variable (Hair et al., 1988). The latter recommendation however, "…may be difficult to maintain in practice" (Hair et al., 1988, p.258). The ratio of 14-to-1 cases per variable for this part of the analysis was deemed appropriate for an overall sample size.

Multivariate normality assumes that each group is drawn from a population with a normal distribution (Klecka, 1980). Normality was assessed via normality (Appendix H) and outlier (Appendix I) tests and the examination of boxplots. The predictor variables HR_{rest}, SBP_{rest}, DBP_{rest} BMI, WHR, $\dot{V}O_{2max}$ and total exercise self-efficacy score were all found to be normally distributed.

The assumption of linearity is met when all pairs of predictor variables are represented by a straight line. Visual inspection of scatterplots best determines the existence of a linear relationship (Hair et al., 1989). Scatterplots for the dataset indicated that there was a linear relationship between the predictor variables.

To satisfy the assumption of homogeneity of variance-covariance, a Box's M test was performed. Violation of this assumption may affect classification analysis (Klecka, 1980). As this test is very sensitive, an alpha level of .001 is recommended. The non-significant value of 0.01 indicated that homogeneity of variance-covariance could be assumed and that the null hypothesis could be rejected with confidence.

Another assumption of DFA is multicollinearity. If independent variables are highly correlated they are said to be multicollinear (Hair et al., 1988). This can prove to be problematic when interpreting results, especially for stepwise DFA. Predictor variables should have correlation values of $< r = 0.90$ (Hair et al., 1988). Pooled within-groups matrices revealed no multicollinearity between variables (Table 7), indicating the relative independence of the predictor variables HR_{rest}, SBP_{rest}, DBP_{rest} BMI, WHR, $\dot{V}O_{2max}$ and total exercise self-efficacy score.

Table 7. Pooled within-groups correlation matrices for resting heart rate (HR_{rest}), resting systolic blood pressure (SBP_{rest}), resting diastolic blood pressure (DBP_{rest}), body mass index (BMI), waist-to-hip ratio (WHR), cardiorespiratory fitness ($\dot{V}O_{2max}$) and exercise self-efficacy

	HR_{rest}	SBP_{rest}	DBP_{rest}	BMI	WHR	$\dot{V}O_{2max}$
HR_{rest}						
SBP_{rest}	.139					
DBP_{rest}	.114	.546				
BMI	.132	.280	.272			
WHR	.216	.390	.238	.342		
$\dot{V}O_{2max}$	-.511	-.267	-.144	-.485	-.277	
ex self-efficacy score	.062	-.027	-.074	-.091	-.166	.110

With all four of the assumptions of normality, linearity, homogeneity of variance-covariance and multicollinearity met, DFA analysis was applied to data. Discriminant functions are a linear combination of the predictor variables, in this case, HR_{rest}, SBP_{rest}, DBP_{rest} BMI, WHR, $\dot{V}O_{2max}$ and total exercise self-efficacy score. The discriminant functions maximise separation between the groups (Klecka, 1980). This separation was derived in a canonical fashion whereby the first derived function is identified as the best discriminator between groups, the second function is the second best discriminator and so on. The maximum number of discriminant functions allowable was the number of groups minus one therefore, one discriminant function was identified.

Once the discriminant function was derived it was tested for significance as measured through eigenvalues, canonical correlations and Wilks' lambda. The eigenvalue, percentage of variance explained and canonical correlation values are presented in Table 8.

Table 8. Eigenvalue, percentage of variance and canonical correlation

Function	Eigenvalue	% of variance	Canonical correlation
1	.774	100.0	.661

The eigenvalue is a measure of the power a function has to discriminate between the two groups. The larger the eigenvalue, the greater the discriminating power between groups (Klecka, 1980). In this case, the eigenvalue indicated a strong discriminating power between exercisers and non-exercisers. Relative percentages are also a measure of the discriminating power held by the functions. As there were only two groups in the analysis, the one function was responsible for 100 % of the discrimination between groups.

Canonical correlations are a measure of association, determining the relatedness between the groups and the discriminant function (Klecka, 1980). The moderate to high canonical correlation coefficient indicated a strong relationship between exercisers and non-exercisers and therefore demonstrated that the function was meaningful in explaining group differences (Klecka, 1980).

Statistical significance of the discriminant function was determined by identifying the ability of the physiological and psychological variables to discriminate between the two groups of postmenopausal women beyond what has already been established. Wilks' lambda is employed as a multivariate measure of group differences over the discriminating variables. Values of Wilks' lambda range between zero and one. Scores closer to zero represent greatly separated centroids and high discrimination (Klecka, 1980). In this case, the value of .564 indicates a moderate separation between the group centroids (Table 9). Wilks' lambda was tested for significance by converting it into a chi-square approximation. A function which lacks significance does not offer practical or theoretical importance and should therefore be ignored (Klecka, 1980). As the function was significant ($p<0.001$) it warranted further interpretation.

Table 9. Tests of significance

Test of Function	Wilks' Lambda	Chi-Square	Df	p
1	.564	54.767	7	.000

Having verified the discriminant function and tested for its significance, variables which contributed most to the function were then identified. Examination of the absolute magnitudes of the standardized canonical discriminant function coefficients served this purpose. Larger magnitudes of coefficients represent a greater contribution to the function (Klecka, 1980). Values above 0.30 were considered as good predictors (Ntoumanis, 2001). Coefficient magnitude values are presented in Table 10.

Table 10. Standardised canonical discriminant function coefficients

Independent variable	**Function**
ex self-efficacy score	.648
BMI	-.513
SBP_{rest}	.317
DBP_{rest}	-.263
$\dot{V}O_{2max}$	.213
HR_{rest}	-.100
WHR	.027

The total exercise self-efficacy score was the strongest contributor, followed by BMI and SBP_{rest}. Interpretation of the significant discriminant function can also be gained by examination of the structure coefficients. Structure coefficients consider the relationship between the predictor variables and the function, allowing the more important variables to be identified (Klecka, 1980). High scores indicate good predictive ability (Ntoumanis, 2001). Structure coefficients are presented in Table 11.

Table 11. Structure matrix

Predictor variable	Function
ex self-efficacy score	.718*
BMI	-.662*
$\dot{V}O_{2max}$	.530*
DBP_{rest}	-.314
WHR	-.276
HR_{rest}	-.216
SBP_{rest}	-.049

*Largest absolute correlation between each variable and the discriminant function

Total exercise self-efficacy score, BMI and $\dot{V}O_{2max}$ were the important variables for the function. Therefore, a higher total self-efficacy score, low BMI and high $\dot{V}O_{2max}$ are the strongest predictor variables for physiological and psychological characteristics investigated in this study. The hypothesis that physiological and psychological characteristics will effectively discriminate between exercising and non-exercising postmenopausal women resident in the tropics is therefore supported. In addition, the significant between-group difference for exercise self-efficacy supports the hypothesis that non-exercising postmenopausal women will have lower exercise self-efficacy compared to those who are exercisers.

Following interpretation of the discriminant function, a classification procedure was applied to determine which group a participant most likely belonged. Correct group classification indicates the accuracy of the classification procedure and the degree of group separation (Klecka, 1980). The classification procedure correctly placed

80.2% of cases of which 84.9% of the exerciser group and 75% of the non-exerciser group were correctly classified (Table 12). If group allocation was made by chance the expected correct classification would be 50%. Therefore, both groups resulted in greater than chance correct allocations by 34% and 25% respectively.

The original classification procedure derived the discriminant functions from all the available data cases, including the case to be classified and can result in an optimistic classification of cases (Hair et al., 1989). A cross-validation procedure was therefore applied to assess the consistency of the original classifications. The cross-validation procedure calculates the discriminant functions from all the cases except for one, often generating lower classifications compared to the original (Tabachnick & Fidell, 1989). This was the case in the current study with a decrease in the percentage of correct classifications to 75.2% of which 81.1% of exercisers and 68.8% of non-exercisers correctly classified (Table 12). However, both groups retained correct classifications which were greater than chance by 21.1% and 18.8% respectively.

Table 12. Classification matrix

	Exercise category	Predicted group membership (%) **1**	**2**
Original	Exerciser	**84.9**	15.1
	Non-exerciser	25.0	**75.0**
Cross-validated	Exerciser	**81.1**	18.9
	Non-exerciser	31.3	**68.8**

Exercise self-efficacy and barriers to exercise

DFA was then performed on the exercise self-efficacy barrier items to determine whether specific barriers can effectively discriminate between the two groups of postmenopausal women. The ratio of 11-to-1 cases per variable for this part of the analysis was deemed appropriate for an overall sample size. The direct entry procedure was again utilised for analysis. The barrier items 2, 4 and 9 were firstly excluded from the analysis due to their repetitiveness. This was in accordance with Resnick & Jenkins (2000) who also removed these items and tested for validity and reliability. Validity was evident through hypothesis testing, with efficacy expectations predicting exercise activity. Lambda χ estimates (>0.81) provided further validity. Reliability was evident through internal consistency (alpha =0 .92) and structure equation modelling (R^2 0.38-0.76).

Multivariate normality of the barrier item predictor variables was assessed via normality (Appendix H) and outlier (Appendix I) tests and the examination of boxplots. The barrier item predictor variables were all found to be normally distributed. Visual inspection of scatterplots for the dataset indicated that the assumption of linearity was met.

To satisfy the assumption of homogeneity of variance-covariance, a Box's M test was performed. For the barrier item variables, a non-significant value of 0.003 indicated that homogeneity of variance-covariance could be assumed and that the null hypothesis could be rejected with confidence. The assumption of multicollinearity was also tested. Pooled within-groups matrices revealed no multicollinearity between variables (Table 13), indicating the relative independence of the barrier item predictor variables.

Table 13. Pooled within-groups correlation matrices for barrier to exercise items

	1	3	5	6	7	8	10	11	12
1									
3	.400								
5	.288	.207							
6	.323	.211	.240						
7	.375	.179	.451	.476					
8	.331	.352	.483	.341	.451				
10	.342	.414	.393	.276	.272	.675			
11	.266	.203	.261	.346	.290	.352	.320		
12	.274	.413	.280	.388	.369	.340	.349	.617	
13	.274	.347	.459	.347	.374	.422	.334	.432	.659

Table 14 shows the mean and standard deviation values for each barrier predictor variable categorised by exercise behaviour. The groups differed across all predictor variables. These differences are supported by significant ANOVA results (Appendix M).

Table 14. Mean ±SD values for barrier items

Barrier items	**Exercisers (n=53)**	**Non-exercisers (n=48)**
1.Weather was very bad (hot/humid)	70.00 ±31.38	38.12 ±33.30*
3. I was on vacation	68.49 ±32.19	48.54 ±36.49*
5. I felt pain/discomfort	41.32 ±32.46	20.00 ±24.06*
6. I had to exercise alone	82.26 ±23.09	67.70 ±31.70*
7. It was not fun/enjoyable	57.17 ±32.43	38.54 ±30.59*
8. Difficult to get to exercise location	61.70 ±30.36	28.95 ±30.75*
10. Schedule conflicted	54.90 ±34.06	18.75 ±22.47*
11. I felt self-conscious	76.41 ±26.46	52.91 ±32.35*
12. Instructor did not offer encouragement	73.39 ±27.45	46.87 ±34.40*
13. Under personal stress	70.19 ±28.24	41.04 ±34.53*

* $p < .05$ level

The discriminant function was then tested for significance via eigenvalues, canonical correlations and Wilks' lambda. The eigenvalue indicated a moderate discriminating power between exercisers and non-exercisers, however the moderate to high canonical correlation coefficient indicated a strong relationship between exercisers and non-exercisers (Table 15). The Wilks' lambda value of .640 indicated a moderate separation between the group centroids (Table 16), however the function was significant and warranted further interpretation.

Table 15. Eigenvalue, percentage of variance and canonical correlation

Function	Eigenvalue	% of variance	Canonical correlation
1	.563	100.0	.600

Table 16. Tests of significance

Test of Function	Wilks' Lambda	Chi-Square	Df	p
1	.640	42.000	10	.000

Barrier item predictor variables which contributed most to the function were then identified. Examination of the absolute magnitudes of the standardized canonical discriminant function coefficients revealed that barrier item 10 (schedule conflicted with exercise) was the strongest contributor, followed by item 1 (the weather was very bad) (Table 17).

Examination of the structure coefficients revealed that barrier item 10, 8 (difficult to get to exercise location) and 1 were the important variables for the function (Table 18). Therefore, barrier item predictor variables 10, 8 and 1 provided the strongest discrimination between exercisers and non-exercisers. The hypothesis that specific barriers to exercise discriminate between exercising and non-exercising postmenopausal women was supported.

Table 17. Standardised canonical discriminant function coefficients

Independent variable	Function
10. Schedule conflicted	.544
1. Weather was very bad (hot/humid)	.426
13. Under personal stress	.259
3. I was on vacation	-.191
8. Difficult to get to exercise location	.157
12. Instructor did not offer encouragement	.127
11. I felt self-conscious	.094
7. It was not fun/enjoyable	-.082
6. I had to exercise alone	-.078
5. I felt pain/discomfort	.002

Table 18. Structure matrix

Predictor variable	Function
10. Schedule conflicted	.834*
8. Difficult to get to location	.720*
1. Weather was very bad (hot/humid)	.663*
13. Under personal stress	.624
12. Instructor did not offer encouragement	.576
11. I felt self-conscious	.537
5. I felt pain/discomfort	.498
7. It was not fun/enjoyable	.397
3. I was on vacation	.391
6. I had to exercise alone	.355

*Largest absolute correlation between each variable and the discriminant function

Correct group classification procedure was applied to determine the group to which a participant most likely belonged. The classification procedure correctly placed

79.2% of cases of which 75.5% of the exerciser group and 83.3% of the non-exerciser group were correctly classified (Table 19). Therefore, both groups resulted in greater than chance correct allocations by 25.5% and 33.3% respectively.

The cross-validation procedure was also applied to assess the consistency of the original classifications. The percentage of correct classifications decreased to 71.3% of which 71.7% of exercisers and 70.8% of non-exercisers correctly classified (Table 9). However, both groups retained correct classifications which were greater than chance by 21.7% and 20.8% respectively.

Table 19. Classification matrix

	Exercise category	Predicted group membership (%) **1**	**2**
Original	Exerciser	**75.5**	24.5
	Non-exerciser	16.7	**83.3**
Cross-validated	Exerciser	**71.7**	28.3
	Non-exerciser	29.2	**70.8**

An ANOVA was then performed on the total exercise self-efficacy score and stages of exercise change to determine if a participant's exercise self-efficacy differed according to their stage of exercise change. The results of this analysis are detailed in Table 20.

A significant difference was found between the reported stage of exercise change of participants and their total exercise self-efficacy score. The Levene statistic revealed heterogeneity of variance ($p<0.05$). A Kruskal-Wallis test was therefore calculated.

The result of the non-parametric analysis supported the ANOVA outcome that participant exercise self-efficacy differed according to their stage of exercise change ($H(2)=28.92$, $p=0.00$).

Table 20. Results of the participants for total exercise self-efficacy score according to their stage of exercise change

Stage of change	Mean	F Stat	p	Levene stat	p
Do not exercise & don't intend to	32.76±27.68	9.21	0.00	2.58	0.04
Do not exercise & thinking to start	23.64±9.11				
Exercise some but not regularly	42.10 ±21.60				
Exercise regularly & begun in last 6 months	51.08 ±12.75				
Exercise regularly & longer than 6 months	60.94 ±21.56				

Tukey's HSD post hoc comparisons of total exercise self-efficacy scores at different stages of change found that participants in the maintenance stage were significantly different in regards to exercise self-efficacy compared to participants in the precontemplation, contemplation and preparation stages (Table 21). Participants in the precontemplation and contemplation stages of exercise change had the lowest exercise self-efficacy scores, while participants in the action and maintenance stages had the highest exercise self-efficacy scores. Therefore, the hypothesis that postmenopausal women at different stages of exercise change would differ in their level of exercise self-efficacy was supported.

Table 21. Multiple pairwise comparisons for stages of exercise change and exercise self-efficacy

Stage of change		Mean Difference	Std. Error	Sig.
precontemplation	contemplation	9.1156	11.52853	.933
	preparation	-9.3456	10.06292	.885
	action	-18.3257	12.10243	.556
	maintenance	-28.1826*	9.66957	.035
contemplation	precontemplation	-9.1156	11.52853	.933
	preparation	-18.4611	7.95544	.147
	action	-27.4413	10.41612	.072
	maintenance	-37.2982*	7.45166	.000
preparation	precontemplation	9.3456	10.06292	.885
	contemplation	18.4611	7.95544	.147
	action	-8.9802	8.76647	.844
	maintenance	-18.8371*	4.88699	.002
action	precontemplation	18.3257	12.10243	.556
	contemplation	27.4413	10.41612	.072
	preparation	8.9802	8.76647	.844
	maintenance	-9.8569	8.31199	.759
maintenance	precontemplation	28.1826*	9.66957	.035
	contemplation	37.2982*	7.45166	.000
	preparation	18.8371*	4.88699	.002
	action	9.8569	8.31199	.759

* $p < .05$ level

Health beliefs

DFA was performed on the six health beliefs categories to determine if the beliefs effectively discriminated between exercising and non-exercising postmenopausal women resident in the tropics. The predictor variables used in the analysis were perceived susceptibility to an obesity-related disease (SU), perceived seriousness of an obesity-related disease (SE), perceived benefits of exercise to decrease the risk of the disease (BE), the barriers to participating in regular exercise (BA), cues that may influence participation in exercise (CU) and health motivation (HM). The dependent variable for analysis was exercise behaviour.

Normality (Appendix H) and outlier (Appendix I) tests and examination of boxplots revealed that the majority of HBM predictor variables were normally distributed. Examination of Z scores indicated that the BE variable was above the threshold. However, with large samples minor deviations from normality are not problematic (Tabachnick & Fidell, 1989). In the current study, the BE variable kurtosis value (3.03) was only slightly above the threshold of 3.

Linearity was found by visual inspection of scatterplots for the dataset. However, the Box's M test revealed that the assumption of homogeneity of variance-covariance was violated. The significant value of 0.000 indicated that the null hypothesis could not be rejected with confidence. However, the Box's M test is a notoriously sensitive test and is likely to return significant results (Tabachnick & Fidell, 1989, Ntoumanis, 2001), with the skewed distribution of a variable often the source of violation (Hair et al., 1998). Examination of the boxplot for the predictor variable BE displayed a negative skewness. Furthermore, DFA is considered robust to violations of the homogeneity assumption if sample sizes are almost equal or large (Ntoumanis, 2001). Robustness is expected when at least 20 cases are in the smallest group (Tabachnick & Fidell, 1989). Though unequal in size, this difference was small and groups in this analysis satisfy the recommendation. Additionally, the ratio of 17-to-1 cases per variable for this part of the analysis was deemed appropriate for an overall sample size. However, in light of the BE predictor variable not meeting the assumption of distribution normality or homogeneity of variance-covariance, caution was exercised in interpretation of this result.

The assumption of multicollinearity was also tested. Pooled within-groups matrices revealed no multicollinearity between variables (Table 22), indicating the relative independence of the mean HBM predictor variables.

Table 22. Pooled within-groups correlation matrices for HBM predictor variables perceived susceptibility (SU), perceived seriousness (SE), perceived benefits (BE), barriers to participating in regular exercise (BA), cues that may influence participation in exercise (CU) and health motivation (HM)

	SU	SE	BE	BA	CU
SU					
SE	.094				
BE	-.191	.366			
BA	.378	.206	-.161		
CU	-.015	.327	.286	-.026	
HM	-.074	.177	.211	-.115	.262

Table 23 shows the mean and standard deviation values for each HBM predictor variable categorised by exercise behaviour. The groups differed across the variables of SU, BA and HM. These differences are supported by significant ANOVA results (Appendix N).

Table 23. Mean ±SD for HBM predictor variables perceived susceptibility (SU), perceived seriousness (SE), perceived benefits (BE), barriers to participating in regular exercise (BA), cues that may influence participation in exercise (CU) and health motivation (HM)

HBM variables	Exercisers (n=53)	Non-exercisers (n=48)
SU	1.68 ±1.06	3.24 ±2.06*
SE	5.02 ±1.18	4.88 ±1.22
BE	6.19 ±0.89	6.19 ±0.74
BA	1.64 ±0.64	2.38 ±1.09*
CU	4.63 ±1.22	4.22 ±0.88
HM	6.13 ±0.78	5.57 ±0.82*

* $p < .05$ level

The discriminant function was then tested for significance via eigenvalues, canonical correlations and Wilks' lambda. The eigenvalue and canonical correlation coefficient indicated a moderate discriminating power and relationship between exercisers and non-exercisers (Table 24). The Wilks' lambda value of .681 indicated a moderate separation between the group centroids (Table 25), however the function was significant and warranted further interpretation.

Table 24. Eigenvalue, percentage of variance and canonical correlation

Function	Eigenvalue	% of variance	Canonical correlation
1	.469	100.0	.565

Table 25. Tests of significance

Test of Function	Wilks' Lambda	Chi-Square	Df	p
1	.681	36.898	6	.000

The HBM predictor variables which contributed most to the function were then identified. Examination of the absolute magnitudes of the standardised canonical discriminant function coefficients revealed that SU was the strongest contributor (Table 26).

Examination of the structure coefficients revealed that SU, BA and HM were the important variables for the function (Table 27). Therefore, these HBM predictor variables provided the strongest discrimination between exercisers and non-exercisers and moderately supported the hypothesis that health beliefs will effectively discriminate between exercising and non-exercising postmenopausal women resident in the tropics.

Table 26. Standardised canonical discriminant function coefficients

Independent variable	Function
SU	.614
BA	.455
BE	.435
HM	-.403
SE	-.261
CU	-.194

Table 27. Structure matrix

Predictor variable	Function
SU	.711*
BA	.614*
HM	-.506*
CU	-.281
SE	-.084
BE	.008

*Largest absolute correlation between each variable and the discriminant function

Correct group classification procedure was applied to determine to which group a participant most likely belonged. The classification procedure correctly placed 75.2% of cases of which 84.9% of the exerciser group and 64.6% of the non-exerciser group were correctly classified (Table 28). Therefore, both groups resulted in greater than chance correct allocations by 34.9% and 14.6% respectively.

The cross-validation procedure was also applied to assess the consistency of the original classifications. The percentage of correct classifications decreased to 69.3% of which 73.6% of exercisers and 64.6% of non-exercisers correctly classified (Table 28). However, both groups retained correct classifications which were greater than chance by 13.6% and 14.6% respectively.

Table 28. Classification matrix

	Exercise category	Predicted group membership (%) **1**	**2**
Original	Exerciser	**84.9**	15.1
	Non-exerciser	35.4	**64.6**
Cross-validated	Exerciser	**73.6**	26.4
	Non-exerciser	35.4	**64.6**

Exercise induced affect

To determine whether the exercise behaviour of postmenopausal women influenced exercise-induced affect, positive well-being (SEESa) and fatigue (SEESc) responses were analysed using separate mixed design repeated measures ANOVAs. Two levels corresponding to the exercise behaviour of the groups (exercisers and non-exercisers) were used for the between-subjects factor. The within-subjects factor of Time of measure represented the pre, during (5 mins, 10 mins, 15 mins and 20 mins) and immediately postexercise measures.

Data was examined for normality (Appendix H) and outliers (Appendix I). SEESb was excluded from the analysis because of the high number of extreme outliers and large values for both kurtosis and skewness at each measurement. The SEESa (post) variable was above the threshold for Z scores. As this variable did not meet the assumption of distribution normality, caution was exercised in interpretation of this result. Mauchly's Test of Sphericity was utilised to determine that the assumption of homogeneity of variance and covariance was met (Vincent, 2005).

For valid interpretation of affect results for the between-subjects factor exercise behaviour, it was firstly necessary to establish that no significant differences occurred in HR and RPE between exercisers and non-exercisers. Significant differences in heart rate and RPE would suggest an exercise stimulus variation and subsequent invalid comparisons of affective responses. RPE measured during the exercise bout were comparable to expected RPE values (ie., 12) for moderate intensity exercise (ACSM, 1986) (Table 29). ANOVA results are presented in Table 30.

Table 29. Mean ±SD values for heart rate (HR) and rating of perceived exertion (RPE) during the exercise bout

Variable	Exercisers (n=53)	Non-exercisers (n=48)
HR5mins	105.47 ±7.10	104.35 ±10.36
HR10mins	107.47 ±7.67	106.12 ±12.36
HR15mins	109.28 ±8.26	106.81 ±12.78
HR20mins	110.43 ±7.65	108.58 ±13.71
RPE5mins	10.70 ±2.13	10.52 ±1.90
RPE10mins	11.13 ±2.01	11.23 ±2.06
RPE15mins	11.43 ±2.14	11.71 ±2.09
RPE20mins	11.60 ±2.03	11.85 ±2.40

Table 30. ANOVA table for heart rate (HR) and rating of perceived exertion (RPE) during the exercise bout

Source of variation	Wilks' lambda	df	F	Sig of F
HR	0.97	3/97	0.98	0.40
RPE	0.97	3/97	0.91	0.43

Sphericity was not satisfied for HR (Mauchly's W = 0.83, χ^2 = 18.63, df = 5, p < 0.05) or RPE (Mauchly's W = 0.40, χ^2 = 92.39, df = 5, p < 0.05) measures, therefore the Huynh-Feldt adjustment was utilised. Repeated measures ANOVA indicated that exercise behaviour did not significantly differentiate HR ($F_{(2.75,272.5)}$ = 0.91, p = 0.43) and RPE ($F_{(1.89,186.93)}$ = 1.51, p = 0.22) measures during exercise.

Means for SEESa measured pre, during and postexercise are presented in Table 31. ANOVA results are presented in Table 32. Sphericity was not satisfied for SEESa (Mauchly's W = 0.11, $\chi^2 = 210.89$, df = 14, $p < 0.05$), therefore the Huynh-Feldt adjustment was utilised. A significant main effect was found for Time of measure ($F_{(2.99,296.6)} = 11.90$, $p = 0.00$). No significant interaction between SEESa and exercise behaviour was found ($F_{(2.99,296.6)} = 0.86$, $p = 0.46$).

Table 31. Mean ±SD positive well-being (SEESa) values determined preexercise (pre), during (5 mins -20 mins) and postexercise (post)

Variable	Exercisers (n=53)	Non-exercisers (n=48)
SEESapre	23.39 ±3.30	22.04 ±4.71
SEESa5mins	23.13 ±3.46	22.66 ±4.16
SEESa10mins	23.47 ±3.43	22.71 ±4.05
SEESa15mins	23.79 ±3.32	22.92 ±4.34
SEESa20mins	24.32 ±3.21	23.04 ±4.51
SEESapost	24.83 ±3.00	24.12 ±3.59

Table 32. ANOVA table for positive well-being (SEESa) values determined during the exercise bout (Time of measure; pre, 5, 10, 15, 20 mins & post) X exercise behaviour (exerciser & non-exerciser)

Source of variation	Wilks' lambda	df	F	Sig of F
Time of measure	0.65	5/95	10.28	0.00
Time of measure X exercise behaviour	0.94	5/95	1.21	0.31

Pairwise comparisons of Time of measure levels revealed that SEESa values were significantly higher postexercise compared to preexercise (Bonferroni adjusted $p < 0.05$, $P = 0.00$), 5 minutes (Bonferroni adjusted $p < 0.05$, $P = 0.00$), 10 minutes (Bonferroni adjusted $p < 0.05$, $P = 0.00$), 15 minutes (Bonferroni adjusted $p < 0.05$, $P = 0.00$) and 20 minutes (Bonferroni adjusted $p < 0.05$, $P = 0.01$).

Means for psychological distress (SEESc) values determined pre, during and postexercise are presented in Table 33. Repeated measures ANOVA results are presented in Table 34. Sphericity was not satisfied for SEESc (Mauchly's W = 0.04, $\chi^2 = 308.96$, df = 14, $p < 0.05$), therefore the Huynh-Feldt adjustment was utilised. A significant main effect was found for Time of measure ($F_{(2.29,227.0)} = 4.27$, $p = 0.01$). No significant interaction between SEESc and exercise behaviour was found ($F_{(2.29,227.0)} = 0.77$, $p = 0.47$). As no significant results were found between SEESa, SEESc and exercise behaviour, the hypothesis that the exercise behaviour of postmenopausal women resident in the tropics will influence exercise induced affect was not supported.

Table 33. Mean ±SD fatigue (SEESc) values determined preexercise (pre), during (5 mins – 20 mins) and postexercise (post)

Variable	Exercisers (n=53)	Non-exercisers (n=48)
SEEScpre	8.26 ±4.58	9.66 ±5.80
SEESc5mins	8.39 ±4.68	9.10 ±5.08
SEESc10mins	8.62 ±4.85	10.23 ±6.30
SEESc15mins	8.77 ±4.89	10.98 ±6.64
SEESc20mins	9.28 ±5.43	11.06 ±6.74
SEEScpost	8.15 ±4.65	9.64 ±6.62

Table 34. ANOVA table for fatigue (SEESc) during the exercise bout (Time of measure; preexercise (pre), 5, 10, 15, 20 mins & postexercise (post) X exercise behaviour (exerciser & non-exerciser)

Source of variation	Wilks' lambda	df	F	Sig of F
Time of measure	0.78	5/95	5.38	0.00
Time of measure X exercise behaviour	0.90	5/95	2.03	0.08

Multiple pairwise comparisons of Time of measure levels revealed that SEESc scores were significantly lower at 5 minutes during the exercise bout compared to 15 minutes (Bonferroni adjusted $p < 0.05$, $P = 0.00$) and 20 minutes (Bonferroni adjusted $p < 0.05$, $P = 0.00$). SEESc scores were also significantly lower postexercise compared to 15 minutes (Bonferroni adjusted $p < 0.05$, $P = 0.01$) and 20 minutes during the exercise bout (Bonferroni adjusted $p < 0.05$, $P = 0.00$).

Test-retest reliability

Within-subjects ANOVA results of reliability data for estimated $\dot{V}O_{2max}$, total exercise self-efficacy score and health belief predictor variables SU, SE, BE, BA, CU and HM are presented in Table 35. The majority of the Cronbach's alpha coefficients indicated high reliability. The health belief variable BE however, indicated a moderate reliability.

Table 35. ANOVA table for reliability data for cardiorespiratory fitness ($\dot{V}O_{2max}$), exercise self-efficacy, perceived susceptibility (SU), perceived seriousness (SE), perceived benefits (BE), barriers to participating in regular exercise (BA), cues that may influence participation in exercise (CU) and health motivation (HM)

Variable	Sum of Squares	df	Mean Square	F	Sig of F	α
$\dot{V}O_{2max}$	0.67	1	.67	0.17	0.69	0.95
ex self-efficacy score	56.00	1	56.00	0.51	0.48	0.89
SU	3.82	1	3.82	5.20	0.04	0.90
SE	0.29	1	0.29	0.57	0.46	0.80
BE	0.36	1	0.36	1.58	0.23	0.65
BA	0.02	1	0.02	0.13	0.73	0.94
CU	0.04	1	0.04	0.07	0.79	0.72
HM	0.16	1	0.16	0.75	0.40	0.83

Summary of results

The participants in this study were exercising and non-exercising postmenopausal women resident in the greater Townsville or Cairns regions. Participants were of similar age, with no significant between-group differences for menopausal status and HRT treatment. A greater percentage of the non-exercising group were employed compared to the exercising group, although this difference was not significant. The majority of both groups (68%) were married or in a de facto relationship.

Exercising postmenopausal women had a significantly higher level of education and were at a significantly higher level of stage of exercise change compared to non-exercisers. Both groups however did not differ in their exercise history during their school years or the quality of the exercise history experience. Regardless of exercise behaviour group, a great majority of the participants (> 84%) correctly selected the cardiovascular risk factors. Similarly, the majority of participants correctly selected heart attack (99%), diabetes (90%), stroke (84%), atherosclerosis (77%) and angina (76%) as obesity-related diseases, while fewer participants correctly chose arthritis (46.5%) or breast cancer (14%). Both groups also had fewer correct responses to the amount of exercise required per week to lose weight (63%) and their current weight (41%), however there were no significant between-group differences for any of the correct knowledge response items.

Non-exercisers were found to have significantly higher $DBP_{rest,}$ BMI and WHR, and significantly lower $\dot{V}O_{2max}$ and total exercise self-efficacy. No difference was found for HR_{rest} or SBP_{rest}. One aim of this study was to determine whether physiological and psychological characteristics would effectively discriminate between exercising and non-exercising postmenopausal women. Total exercise self-efficacy was the strongest contributor to discriminate between-groups, followed by BMI and SBP_{rest}.

DFA also revealed that a higher total self-efficacy score, low BMI and high VO_{2max} were the important variables for the function and therefore the strongest predictor variables of the combined physiological and psychological characteristics.

The barrier items of perceived lack of time, location of facility and weather were found to provide the strongest discrimination between exercisers and non-exercisers. A second aim of the study was to determine whether non-exercising postmenopausal women would have lower exercise self-efficacy compared to those who are exercisers. The results revealed that non-exercisers had significantly lower exercise self-efficacy and felt significantly less confident to exercise when faced with barriers compared to exercisers.

Further analysis was conducted on the total exercise self-efficacy score and stage of exercise change to determine if a participant's exercise self-efficacy differed according to their stage of exercise change. A significant finding indicated that the more efficacious participants were in the higher stages of exercise change.

A third aim of the study was to determine whether health beliefs effectively discriminated between exercising and non-exercising postmenopausal women. The health belief variable SU was the largest contributor to the function while SU, BA and HM were the strongest health belief predictor variables. Therefore, positive perceptions of susceptibility to developing an obesity-related disease and the consequences of participating in regular exercise, coupled with the negative perception of how individuals could control an obesity-related disease provided the strongest discrimination between-groups.

The final aim of the study was to determine whether the exercise behaviour of postmenopausal women influenced exercise-induced affect. It was determined that the exercise bout significantly influenced positive well-being (SEESa) and fatigue (SEESc), with (SEESa) significantly higher postexercise compared to prior to and during (5, 10, 15 and 20 mins) the exercise bout, while SEESc was significantly lower at 5 minutes compared to 15 minutes and 20 minutes during exercise and lower postexercise compared to 15 minutes and 20 minutes during exercise. No significant differences were found between SEESa, SEESc and exercise behaviour. Therefore the hypothesis that exercise behaviour would influence exercise-induced affect was not supported.

ICC results revealed high reliability for cardiorespiratory fitness, self-efficacy for exercise and SU, SE, BA, CU and HM values and moderate reliability for BE.

Chapter 5

Discussion

The message from health and medical professionals is that regular exercise should be a part of one's lifestyle. The plethora of literature associating regular exercise and health benefits supports this message. However, incorporating regular exercise into one's lifestyle may only occur through the elimination of detrimental behaviours. If individuals are to participate in future exercise practices, they must believe that they are capable of regulating their own behaviour. The aim of this study was to examine the exercise behaviour of exercising and non-exercising postmenopausal women residing in North and Far North Queensland. Identifying the behavioural patterns of non-exercising postmenopausal women will enable health professionals to incorporate strategies in order to increase the likelihood of exercise adoption. This chapter will consider the results of the study in relation to existing literature. The comparison of exercising and non-exercising postmenopausal women will be considered in relation to their personal, physiological and psychological characteristics. Exercise self-efficacy and health belief differences will be discussed. The physiological and psychological responses to an acute exercise bout will also be considered.

Personal characteristics

To test the hypothesis that personal characteristics would differ between exercising and non-exercising postmenopausal women, the variables of age, education level, employment and marital status and extent of participant knowledge concerning heart-disease risk factors, obesity-related diseases, current body weight and the amount of exercise required per week to lose body weight were analysed. Exercising and non-exercising postmenopausal women who participated in the current study were of similar mean age, with 96.1% of non-exercisers and 81.5% of exercisers between 50-69 years. However, while the mean age of both groups of participants were between 50-69 years, the exercising group participants were aged 45-83 years compared to participants in the non-exercising group who were aged 49-71 years. Additionally, 9.5% of exercisers and 2.1% of non-exercisers were aged 70-89 years. The disparity in participant age between 70-89 years may explain the greater percentage of employed non-exercising women.

No significant between-group difference was found for employment status, however 66.7% of non-exercisers compared to 49.1% of exercisers were currently employed either full or part-time. Of those participants currently employed, 58.6% of non-exercisers and 45.6% of exercisers were aged between 45-64 years. These figures decreased for participants aged between 60-64 years, with 23% of non-exercisers and 7.6% of exercisers currently employed. The current finding of women employed in both groups underrepresents that of the wider community, with 73% of Australian women aged 45-64 years employed in 2005 (Australian Bureau of Statistics, 2005). However, the percentage of non-exercising women aged 60-64 years in this study reflects that of the larger Australian population of 28% (Australian Bureau of Statistics, 2005).

The majority of both groups were aged between 50-69 years. A woman employed at 50-60 years may be at the peak of her career, working longer hours and placing work goals ahead of time for exercise. This is a particular problem for women who perform multiple roles such as parent, employee and spouse (Marcus, 1995). In the current study 48.3% of the non-exercising women and 41.8% of the exercising women were employed in professional or managerial positions, and para-professional (Australian Bureau of Statistics, 1997) positions. These figures reflect the wider Australian population of postmenopausal women in professional or managerial positions and para-professional positions (Australian Bureau of Statistics, 2005).

An interesting finding was that of the 48.3% of non-exercising women with professional or para-professional positions, 50% reported that they were too busy to exercise over the past seven days due to work commitments. In contrast, only 36% of the exercising women holding professional or para-professional positions reported being too busy to exercise. However, whilst the exercising women claimed they were too busy to pursue various activities in the past seven days, they were still able to perform the minimum requirement of exercise to place them into this group.

The notion that higher income equates to less discretionary time available for exercise conflicts with the more accepted view that individuals with a higher socioeconomic status are more likely to exercise (Baum et al., 2000; Bauman et al., 1990; Bell & Lee, 2005; Dishman et al., 1985; McTiernan et al., 1998; Owen & Bauman, 1992; Parks et al., 2003). Women with a higher socioeconomic status are thought to be able to maintain a healthy weight (Peters et al., 2002) because they have the material resources to exercise regularly. However this did not seem to be the case for 50% of the non-exercising postmenopausal women in professional and para-professional positions. Perhaps it is lack of motivation rather than lack of time to exercise that is the real barrier for these women, a view shared by Johnson, Corrigan, Dubbert, and Gramling (1990) and Dishman et al., (1985). Lack of time may be a more socially desirable response to report rather than lack of motivation (Johnson et al., 1990).

The finding that exercisers had completed a significantly higher level of education compared to the non-exercisers supports the literature. There is strong evidence to suggest that a higher level of education equates to higher income levels. A large telephone survey of American adults from urban and rural residences and various socioeconomic backgrounds was performed to determine physical activity patterns (Parks et al., 2003). Low income participants had lower levels of education regardless of area of residence. Low income residents and those residing in rural areas were less likely to meet physical activity recommendations compared to high income residents and those living in urban areas. The results of the current study support this view. Eight of the non-exercising women who were employed in lower skilled positions had not gained higher educational qualifications following high school. In contrast, only two of the exercisers had no higher qualifications than high school. Lower socioeconomic status is associated with physical labour as an occupation, caregiver responsibilities, lack of transportation, unsafe neighbourhoods and inflexible working hours (Seefeldt et al., 2002).

Individuals from a lower socioeconomic background may also find the cost of privately-based exercise facilities prohibitive, and may not have an understanding of the correct exercise prescription in an unsupervised exercise setting (Bauman et al., 1990). In the current study, 17% of non-exercising women agreed with the health belief statement that exercise can be expensive, compared to only 6% of exercising women.

Health professionals should become more aware of this socioeconomic distribution of exercise and shift their primary focus away from those with adequate resources and motivation (Bauman et al., 1990). Rather than ‘preaching to the converted’, community health promotion policy makers should place greater emphasis on trying to involve those least likely to seek out exercise opportunities. Providing affordable, convenient community-based exercise facilities and greater access to informational instruction on simple activities such as walking has worked in some locations (Sly et al., 1999) and should become the norm. Townsville municipal council takes pride in the variety of community activities it provides. However more community-based activities emphasising exercise should be included. An association between health and community engagement has been found in rural and regional populations, whereby those with low incomes have poor physical and mental health and poor exercise participation rates (Savage, Bailey, & O’Connell, 2003). Developing strategies for the promotion of community-based exercise activities may improve the mental health of the community as a whole by reducing social isolation (Savage et al., 2003).

Bauman, Owen and Rushworth (1990) believed that an individual with a lower level of education will have less knowledge regarding health issues. This did not appear to be the case for the current sample of postmenopausal women. No significant between-group differences were found for the extent of participant knowledge regarding cardiovascular risk factors, obesity-related diseases, the amount of exercise required per week to lose body weight and their current body weight. Five cardiovascular risk factors were assessed, including smoking, high fat diet, obesity, low levels of activity and family history of the cardiovascular disease. The majority of both groups (at least 80%) correctly indicated all five of the risk factors. The lowest response was low levels of activity, with 88.7% of exercisers and 79.2% of non-exercisers correctly listing this as a risk factor. Therefore, the majority of participants in the current study were able to recognise important cardiovascular risk factors regardless of education level. This result is in direct contrast to Bauman and associates (1990). Covington & Grisso (2001) also found that American women resident in a homeless shelter were able to indicate the cardiovascular risk factors of obesity, high-fat diet and lack of exercise.

While no between-group difference was found on the extent of participant knowledge regarding obesity-related diseases, 73% or more of participants in both groups correctly indicated heart attack, stroke, diabetes, atherosclerosis and angina as obesity-related diseases. Arthritis was correctly identified by less than 50% of participants and breast cancer was correctly identified by less than 20% of participants. Heart disease and stroke were also correctly listed as obesity-related diseases by the majority of women from low and high socioeconomic areas of

Melbourne (Paxton, Sculthorpe, & Gibbons, 1994). Diabetes was correctly identified as an obesity-related disease by 58% of respondents while arthritis was correctly identified by 35%. The fact that most participants in the current study correctly identified major cardiovascular disease risk factors and obesity-related diseases suggests that the health promotion message is being heard by the non-exercisers. However, it appears that having this knowledge is not sufficient for non-exercisers to initiate an exercise regime. Therefore, while participants have the theoretical knowledge, putting this knowledge into practice may require much more motivation.

No significant between-group difference was found for participant knowledge regarding their current body weight. Indeed, less than 50% of the participants in both groups responded correctly. The majority of participants who did not respond correctly underestimated their weight, a finding that is in contrast to the literature.

Paxton et al. (1994) examined the weight-loss perceptions of men and women in high and low socioeconomic areas of Melbourne. Men were more likely to underestimate their weight while women overestimated their body weight. Similarly, Craig and Caterson (1990) surveyed women who had attended a weight control program in Sydney. The women also tended to overestimate their body weight. However, half of the participants in both studies were under 45 years of age.

Age is associated with over and underestimation of bodyweight. Older women have been found to underestimate their weight while younger women tend to overestimate their weight (Bolton-Smith, Woodward, Tunstall-Pedoe, & Morrison, 2000; Bostrom & Diderichsen, 1997; Brug, Wammes, Kremers, Giskes, & Oenema, 2006). Social comparison with slender women in the media has been found to influence younger women to overestimate their body weight (Steenhuis, Bos, & Mayer, 2006). It has been suggested that older women view being overweight as a normal part of aging (Brug et al., 2006). Older women who underestimate their body weight may feel less motivated to undertake measures to avoid weight gain. Given the direct link between obesity and cardiovascular disease in postmenopausal women, the number of women incorrectly estimating their weight in the current study is of concern.

No significant between-group difference existed for participant knowledge regarding the amount of exercise needed to lose body weight per week. Rippe and Hess (1998) have suggested that performing 30-45 minutes of moderate intensity exercise for 5-7 days will produce approximately 1500 – 2100 kilocalories per week of energy expenditure and result in weight loss. This amount of exercise is equivalent to the exercise guidelines recommended by the National Physical Activity Guidelines for Australians (DHAC, 1999). Timperio et al. (2000) found that women incorrectly believed they should perform approximately 14 hours of exercise per week and also perform more vigorous activity. The result of this study however differed to that of Timperio et al. as participants were given a choice for the amount of exercise. The unrealistic beliefs held by participants in the previous literature were thought to decrease motivation to exercise in women, especially as perceived lack of time is a common barrier to exercise. In this study, the greatest duration offered to participants was 7 hours per week (1 hour per day). This exercise duration is far more realistic to achieve weekly, thus lending further support that lack of time was a perceived rather than real barrier for the non-exercising women.

Exercisers were found to be at a significantly higher stage of exercise change compared to the non-exercisers. Twenty-nine percent of non-exercisers were at the pre and contemplation stages and 92% of exercisers were at the action and maintenance stages of exercise change. An interesting finding was that a large majority (48%) of non-exercising women reported they were at the preparation stage. This finding may indicate that for these non-exercising women, little guidance may be required to increase their motivation for regular exercise particularly as the majority (67%) of non-exercising women were either thinking to start exercise or were currently doing some exercise, albeit infrequently. Prochaska and DiClemente (1983) suggested that individuals at different stages of change differ in their attitudes, beliefs and motivations to a new behaviour and as such, different strategies may be necessary for individuals to progress through the different stages. For example, contemplators use the process of consciousness raising and would be more likely to respond to feedback and education as sources of information about the new behaviour (Prochaska & DiClemente). The non-exercising women in this study who were in the contemplation and preparation stages may benefit from these strategies, particularly as these strategies are also suggested for increasing exercise self-efficacy (Bandura, 1977).

A study by Rich and Rogers (2001) examined the attitudes of older adults according to their stage of exercise change. Participants in the action and maintenance stages felt that the health benefits of exercise were more important than those in the pre & contemplation stages. Lee (1993) also found that Australian women aged 50-64 years in the action stage of exercise change perceived that the health benefits of exercise were important. The authors recommended using educational programs for the participants in the lower stages of change to increase awareness of the health benefits of exercise. However, the findings by Lee are in contrast to the current findings as the non-exercisers in the lower stages of change moderately agreed with the perceived benefits of exercise to decrease the risk of developing an obesity-related disease. Therefore, rather than using programs emphasising the health benefits of exercise, this sample of non-exercising postmenopausal women might benefit more from programs designed to increase efficacy beliefs.

No significant between-group difference was found for exercise participation during the participants' school years or whether this exercise experience was perceived as positive or negative. Seventy-three percent of exercisers and 75% of non-exercisers had regularly participated in exercise during their school years. Previous research has suggested that self-efficacy can act as a determinant and a consequence of past exercise participation (McAuley & Blissmer, 2000). McAuley (1992b) believed that failure to master an activity can lead to low self-efficacy, with women who attach negative experiences with past exercise participation less likely to participate in exercise as adults. Exercise is therefore believed to be physiologically and psychologically reinforcing (Alfano, Klesges, Murray, Beech, & McClanahan, 2002). The current finding that 75% of non-exercisers had participated regularly in exercise during their school years and that 81% had perceived this experience as positive is in direct contrast to the literature.

However, a possible explanation for this result may be that past adult exercise participation may be a greater predictor of exercise behaviour compared to participation during the school years. Evenson et al. (2002) found that past exercise participation at the age of 50 years was a greater predictor of exercise participation at 65 years compared to past exercise participation at 18 years. Hirvensalo, Lintunen and Rantanen (2000) also found that exercise participation at 40-64 years was a predictor of exercise participation at 65-84 years.

For this sample of non-exercising postmenopausal women, the influence on exercise behaviour of exercise participation during school years may be overridden by other more recent personal and environmental influences (Dishman, Sallis, & Orenstein, 1985). As exercise behaviour in the perimenopausal period has been found to determine exercise behaviour in later years, this period may be a critical time to develop strategies for lifelong patterns of regular exercise in non-exercising women (Evenson, et al., 2002).

In contrast to positive experiences of past exercise participation increasing self-efficacy (Sherwood & Jeffery, 2000), being forced to perform various exercise activities in childhood may have a negative influence on exercise behaviour in later life (Taylor, Blair, Cummings, Wun, & Malina, 1999). The authors found that mastery of a skill during the teenage years was positively related to adult exercise behaviour while being forced to exercise during preteenage years was inversely related to adult exercise behaviour. In this study, the participants who reported a negative experience for past exercise participation claimed they had either been forced to perform sport activities or were not encouraged to participate in activities due to health reasons or being perceived as not being 'sporty'. Children should have choice in the activities they participate in (Taylor et al., 1999). Positive feedback given during participation in activities may lead to an increase in lifelong self-efficacy beliefs through mastery experiences (Sherwood & Jeffery, 2000).

Physiological characteristics

The significantly higher BMI, WHR and DBP_{rest} and significantly lower $\dot{V}O_{2max}$ of the non-exercising participants compared to the exercising participants is of concern. These variables represent risk factors for obesity-related diseases. Weight gain following menopause is associated with elevated low density lipoproteins, triglycerides and total cholesterol and lower high density lipoproteins (Poehlman, 2002). Lower $\dot{V}O_{2max}$ is also associated with higher triglycerides, total cholesterol lower high density lipoproteins (Mohanka et al., 2006). It has also been reported that healthy postmenopausal women between 65-74 years with a BMI of 28-29.9 kg/m^2 have a twenty-eight percent increased risk for all cause mortality (as cited in Dubnov, Brzezinski & Berry, 2003). In the current study, BMI was found to be inversely related to exercise behaviour. A mean BMI of 28.9 kg/m^2 placed the non-exercisers in the upper range of the overweight category and is similar to mean BMI values of non-exercising North American (Kushi et al., 1997) and Australian postmenopausal women (Guthrie et al., 1995).

The difference in BMI between the exercisers and non-exercisers may reflect the differences found in education level and socioeconomic status. An inverse relationship has been found between socioeconomic status and obesity (Mujahid, Roux, Borrell, & Nieto, 2005) and level of education and BMI (Molarius, Seidell, Sans, Tuomilehto, & Kuulasmaa, 2000) for middle-aged women. An Australian Institute and Welfare survey (2003) found the most disadvantaged women to have twice the rate of obesity compared to the most advantaged. The significantly higher BMI and significantly lower level of education of the non-exercising participants lend support to this relationship between socioeconomic status, exercise and obesity of the wider community.

While a significant between-group difference was found for mean WHR, an unexpected finding was that both exercising and non-exercising participants had WHR values that were classified as acceptable. A WHR of .80 or greater increases the risk of death from cardiovascular disease, regardless of BMI (McArdle, Katch, & Katch, 2001). The WHR of .76 for the exercisers and .78 for the non-exercisers would suggest that both groups of postmenopausal women did not have a redistribution of body fat to the abdominal region following menopause. As the majority of women in both groups did not take HRT, this result supports the literature that oestrogen deficiency is not solely responsible for central distribution of body fat during the menopausal period (Blumel,et al., 2001; Crawford et al., 2000; Davies et al., 2001; Singh et al., 2001).

However, while both the exercising and non-exercising participants may be categorised within the acceptable range, WHR values of .78 for non-exercising participants and .76 for exercising participants belie the fact that a number of participants may still be at increased risk of cardiovascular disease. US women aged 40-65 years were assessed to determine their risk of developing coronary heart disease (Rexrode et al., 1998). WHR was found to be significantly associated with increased risk of coronary heart disease regardless of BMI. Women with a WHR of .76 or more were found to be twice as likely to develop cardiovascular disease during follow-up. A similar cohort study of older women aged 55-69 years found WHR to be positively associated with mortality from cardiovascular disease (Folsom et al., 1993). Women with a WHR of greater than .76 had a 1.36-fold increased risk of death compared to women with a WHR of less than .76. The WHR value of .76 would suggest that the exercisers had an increased risk of developing cardiovascular disease despite regular exercise participation.

Waist circumference has also been shown to relate more strongly to abdominal visceral adipose tissue accumulation than WHR (McArdle, Katch, & Katch, 2001). Women with a waist circumference of 76.2 centimetres or greater were found to have a 2-fold higher risk of coronary heart disease compared with participants with a waist circumference of less than 71.1 centimetres. Waist circumference was also found to be strongly associated with increased risk of coronary heart disease among women with a BMI of less than 25 kg/m^2 (Rexrode et al., 1998). In this study, 49% of exercisers and 85% of non-exercisers had a waist circumference of greater than 76.2 centimetres. Therefore, despite the mean BMI of 24.4 kg/m^2 of exercisers, almost half of these participants were at increased risk of coronary heart disease.

A considerable difference in mean $\dot{V}O_{2max}$ was found between groups. The exercisers' mean $\dot{V}O_{2max}$ value of 26.06 $mL \cdot .kg^{-1} \cdot min^{-1}$ placed them in the 50^{th} - 60^{th} percentile for their age. The non-exercising participants however were placed in the 10^{th} - 20^{th} percentile for their age with a mean $\dot{V}O_{2max}$ of 21.8 $mL \cdot .kg^{-1} \cdot min^{-1}$ (Franklin, 2000). The very low cardiorespiratory fitness of the non-exercising participants may not only provide a real barrier to exercise but also be detrimental to health.

A relationship has been found between poor cardiorespiratory fitness and cardiovascular mortality. Carnethon, Gulati and Greenland (2005) found that women aged 20-49 years with low levels of cardiorespiratory fitness have higher mean BMI values, waist circumferences and diastolic blood pressures. Women aged 20-59 years with moderate to high cardiorespiratory fitness were found to have lower levels of total and abdominal adiposity compared to those with low cardiorespiratory fitness (Ross & Katzmarzyk, 2003). The findings of significantly higher BMI, WHR and DBP_{rest} and significantly lower $\dot{V}O_{2max}$ of the non-exercisers in this study are consistent with the findings of Ross and Katzmarzyk and suggest a mechanism whereby low cardiorespiratory fitness can increase the risk of developing obesity-related diseases.

Fortunately, non-exercising postmenopausal women can improve their cardiorespiratory fitness. Sedentary postmenopausal women aged 50-75 years and with a mean $\dot{V}O_{2max}$ of 20.2 mL·.kg^{-1}·min^{-1} increased their $\dot{V}O_{2max}$ by eleven percent and reduced body weight, percent body fat and intraabdominal fat following a one year moderate intensity aerobic exercise intervention program (Mohanka et al., 2006). In light of the number of identified risk factors for obesity-related diseases in the non-exercisers, it is critical that exercise participation rates increase in this sample of postmenopausal women. Eighty percent or more of the participants were aware of the known risk factors for cardiovascular disease. However, the health belief seriousness of an obesity-related disease was the least important discriminator between exercisers and non-exercisers. These results would suggest that participants are not associating their knowledge of cardiovascular disease risk factors with their own personal measurements.

The non-exercisers may not understand the more complex link between BMI, WHR, waist circumference, poor cardiorespiratory fitness and increased risk of mortality. Organisations administering cardiovascular disease risk factor information may need to inform the public more fully rather than use blanket statements such as ‘being overweight, eating a high fat diet and not getting enough exercise will increase your risk of cardiovascular disease’. Medical professionals may also need to offer more detailed information on the relationship between BMI, WHR, waist circumference, poor cardiorespiratory fitness and increased risk of mortality (Williams, Germov, & Young, 2007).

The mean DBP_{rest} of 74 mmHg was significantly higher in the non-exercising group compared to 69 mmHg for the exercising group. There was no significant between-group difference in mean SBP_{rest}. However, SBP_{rest} results of 124 mmHg for the exercisers and 125 mmHg for the non-exercisers were alarming. The National Heart, Lung and Blood Institute (NHLBI) released new guidelines in 2003 for the prevention, treatment and control of hypertension (Chobanian et al., 2003). A new category of prehypertension was incorporated into the guidelines. This category consisted of 120-139 mmHg for SBP_{rest} and 80-89 mmHg for DBP_{rest}. The guidelines also stated that for individuals aged 40-70 years, an increment of 20 mmHg for SBP and 10 mmHg for DBP above 115/75 mmHg doubles the risk of cardiovascular disease. The SBP results in this study therefore place both groups of women in the prehypertension category, with an increased risk of progressing to hypertension (Chobanian et al.). According to the NHLBI guidelines, the DBP_{rest} result of 74 mmHg also increases the non-exercisers risk of cardiovascular disease.

Lifestyle modifications, including participating in regular exercise, have been recommended for prehypertensive individuals in order to decrease SBP by 4-9 mmHg (Chobanian et al., 2003). A reduction of 4-9 mmHg in SBP would place the non-exercising participants within the normal category, thus reducing their risk of developing an obesity-related disease. This important new information regarding blood pressure should also be made available to postmenopausal women via health professionals and medical practitioners. Many individuals would still be under the premise that a resting blood pressure of less than 140/90 mmHg is acceptable.

Another lifestyle modification recommended by the NHLBI for the management of prehypertension is to reduce BMI to less than 25 kg/m^2, as a 5-20 mmHg reduction can occur for every 10 kg of weight lost (Chobanian et al., 2003). The exercising group in this study had a mean BMI of 24.4 kg/m^2. This result, while within the recommended healthy category, is close to the cut-off value of 25 kg/m^2. In fact, 44% of the exercising participants had a BMI of between 24.6-25 kg/m^2. As these postmenopausal women are performing the weekly recommended amount of exercise required for health benefits, it may be necessary for the introduction of dietary modifications in an effort to reduce their SBP.

No significant between-group difference was found for mean HR_{rest}, with mean HR_{rest} of 70 bpm for exercisers and 73 bpm for non-exercisers. The higher mean HR_{rest} of the non-exercisers may be due in part to their significantly higher mean DBP_{rest}. Higher levels of body fat increase the mechanical work of the heart and also increase the risk of low-grade inflammation within the artery walls (McArdle et al., 2001). The increased peripheral resistance created by chronic low-grade inflammation increases DBP_{rest}.

The mean HR_{rest} of 70 bpm for the exercisers and 73 bpm for the non-exercisers in this study were higher than exercising (65 bpm) and non-exercising (66 bpm) previously sedentary North American postmenopausal women residing in Dallas, Texas (Jurca, Church, Morss, Jordan, & Earnest, 2004). The difference in HR_{rest} between the sample of women in this study and those of the North American women may be explained by the differences in the climate of tropical North Queensland compared to the more temperate region of Dallas, Texas.

Average annual temperatures in North Queensland range between 25-31°C (Townsville Enterprise website) with an average humidity of 75% (Bureau of Meteorology, n.d). In contrast, average annual temperatures in Dallas, Texas range between 13-24°C with average humidity of 65% (World Meteorological Organisation, n.d). HR_{rest} increases in hot weather to augment heat dissipation (McArdle, Katch & Katch, 2001). It would therefore be expected that HR_{rest} may be slightly elevated compared to other postmenopausal women living in a more temperate climate. Indeed, postmenopausal women resident in Sao Paulo, Brazil were found to have average HR_{rest} of 76 bpm (Aldrighi, Calvoso-Junior, Alecrin, Trombetta, & Negrao, 2005). These women were of similar mean age and BMI to those who participated in the current study.

Psychological characteristics

Exercise self-efficacy

Consistent with previous research, total exercise self-efficacy was found to be significantly lower in non-exercisers compared to exercisers (Grembowski et al., 1993; Masters, Ogles, & Gurney, 1996; McAuley & Jacobson, 1991; Wilcox & Storandt, 1996). Bandura (1977) believed that efficacy beliefs can predict if an individual will engage in a behaviour, how much effort they will expend on the behaviour and how persistent they will be at maintaining the behaviour in the face of obstacles. It is therefore important to find ways of increasing exercise self-efficacy in sedentary postmenopausal women if success is to be expected in future exercise participation.

Historically, exercise prescription has focused on the physiological components of frequency, intensity, duration and mode of exercise. However, as self-efficacy has long been identified as an important predictor of future exercise behaviour (McAuley & Blissmer, 2000), it would seem logical that exercise and health professionals incorporate the psychological component of exercise self-efficacy into exercise prescription. Identifying postmenopausal women with lower exercise self-efficacy will allow for the provision of informational and motivational instruction to increase their exercise efficacy beliefs instead of solely relying on the physiological components of exercise prescription. Administering an exercise self-efficacy scale would be a simple way to identify those with lower exercise self-efficacy and would enable exercise and health professionals to offer specific information on how to increase efficacy beliefs.

Loughlan and Mutrie (1995) suggested that exercise consultations include determination of the client's exercise history in order to establish likes and dislikes, a discussion of the advantages and disadvantages of change, the identification of exercise barriers, available social support, goal-setting and relapse prevention. This technique was found to be successful with a group of non-exercising housing estate residents (Lowther, Mutrie & Scott, 2002) and could be equally applied to postmenopausal women of North Queensland.

There are four primary intervention measures that Bandura (1977) has identified whereby efficacy can be learned or enhanced including mastery accomplishments, vicarious experiences, verbal persuasion and emotional arousal. Mastery accomplishment has a strong influence on efficacy as it is based on personal experiences. Many postmenopausal women believe that they are unable to perform an activity before a first attempt is made. This can often be due to a lack of experience or knowledge regarding exercise, particularly if they have been socially discouraged from participating in exercise in their younger years (Branigan & O'Brien Cousins, 1995). In this study, the non-exercising participants experienced significantly higher positive well-being and lower fatigue values postexercise compared to during the acute exercise bout. These results may indicate that an increase in self-efficacy was experienced by the non-exercisers for their successful completion of the acute exercise bout. This experience is consistent with middle-aged participants who increased their efficacy expectations following an acute bout of exercise testing (McAuley et al., 1993). Repeated success in the chosen activity will raise mastery expectations through the acquisition of a skill for dealing with stressful situations (Bandura, 1977). This will ultimately increase efficacy beliefs.

The exercise professional can structure the exercise environment so that successful completion of the activity is ensured. This can be done by graduating tasks, execution over graduated intervals, joint performance of the activity with the exercise professional and protective aids to reduce the perception of negative consequences (Bandura, 1977). Information to accompany the supplementary aids could include the completion of logbooks by the exercise professional noting HR, RPE and minutes of exercise completed, with regular focus on the successful progress made in relation to individual health and wellness (McAuley, Courneya, Rudolph, & Lox, 1994).

Several short 10- to 15-minute bouts of exercise to accumulate 30-40 minutes per day could be recommended rather than one longer bout of 30-40 minutes as this has been shown to increase cardiorespiratory fitness and to enhance exercise adherence (Jakicic, Wing, Butler, & Robertson, 1995). A shift towards self-directed mastery experiences should gradually occur so that the participant can effectively perform the activity unassisted (Bandura, 1977).

Vicarious experiences rely on inferences from social comparison, whereby the observation of others performing the chosen activity without adverse consequences may increase participant expectations that they will also be able to successfully complete the activity (Bandura, 1977). This intervention measure is most successful when modelling information comes from individuals of similar characteristics, such as other sedentary, postmenopausal women.

Observing a videotape of postmenopausal women participating in a chosen exercise activity has been shown to positively influence low exercise self-efficacy participants by increasing their efficacy for the chosen activity (McAuley et al., 1994). This intervention may also be appropriate for non-exercising postmenopausal women. The health belief, cues to exercise, was not a strong discriminator between exercising and non-exercising groups. Participants were asked whether observing a well-known personality exercising on television or observing someone exercising in a film would influence them to exercise. Modification of the HBM so that these two questions are more applicable to postmenopausal women, such as including a postmenopausal woman who is well-known to the participants, may produce different results. Alternatively, observing friends performing the activity may prove successful in increasing the efficacy beliefs of non-exercising women.

Verbal persuasion encourages participants to believe that they have the capabilities to master an exercise activity. Used in conjunction with supplementary aids, verbal persuasion increases self-efficacy from corrective practice (Bandura, 1977). Verbal persuasion can be in the form of positive feedback from an exercise instructor or by exercising with a 'buddy' to provide encouragement (McAuley et al., 1994). Forming exercise groups focusing on the social aspects of exercise may enhance efficacy beliefs through vicarious experiences and verbal persuasion and ultimately lead to positive outcome experiences.

Lastly, emotional arousal can affect self-efficacy (Bandura, 1977). Physiological system responses to exercise such as increased heart and respiratory rate can elicit emotional arousal, particularly if participants are not used to these feelings. As high arousal negatively affects performance, participants will only expect success if they are not fearful of these physiological events occurring (Bandura, 1977). Providing information regarding the physiological responses participants are experiencing during an exercise activity will reassure the participants that they are normal responses designed to make the body healthier (McAuley et al., 1994). In this study, many of the non-exercising women enquired if their HR responses during the twenty-minute cycle ergometer test were normal. Providing information to non-exercisers regarding the normal HR responses to be expected during exercise may reduce their emotional arousal during future exercise participation.

To test the hypothesis that physiological and psychological characteristics would discriminate between exercising and non-exercising postmenopausal women, the variables of HR_{rest}, SBP_{rest}, DBP_{rest} BMI, WHR, $\dot{V}O_{2max}$ and exercise self-efficacy were analysed using discriminant function analysis (DFA). The results revealed that exercise self-efficacy, BMI and $\dot{V}O_{2max}$ discriminated between the exercisers and non-exercisers. These results are somewhat consistent with those of McAuley (1993) who examined the influence of exercise self-efficacy, $\dot{V}O_{2max}$ and body composition on exercise participation in previously sedentary middle-aged adults. Exercise self-efficacy and $\dot{V}O_{2max}$ were found to predict exercise behaviour 4 months following an exercise intervention program Participants who had higher aerobic capacity and exercise self-efficacy levels reported higher exercise participation maintenance rates during the 4 months postprogram. Body composition however was not found to predict exercise behaviour.

The relationship between exercise self-efficacy and cardiorespiratory capacity demonstrates the reciprocity of efficacy beliefs and mastery behaviour (Bandura, 1977). In the adoption stage of exercise behaviour, exercise participation places stress on the cardiorespiratory system. If exercise self-efficacy is low, it will be difficult for the participant to believe they can overcome this adverse stress

(McAuley, 1992b). A participant's initial exercise experience must be a positive one to ensure that efficacy beliefs are increased. Exercise prescription that is agreeable to the participant and which is conducted at an appropriate exercise intensity is therefore recommended (Oman & King, 1998).

Exercise self-efficacy was found to be the greatest predictor variable of the participants' physiological and psychological characteristics. This finding is consistent with the literature that efficacy beliefs play a significant role in predicting exercise behaviour (DuCharme & Brawley, 1995; Masters, Ogles & Gurney, 1996; McAuley, 1992b; McAuley et al., 1993; McAuley et al., 1994; Oman & King, 1998; Rhodes, Martin, & Tauton, 2001; Sallis, Haskell, Fortmann, Vranizan, Taylor, & Solomon, 1986).

Exercise self-efficacy and stage of exercise change

The hypothesis that postmenopausal women at different stages of exercise change would differ in their level of exercise self-efficacy was supported. Participants in the precontemplation and contemplation stages had the lowest exercise self-efficacy scores. For the preparation, action and maintenance stages, the higher the stage of change, the higher the exercise self-efficacy scores. The current results are similar to those of Marcus et al. (1992), who also suggested that participants at different stages of change may benefit from different strategies to increase exercise self-efficacy. Forty-eight percent of the non-exercising women were in the preparation stage of exercise change. A number of these participants may have had a history of exercise relapse, however exercise relapse information was not included in the questionnaire. As this information may assist in determining self-efficacy enhancement strategies, future investigation of exercise relapse is warranted, particularly as individuals who have had insufficient past positive experiences with exercise may develop lower exercise self-efficacy for future exercise practices (Oman & King, 1998).

Barriers to exercise

The hypothesis that specific barriers to exercise would discriminate between exercising and non-exercising postmenopausal women was also analysed using DFA. Significant between-group differences were found for all ten barrier items. Non-exercisers were less confident to exercise if they felt self-conscious about their appearance. Negative self-presentation can therefore be an important barrier to exercise. Katula et al. (1998) found that exercising in front of a mirror produced lower efficacy in women and proved to be a demotivating influence for exercise. This influence of negative self-presentation on the non-exercisers' exercise self-efficacy may be related to their BMI (for example, 'I had a negative exercise experience because of my bad body image').

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A strong association exists between exercise self-efficacy and body weight with overweight and obese women less likely to exercise compared to normal weight women. Australian men and women between the ages of 18-78 years were required to report their weight (Ball et al., 2000). A significantly greater percentage of women compared to men reported that being too fat was a barrier to exercising. The authors also found women who perceived themselves as too fat were too shy and embarrassed to exercise however, no significant association was found between being too fat and poor health. Lower self-efficacy was therefore linked with perceived appearance rather than poor health. For this study, it is therefore reasonable to assume that the lower exercise self-efficacy of the non-exercisers is in part due to a relationship between negative self-presentation and BMI.

The perception that exercise is more appropriate for younger individuals can also create an obstacle for older women wishing to adopt an exercise regime (Seefeldt et al., 2002). The media reinforces these perceptions with depictions of slender young females engaged in exercise (Dunlap & Barry, 1999). Establishing a non-threatening exercise environment that emphasises the social aspects of activities with women of similar age may increase the likelihood of non-exercising postmenopausal women participating in exercise.

The non-exercising postmenopausal women felt less confident to exercise if an instructor did not offer encouragement. A perception may exist among the non-exercisers that fitness centres and gyms do not do enough to help those at high risk of attrition from an exercise regime once adopted (for example, ‘The trainers were not interested in offering me alternative exercises’). Instructor support has been found to impact on exercise adherence (McAuley & Jacobson, 1991). Individualised positive feedback on performance can enhance self-efficacy in women (McAuley et al., 1999) through mastery accomplishment and social persuasion.

The exercisers felt confident they would be able to exercise if they did not receive encouragement from an instructor. The long-term efficacious participants in fitness centres are individuals with enough intrinsic motivation and efficacy beliefs to exercise without instructor encouragement (McAuley, 1992a). Participants in the adoption stage of exercise will more likely increase their efficacy beliefs if the initial exercise experience is a positive one (Oman & King, 1998). Offering individualised feedback based on performance progress, particularly in the early stages of exercise adoption (McAuley, Talbot & Martinez, 1999), may assist postmenopausal women to move from the contemplation and preparation stages of change to the action and maintenance stages.

Of the ten barrier items used for the DFA, conflicting schedules (lack of time) was found to be the greatest barrier to exercise between exercisers and non-exercisers. This result is consistent with that of the wider Australian community (RIGH, 1997; AIHW, 2000; Owen & Bauman, 1992). It would appear that the barrier item conflicting schedules (lack of time) may be a perceived barrier rather than a real one as the exercising group were using self-regulatory skills to exercise despite being busy. Yoshida, Allison and Osborn (1988) had a similar finding with 25% of exercisers and 31% of non-exercisers citing lack of time due to work commitments as a barrier to exercise. Indeed, Johnson et al. (1990) believed that exercise programs will not succeed unless the perception of lack of time is addressed. The authors suggested that time management training be added to exercise programs. Self-regulatory skills such as effective goal setting, self-monitoring of progress, self-reinforcement (King et al., 1992) and supportive feedback (Woodard & Berry,

2001) should also be incorporated into exercise programs. As the exercising participants in this study rated exercise as a high priority in time management terms, future research should investigate the self-regulatory skills employed by this population. Alternatively, exercising women could become mentors for non-exercising friends in regards to scheduling and maintaining time for exercise.

Lack of time appears to have been a common barrier to exercise for the participants no matter whether the participant was a professional, para-professional, blue collar worker or a non-worker. For the non-working participants who claimed that they were too busy for exercise, the perception of lack of time may be influenced by social desirability ('I am busy, therefore I am worthy'), due to their role obligations of wife and mother/grandmother. Many postmenopausal women were brought up with the ideal of caregiver to husband and children. They have had a lifetime of believing that their needs are secondary to those of their family (Mutrie & Choi, 2000). Therefore, a strategy to increase exercise participation could be to encourage exercising with their significant other. Social support has been found to be a strong determinant of exercise for women (Gallant & Dorn, 2001; Nies & Kershaw, 2002) with women who did not have company to exercise less likely to exercise (Ball et al., 2001). The significant between-group difference for the barrier item of exercising alone further supports the recommendation to exercise with a significant other. Ball et al. also cited safety concerns as a possible reason for Australian women being less likely to walk for exercise if they did not have company.

The barrier item of difficulty travelling to the exercise location was also found to discriminate between exercising and non-exercising postmenopausal women. The non-exercisers did not feel confident they would exercise if it was difficult to travel to their exercise location. This result is consistent with findings in research conducted by Ball et al. (2001) and Giles-Corti & Donovan (2002b). Certain aspects of the local environment, such as pedestrian-friendly neighbourhoods, have been found to have an important influence on the exercise participation rates of North American postmenopausal women (King et al., 2005) and older adults (Berke, Koepsell, Moudon, Hoskins, & Larson, 2007). It is evident from this study that exercise facility accessability may also influence the exercise participation rates of postmenopausal women in North Queensland.

In 2005 the Queensland Government issued a report on the important social, physical and mental, environmental and economic benefits of physical activity to encourage greater exercise participation rates (Queensland Government, 2005). The report outlined that more than $190 million of the 2005-2006 budget had been allocated to sport and exercise facilities. Exercise facility accessibility has been somewhat addressed in the regional cities of Townsville, Thuringowa and Cairns. Since 1999, Townsville and Cairns have redeveloped their foreshore with walkways and swimming pools, while Thuringowa has recently completed their redevelopment of an area along the Ross River banks. These redevelopments were designed for residents to more readily access exercise facilities, as a coastal environment has been found to increase self-efficacy for exercise (Bauman et al., 1999).

Unfortunately, recent safety issues at the Thuringowa redevelopment has resulted in less people using the facility. In 2007 the Townsville council had moved to close one of the public swimming pools ("A Line in the Sand", 2006). This pool holds regular aqua aerobics classes, a popular exercise activity given the climate in North Queensland. Indeed, aqua aerobics was an activity performed by the exercising participants in the past seven days. It is therefore important to provide safe, affordable and easily accessible facilities to ensure that exercise participation rates in postmenopausal women increase.

The World Health Organisation (2007) has recently produced a guide for population-based approaches to increase exercise particpation levels. The aim of the guide was to provide guidance on policy options for the effective promotion of exercise. A number of objectives were given for national and regional governments including the implementation of transport and land-use policies for appropriate conditions for safe walking and cycling and an increase in the amount of recreational exercise facilities (WHO, 2007). It is crucial that the Queensland government allocate appropriate funding for regional North Queensland to enable these objectives to be met.

The non-exercising women did not feel confident that they would exercise if the weather was very bad, such as hot, humid or raining. Heat and humidity have previously been cited as barriers to exercise for Canadian women (Rhodes, Martin & Tauton, 2001) and Japanese adults (Dunlap & Barry, 1999). To date, no study had examined heat and humidity as barriers to exercise in postmenopausal women resident in North Queensland.

The weather is an important component of living in North Queensland. With humidity ranging from 50-80% throughout the year (Bureau of Meteorology) exercising outdoors can prove to be uncomfortable, particularly for postmenopausal women who may have residual vasomotor symptoms coupled with the normal vascular changes that occur through aging (McArdle et al., 2001). If no other alternative is available, postmenopausal women residing in a tropical environment may be less likely to exercise outdoors.

Health beliefs

The hypothesis that health beliefs would effectively discriminate between exercising and non-exercising postmenopausal women was moderately supported by the results. Three of the six health belief variables correctly predicted between exercising and non-exercising postmenopausal women. It was found that the non-exercising postmenopausal women felt significantly more susceptible to developing an obesity-related disease, had a significantly higher perception of barriers to participating in regular exercise and felt significantly less health motivated to control an obesity-related disease compared to exercising women.

The finding that the non-exercisers felt significantly more susceptible to developing an obesity-related disease compared to the exercisers would appear to be somewhat intuitive. However, while the non-exercisers felt more susceptible compared to the exercisers, the mean susceptibility score of 3.24 indicates that the non-exercisers were in slight disagreement with the belief that they were susceptible to an obesity-related disease. This is despite the fact that they had significantly lower cardiorespiratory fitness, and significantly higher DBP_{rest}, BMI and WHR. In addition, the non-exercisers were knowledgeable regarding obesity-related diseases and cardiovascular disease risk factors. Clearly, these results suggest that knowledge by itself of obesity-related consequences is not enough to change exercise behaviour in this population. Biddle and Mutrie (2001) have suggested that the motivations for adopting and adhering to exercise are diverse and may therefore not include illness-avoidance motives.

Previous researchers found susceptibility to be inversely associated with exercise adoption (Morgan, Shephard, Finucane, Schimmelfing, & Jazmaji, 1984) and adherence (Lindsay-Reid & Osborn, 1980; Oldridge & Streiner, 1990; Tirrel & Hart, 1980). It has been suggested that individuals are motivated more from immediate gratification rather than through the delayed consequences of health outcomes (Rejeski, 1992).

The HBM proposes that perceptions of susceptibility to developing a disease and its seriousness are the driving forces behind adopting a health behaviour (Rosenstock, 1974a). With this in mind, postmenopausal women would be more likely to exercise if they felt susceptible to developing an obesity-related disease and perceived the threat of an obesity-related disease and its consequences to be serious. According to the mean seriousness score of 4.88, the non-exercisers only slightly agreed with the perceived seriousness of developing an obesity-related disease and did not feel particularly susceptible to developing a disease. It would therefore be expected that this group of women would be non-exercisers.

The finding that non-exercising postmenopausal women had a significantly higher perception of barriers to participating in regular exercise was also expected. Results from the self-efficacy for exercise scale found that this group felt significantly less confident to exercise when faced with barriers compared to exercising women. The relationship between health beliefs and self-efficacy was also found in a group of older non-exercising Canadian women (O'Brien Cousins, 2000), with the perceived risks of exercise outweighing the potential benefits.

It is thought that one must weigh up the perceived benefits of participating in regular exercise with the consequences, or barriers to, participation in order to determine which path of action to take (Rosenstock, 1974a). When the perceived benefits outweigh the perceived barriers, an individual will adopt the health behaviour. However, this did not appear to be the case for the non-exercisers. According to the mean barriers score of 2.4, the non-exercising women moderately disagreed with the belief that there were barriers to engaging in regular exercise. Additionally, both non-exercising and exercising women moderately agreed with the benefits of exercise to decrease the risk of an obesity-related disease. Therefore, the current results were in contrast to the HBM theory. The exercise behaviour of the non-exercising postmenopausal women therefore cannot be simply explained by their health beliefs. Other psychological and physiological factors discussed earlier appear to play a role.

The non-exercisers felt significantly less health motivated to control an obesity-related disease compared to exercising women. However, in terms of the mean health motivation score of 5.58, the non-exercisers had moderately agreed with the belief that they were health motivated to control an obesity-related disease. This result is contradictory as the non-exercisers have a number of risk factors for developing cardiovascular disease. It is therefore evident that health beliefs influence the intention to exercise rather than predict actual participation (Dishman et al., 1985).

According to the HBM, cues to action act as triggers to motivate behaviour change. These cues can be internal or external (Sanderson, 2004). The internal cues to action used for the current study were perceived cardiovascular symptoms while external cues included the media, a doctor's recommendation, family support or having family diagnosed with an obesity-related disease. Cues to engage in regular exercise was not found to effectively discriminate between the two groups, however a significant ANOVA result was found between exercisers and non-exercisers. Non-exercisers were found to be less open to cues to engage in regular exercise compared to exercisers.

Consistent with the literature (Cohen-Mansfield, Marx, Biddison, & Guralnik, 2004; Schutzer & Graves, 2004) a large majority of participants (50% of non-exercisers;

62% of exercisers) felt that their doctor's recommendation would strongly influence their decision to exercise. This result is interesting as both groups had a weak belief in the seriousness of an obesity-related disease. It would appear that the non-exercisers were not internalising the potential threat of developing an obesity-related disease. The delayed consequences of an obesity-related disease may not be enough motivation to begin an exercise regime. Rather, the non-exercisers may only become motivated following the contraction of a disease.

As older individuals respect their general practitioner's advice (Schutzer & Graves, 2004), a general practitioner may be a useful source of information for explaining the link between a patient's particular risk factors and the development of obesity-related diseases. A general practitioner may also be able to make suggestions regarding regular exercise to reduce the likelihood of developing these diseases. Eakin, Brown, Mummery, Schofield and Reeves (2007) found that 24% of participants from the regional Queensland communities of Rockhampton and Mackay had received advice from their general practitioner regarding exercise behaviour. Furthermore, findings from the Australian Longitudinal Study on Women's Health (ALSWH) (Brown et al., 2006) revealed that almost 50% of middle-aged women always visited the same general practictioner. This represents a good opportunity for the promotion of exercise to postmenopausal women. It is therefore important for the medical profession to be better educated in the benefits of exercise behaviour.

Exercise-induced affect

To test the hypothesis that exercise behaviour of postmenopausal women residing in the tropics will influence exercise-induced affect, the SEES items of positive well-being and fatigue were analysed. The SEES item of psychological distress could not be analysed due to the high number of extreme outliers and large values for both kurtosis and skewness at each measurement. Markland, Emberton and Tallon (1997) also found this to be the case for their validation study of the SEES, however values were found to be only moderately skewed or kurtotic. Modification of the psychological distress subgroup was made by eliminating the item 'I feel awful' from their analysis, which improved the goodness-of-fit indices across all participant groups tested. Modification of the psychological distress subgroup was not performed for the current study due to the much larger skewness and kurtosis values.

The measurement of positive well-being and psychological distress separately has been questioned (Markland et al., 1997; Ekkekakis & Petruzzello, 1999). The two factors may not be totally independent and as such do not fit the orthogonal and bipolar concept as proposed by Watson and Tellegen (1985). The authors defined high positive affect as being enthusiastic, active and alert while low positive affect as feelings of sadness and lethargy. High negative affect was defined as feelings of anger, guilt and fear while low negative affect reflected calmness and serenity (Watson, Clark, & Tellegen). However according to McAuley & Courneya (1994), positive well-being and psychological distress are the positive and negative poles of psychological health. This theoretical assumption would suggest a unipolar dimension rather than a bipolar one (Ekkekakis & Petruzzello, 1999). Moderately strong negative correlations were found between positive well-being and psychological distress scores by McAuley and Courneya (1994) ($r = -.52$) and Markland and associates (1997) ($r = -.36$ to $-.74$). Moderate negative correlations were also found in the current study ($r = -.45$ to $-.65$).

On examination of SEESb boxplots, a possible floor effect was observed with the majority of scores across all measurement times maintained at low levels. This floor effect for SEESb has been reported elsewhere (Watt & Spinks, 1997), suggesting that exercise may have a greater influence on increasing positive affect compared to decreasing negative affect. A possible baseline floor effect for psychological distress was also reported by Daley and Welch (2004). In the current study, boxplots revealed that the majority of participant SEESb baseline scores were also low (4/59), with three exercisers and five non-exercisers above the score of ten. If participants have low levels of negative affect prior to exercise, significant changes would not be expected during exercise (Gauvin & Brawley, 1993). This possible floor effect would further question the inclusion of the psychological distress items within the scale in their current form. It has been recommended that only unambiguous affect words that generalise as emotions be employed in measurement scales (Gauvin & Brawley). Continued research into the construct validity of the SEES is therefore warranted.

The exercising postmenopausal women obtained higher positive well-being (SEESa) scores and lower fatigue (SEESc) scores compared to non-exercisers

across time, however these differences were not found to be significant. Therefore, the hypothesis that exercise behaviour would influence exercise-induced affect could not be supported for positive well-being or fatigue. A similar non-significant finding occurred between younger exercisers and non-exercisers (Watt & Spinks, 1997). A possible reason given for this result was that the exercise behaviour variable was not sufficiently manipulated. Exercise behaviour was determined by a self-selection procedure based on frequency, duration and mode of exercise but not intensity. However, the current study did include intensity along with the other physiological parameters for exercise behaviour determination. Therefore, current exercise history may be unrelated to exercise-induced affect (Watt & Spinks).
A possible explanation for the non-significant finding for SEESa and SEESc scores in this study may be the intensity of the exercise bout. An interaction between exercise intensity and exercise induced affect has been previously reported (Parfitt & Eston, 1995), with less fit participants reporting lower positive feelings during high intensity exercise compared to fitter participants. In contrast, Dunn and McAuley (2000) found no difference in SEES affective responses between moderate intensity (60% $\dot{V}O_{2max}$) and high intensity (80% $\dot{V}O_{2max}$) exercise. Future research is recommended to determine whether the affective response differences would be more pronounced at an intensity of greater than 60% $\dot{V}O_{2max}$.

The exercise bout did significantly influence SEESa for both groups. Therefore, moderate intensity exercise had a beneficial effect across time, with SEESa higher post exercise compared to pre-exercise and during exercise. This result is consistent with the literature (Cox, Thomas, Hinton & Donahue, 2006; Daley & Welch, 2004; McAuley & Courneya, 1994; Raedeke, 2007; Watt & Spinks, 1997).

Self-efficacy levels have been shown to have an effect on affective responses during exercise, with the more efficacious individual experiencing greater positive well-being and less fatigue (McAuley et al., 1999) and increased positive engagement (Bozoian, Rejeski, & McAuley, 1994). An increase in exercise-induced positive affect is thought to be related to personal perceptions regarding the exercise bout (Bartholomew & Miller, 2002). It would therefore seem intuitive that a significant difference would exist between the two groups for positive well-being and fatigue, given the significantly different exercise self-efficacy levels of the two groups. However, McAuley et al., (1999) manipulated self-efficacy feedback during the exercise bout, with one group receiving positive feedback on their performance while a second group received negative feedback.

A possible explanation for the non-significant result between the groups for positive well-being may be that self-efficacy increased in the non-exercisers for stationary cycling through mastery accomplishment. Self-efficacy is said to be specific to the task being performed (Bandura, 1977). Therefore, the exercise self-efficacy levels of the current non-exercising women may have increased for this particular task through a sense of accomplishment at completing 20 minutes of moderate intensity exercise. Bartholomew and Miller (2002) also found that participants who had a strong sense of mastery accomplishment reported greater postive well-being following an acute exercise bout. The mastery experience mechanism may increase future exercise self-efficacy for performing stationary cycling, and may increase the likelihood of future participation in exercise. Future research into the relationship between post-exercise self-efficacy and affective responses is warranted.

The exercise bout also had a significant influence on SEESc for both groups. SEESc scores were significantly higher at the 15 and 20 minute stage compared to the 5 minute stage of exercise. SEESc scores were also significantly lower postexercise compared to the 15 and 20 minute stage of exercise. The increased levels of SEESa and decreased levels of SEESc postexercise would suggest that moderate intensity exercise can have postexercise affective benefits for both exercisers and non-exercisers.

Similar results were found by Watt and Spinks (1997). In contrast, McAuley & Courneya (1994) found SEESc scores to increase immediately postexercise in middle-aged adults performing a submaximal cycle ergometer graded exercise test. SEESa scores were found to be significantly higher postexercise. The authors suggested that it was possible to feel physically fatigued but also positive about the experience. The current results would support this view. Fatigue can therefore have a positive dimension, and will depend on the circumstances (McAuley & Courneya). Indeed, Focht et al., (2007) found an inverse relationship between self-efficacy levels and feelings of fatigue in previously sedentary adults following an acute exercise bout. The authors found that those particpants who reported greater feelings of fatigue during and immediately following the exercise bout had lower levels of self-efficacy immmediately following exercise. The lower feelings of fatigue reported in this study may further represent an increase in self-efficacy through mastery accomplishment in the non-exercisers.

One exercise barrier for older adults is the perception that exercise will be tiring, causing concerns for their health (O'Brien Cousins, 2000). The current sample of non-exercising women were able to complete the exercise bout feeling no ill effects despite being fatigued during the task, and may have implications for future exercise participation. Giving non-exercising postmenopausal women the opportunity to perform previously untried exercise tasks may increase their physical self-worth (Mutrie & Choi, 2000) and motivate them to perform these newly accomplished tasks in the future. Positive affective interpretations of an exercise bout can therefore represent an internally driven motive for adopting and maintaining an exercise program, as externally driven motives for exercise rarely produce long-term exercise adherence (Annesi, 2002; Mutrie & Choi, 2000).

Summary of discussion

This study examined the exercise behaviour of exercising and non-exercising postmenopausal women residing in North and Far North Queensland. Identifying the underlying predictors of exercise behaviour is necessary for the effective design and implementation of strategies to ensure success in the future exercise participation of postmenopausal woman. A number of personal, physiological and psychological predictors of exercise behaviour were identified in this study. A significant between-group difference was found for the personal characteristic of level of education. The exercisers had a higher level of education compared to the non-exercisers. A higher level of education equates to higher income. Women with a higher level of education and therefore socioeconomic status are thought to have the educational and material resources to exercise regularly. Therefore, providing affordable, convenient community-based exercise facilities and greater access to informational instruction on simple activities is recommended for non-exercising postmenopausal women.

The exercisers were also at a higher stage of exercise change compared to the non-exercisers. Sixty seven percent of the non-exercisers were at the contemplation and preparation stages of exercise change. This result indicated that these non-exercisers may require strategies such as feedback and education about exercise to encourage a progression into the action stage of exercise change.

The participants also differed in employment status, however this difference was not found to be significant. Sixty seven percent of the non-exercisers were currently employed either full or part-time. Perceived lack of time due to work commitments is a common barrier to exercise, particularly for postmenopausal women who perform the multiple roles of parent, employee and spouse. However, 49% of the exercisers were employed either full or part-time and were still able to participate in regular exercise. The exercise barrier of lack of motivation may be more relevant to the employed non-exercisers rather than perceived lack of time.

A significant between-group difference was also found for physiological characteristics. The non-exercisers had a higher BMI, WHR, DBP_{rest} and lower cardiorespiratory fitness compared to the exercisers. These variables represent risk factors for obesity-related diseases and further support the view that non-exercising postmenopausal women should adopt an exercise regime.

A significant between-group difference was also found for the psychological characteristic of exercise self-efficacy, with non-exercisers having lower exercise self-efficacy compared to the exercisers. This finding supports the literature that efficacy beliefs play a significant role in predicting exercise behaviour.

Exercise self-efficacy was further explored in relation to the participants' stage of exercise change. Participants in the precontemplation and contemplation stages had the lowest exercise self-efficacy scores, while participants in the action and maintenance stages had the highest exercise self-efficacy scores. This result is in keeping with the finding that the non-exercisers had significantly lower exercise self-efficacy compared to the exercisers.

Incorporating an exercise self-efficacy scale into the exercise prescription process would enable exercise professionals to identify postmenopausal women with low exercise self-efficacy, particularly those participants at the earlier stages of change. Efficacy beliefs could be subsequently increased through the intervention strategies of mastery accomplishments, vicarious experiences, verbal persuasion and emotional arousal.

Significant between-group differences were found for the ten barrier items analysed. Therefore, the non-exercisers felt significantly less confident to exercise when faced with each of the barriers compared to the exercisers. Further examination found that the barrier items of conflicting schedules (lack of time), difficulty with getting to the exercise location and the weather provided the greatest discrimination between the groups. The strategies of time management training, mentoring of non-exercising women by their exercising conterparts and the provision of safe, affordable and easily accessible facilities suited to the North Queensland climate are recommended to increase exercise participation levels in postmenopausal women.

Three of the six health belief variables predicted group membership. The non-exercisers felt significantly more susceptible to developing an obesity-related disease, had a significantly higher perception of barriers to participating in regular exercise and felt significantly less health motivated to control an obesity-related disease compared to the exercisers. Although the health beliefs of the non-exercisers have intuitive appeal, the mean susceptibility score suggested that the non-exercisers did not agree that they were susceptible to developing an obesity-related disease. In line with the HBM, individuals will adopt a health behaviour if they feel that they are susceptible to a disease. As the non-exercisers did not internalise the potential threat of developing an obesity-related disease, it would be expected that they would not adopt exercise practices.

The mean health motivation score also suggested that the non-exercisers were in moderate agreement with the belief that they were health motivated with controlling an obesity-related disease. The perceptions of the non-exercisers are therefore in contrast to their physiological profile and increased risk of chronic disease. The motivations for adopting exercise appear to be more complex than illness-avoidance or health enhancement motives.

No significant between-group differences were found for positive well-being (SEESa) and fatigue (SEESc) during an acute exercise bout. Therefore, the hypothesis that exercise behaviour would influence exercise-induced affect could not be supported for positive well-being or fatigue and suggested that current exercise history may be unrelated to exercise-induced affect.

Consistent with the literature, the acute exercise bout did significantly influence SEESa for both groups, with SEESa higher post exercise compared to pre-exercise and during exercise. This increase in positive well-being for the non-exercisers may have represented an increase in exercise self-efficacy through mastery experience, and may increase the likelihood of future participation in exercise.

The acute bout of exercise also had a significant influence on SEESc for both groups, with SEESc significantly higher at the 15 and 20 minute stage compared to the 5 minute stage of exercise and significantly lower postexercise compared to the 15 and 20 minute stage of exercise. As the non-exercisers were able to complete the exercise bout feeling no ill effects despite being fatigued during the task, this may also increase the likelihood for future exercise participation in this population. Giving non-exercising postmenopausal women the opportunity to successfully complete exercise activities may promote a sense of accomplishment and the belief that exercise can be an enjoyable experience.

Chapter 6

Summary, Conclusions and Recommendations

Summary

The postmenopausal period is associated with weight gain and the increased risk of coronary artery disease. Moderate intensity exercise however may be cardioprotective in postmenopausal women through its positive effect on lipoprotein levels, intra-abdominal adipose tissue, resting blood pressure and metabolic rate. Regular exercise can also lower the risks of NIDDM and breast cancer, relieve postmenopausal symptoms and enhance psychological well-being. Despite the numerous health benefits of regular exercise, Australian postmenopausal women remain predominately sedentary. Given the increased life expectancy, women can spend a considerable time in the postmenopausal state. As exercise participation levels decline with age in women it is critical to understand the reason behind this decline, so as to ensure that in this period of life women remain free from various disabilities.

A multitude of initiatives have been used to encourage individuals to adopt and adhere to exercise. However, exercise promotion campaigns have remained largely unsuccessful in changing exercise behaviour. Exercise professionals have traditionally focused on physiological aspects when prescribing exercise. However, it seems that exercise adoption and adherence is a much more complex process, particularly for women.

Over the past twenty years a greater emphasis has been placed on the behavioural factors associated with adopting and adhering to exercise. Differences in exercise behaviour between exercising and non-exercising postmenopausal women have been previously documented. However, whether these differences existed amongst postmenopausal women living in North and Far North Queensland had yet to be determined. If the aim is to persuade more postmenopausal women residing in these regions to incorporate regular exercise into their daily lives, it is necessary to identify the determinants of exercise for this population.

Determinants can be categorised into personal characteristics, environmental factors, and psychological variables. Personal characteristics include individual education level and socioeconomic status. Environmental factors include discretionary time for exercise, facility access, and climate. Psychological variables include self-efficacy, perceived health beliefs, stage of exercise change and the affective response to exercise. These determinants can sometimes act as barriers to postmenopausal women adopting exercise. Barriers may also exist that are unique to postmenopausal women living in an Australian regional tropical environment.

Behavioural models form the basis for understanding exercise behaviour. The Social Cognitive Theory of behaviour is based on self-efficacy. Exercise self-efficacy is one's belief in the ability to successfully perform exercise. Individuals possessing high exercise self-efficacy are more likely to adopt an exercise regime and adhere to it until it becomes habitual. The Transtheoretical (Stages of Change) Model suggests that individuals move through five stages of change sequentially when adopting exercise. Individuals will differ in their attitudes, beliefs and motivations at each stage. The Health Belief Model (HBM) proposes that adherence to exercise will be greater if an individual believes that the exercise will help prevent a perceived health threat. Exercise induced affective responses are thought to influence exercise behaviour through their effect on psychological well-being. Those individuals who experience enhanced positive affect and reduced negative affect from participation in a single exercise bout are more likely to adopt exercise practices in the future.

This study investigated the exercise behaviour of exercising and non-exercising postmenopausal women resident in Australian regional tropical centres. The aims of the research were to determine whether differences existed between the two groups for physiological and psychological variables and if so, which of these variables might predict future exercise behaviour.

Exercising (n = 53) and non-exercising (n = 48) postmenopausal women from the greater Townsville and Cairns regions participated in this study. A self-report measure of exercise history was administered during a face-to-face interview. This measure was a modified version of the Melbourne Women's Midlife Health Project questionnaire (Guthrie, 2002) and was used to determine demographic information, the depth of a participant's knowledge on various health issues, stage of exercise change, recent exercise history and non-leisure time information.

Participants completed two exercise behaviour scales. The Self-efficacy for Exercise Scale used was a modified version of McAuley's scale (1992b). The scale is a barrier-specific, thirteen-item instrument listing common reasons for preventing participation in exercise. The second measurement scale used was a modified version of the Health Belief Model (Rosenstock et al., 1974), constructed and tested by Champion (1984). This scale required participants to indicate how much they agreed or disagreed with various statements relating to their individual health beliefs on exercise and obesity. Anthropometric and physiological measurements were also taken including resting heart rate and blood pressure, height and weight and cardiorespiratory fitness.

Participants performed a twenty minute moderate intensity exercise bout on a cycle ergometer while measures of pre, during and post-exercise affect were obtained using the Subjective Exercise Experience Scale (SEES) (McAuley and Courneya, 1994). The SEES is a twelve-item, three-dimensional scale designed to assess the subjective experiences unique to exercise, both during and following activity. Univariate and multivariate statistical tests including DFA were utilised to determine whether significant between-group differences existed for the physiological and psychological variables.

Consistent with the literature, the non-exercising postmenopausal women had obtained a lower level of education (U = 971.5, p = .03), were at a lower stage of exercise change (U = 308.0, p = .00), had higher resting diastolic blood pressure ($F_{1,99}$=7.57, p=0.01), BMI ($F_{1,99}$=33.63, p=0.00) and WHR ($F_{1,99}$=5.83, p=0.02) and lower cardiorespiratory fitness ($F_{1,99}$=21.57, *p*=0.00) and exercise self-efficacy ($F_{1,99}$=39.56, *p*=0.00) compared to the exercisers. Each of these variables may therefore represent barriers to exercise adoption for this sample of non-exercising postmenopausal women.

The physiological and psychological variables of interest were exercise self-efficacy, BMI and $\dot{V}O_{2max}$. Therefore, for the current sample of postmenopausal women, those with higher exercise self-efficacy, lower BMI and higher cardiorespiratory fitness were more likely to be exercisers. This result supported the hypothesis that physiological and psychological characteristics would effectively discriminate between exercising and non-exercising postmenopausal women. The significantly lower exercise self-efficacy result for the non-exercisers supported the hypothesis that non-exercising postmenopausal women would have lower exercise self-efficacy compared to those who are exercisers.

DFA was then performed on the exercise self-efficacy barrier items to determine whether specific barriers effectively discriminated between the two groups of postmenopausal women. The barrier items of perceived lack of time, difficulty getting to an exercise location and the weather provided the greatest discrimination between exercisers and non-exercisers. While perceived lack of time and difficulty getting to an exercise location are barriers consistently found in the wider community, the barrier item of the weather is particularly relevant to postmenopausal women residing in a tropical environment. This result supported the hypothesis that specific barriers to exercise would discriminate between exercising and non-exercising postmenopausal women

Further analysis of exercise self-efficacy revealed that participants at different stages of change possessed different levels of exercise self-efficacy. As would be expected, participants with the lowest exercise self-efficacy were in the precontemplation and contemplation stages of change. For those participants in the preparation, action and maintenance stages, the higher the stage of change, the higher the exercise self-efficacy. This result supported the hypothesis that postmenopausal women at different stages of exercise change would differ in their level of exercise self-efficacy.

Results from the HBM scale revealed that the non-exercising postmenopausal women had higher perceptions of susceptibility to developing an obesity-related disease, perceived a greater number of consequences from participating in regular exercise and felt they were less health motivated to control an obesity-related disease compared to the exercising women. These findings would appear somewhat intuitive however the mean susceptibility score for the non-exercising women suggested that they were in slight disagreement with the belief that they were susceptible to an obesity-related disease. Additionally, the mean health motivation score suggested that the non-exercisers had a moderate agreement with the belief that they were health motivated to control an obesity-related disease. Therefore, the perceptions of this sample of non-exercising postmenopausal women are in contrast to their physiological profile and increased risk of chronic disease. These results would suggest that the motivations for adopting exercise are far more complex than illness-avoidance or health enhancement motives.

While twenty minutes of moderate intensity cycling elicited higher positive well-being and lower fatigue scores in the exercising women compared to the non-exercising women, these results were not significant. The non-significant results therefore suggested that current exercise history may be unrelated to exercise-induced affect, a finding in common with Watt and Spinks (1997).

The acute exercise bout did have a beneficial effect for both groups across time, with higher SEESa scores postexercise compared to pre and during exercise. Additionally, SEESc scores for both groups were lower postexercise compared to during the latter stages of exercise. These results demonstrated that postexercise affective benefits can be obtained for both exercisers and non-exercisers following moderate intensity exercise. The results also imply that task-specific exercise self-efficacy increased for the non-exercisers through a sense of mastery experience.

This study identified a number of characteristics that will help predict the future exercise behaviour of postmenopausal women residing in North and Far North Queensland. Non-exercisers had achieved a lower level of education and were at a lower stage of exercise change compared to the exercisers. DFA revealed that postmenopausal women with higher exercise self-efficacy, lower BMI and higher cardiorespiratory fitness were more likely to be exercisers. DFA also revealed that perceived lack of time, difficulty getting to an exercise location and the weather represented barriers to exercise for the non-exercisers. It was also found that participants at different stages of exercise change possessed different levels of exercise self-efficacy.

The non-exercisers had higher perceptions of susceptibility to developing an obesity-related disease, perceived a greater number of consequences from participating in regular exercise and felt they were less health motivated to control an obesity-related disease compared to the exercisers. All of the above characteristics act as barriers to the adoption of exercise for sedentary postmenopausal women. However, postexercise affective benefits were obtained for both exercisers and non-exercisers following moderate intensity exercise. Identification of these differences in exercise behaviour between exercisers and non-exercisers will enable exercise professionals and government organisations to develop intervention strategies to increase the likelihood of greater exercise participation in this population.

Conclusions

Within the limitations of this study, the following conclusions arising from the hypotheses seem justified:

1. Exercising postmenopausal women had achieved a higher level of education and were at a higher stage of exercise change compared to the non-exercising postmenopausal women.

2. Higher exercise self-efficacy, lower BMI and higher cardiorespiratory fitness discriminated between exercising and non-exercising postmenopausal women.
3. The specific exercise barrier items of perceived lack of time, difficulty getting to an exercise location and bad weather provided the greatest discrimination between exercising and non-exercising postmenopausal women.
4. Postmenopausal women at different stages of exercise change possessed different levels of exercise self-efficacy.
5. Perceptions of susceptibility to an obesity-related disease, the perceived barriers to participating in regular exercise and health motivation to control an obesity-related disease were the greatest contributors to discrimination between exercising and non-exercising postmenopausal women.
6. Exercise behaviour of postmenopausal women did not influence exercise-induced affect for positive well-being or fatigue during an acute exercise bout.
7. Moderate intensity exercise induced a postexercise affective improvement, characterised by increases in positive well-being and decreases in fatigue in both exercising and non-exercising postmenopausal women.

Recommendations

It is recommended that further study be conducted in the following areas:

1. A comparison study to determine whether differences in exercise behaviour exist between:

i) postmenopausal women residing in a temperate environment

ii) postmenopausal women residing in a capital city

iii) early and late postmenopausal women

2. Determination of the extent to which motivation and personality characteristics differentiate exercising and non-exercising postmenopausal women residing in North and Far North Queensland.

3. Investigation of possible modifications to the SEES in relation to the psychological distress items to eliminate a possible floor effect in the results.

4. Determination of the extent to which a higher intensity exercise bout would influence the affective responses of exercising and non-exercising postmenopausal women.

5. Determination of the extent to which exercise self-efficacy levels increase following an acute exercise bout in non-exercising postmenopausal women.

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Appendix A

Informed consent form

Respondent No. ____

INFORMED CONSENT FORM

PRINCIPAL INVESTIGATOR	Fiona Barnett
PROJECT TITLE:	Psychobiological predictors of exercise behaviour in postmenopausal women residing in the tropics.
SCHOOL	Public health and tropical medicine
CONTACT DETAILS	***4781 6678***

DETAILS OF CONSENT:

You will be asked to complete questionnaires on health beliefs, cardiovascular heart disease knowledge, exercise history and health.
You will also be asked to participate in a physical fitness assessment. This will include waist and hip girth measurements, resting heart rate and resting blood pressure. You will undertake a sub-maximal aerobic test on a stationary bike. Your heart rate will be measured via a wristwatch type heart rate monitor.
On another day you will undertake a graded exercise test on a stationary bike. Heart rate will also be measured before, during and after exercise. Perceived exertion and how you feel during and after the exercise bout will be recorded.
We will need you for a total time of 90 minutes over the two days.

CONSENT
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.

Name: *(printed)*	
Signature:	**Date:**

Appendix B

Physical Activity Readiness Questionnaire (PAR-Q)

Physical Activity Readiness
Questionnaire - PAR-Q
(revised 1994)

PAR - Q & YOU

(A Questionnaire for People Aged 15 to 69)

Regular physical activity is fun and healthy, and increasingly more people are starting to become more active every day. Being more active is very safe for most people. However, some people should check with their doctor before they start becoming much more physically active.

If you are planning to become much more physically active than you are now, start by answering the seven questions in the box below. If you are between the ages of 15 and 69, the PAR-Q will tell you if you should check with your doctor before you start. If you are over 69 years of age, and you are not used to being very active, check with your doctor.

Common sense is your best guide when you answer these questions. Please read the questions carefully and answer each one honestly: check YES or NO.

YES	NO		
☐	☐	1.	Has your doctor ever said that you have a heart condition and that you should only do physical activity recommended by a doctor?
☐	☐	2.	Do you feel pain in your chest when you do physical activity?
☐	☐	3.	In the past month, have you had chest pain when you were not doing physical activity?
☐	☐	4.	Do you lose your balance because of dizziness or do you ever lose consciousness?
☐	☐	5.	Do you have a bone or joint problem that could be made worse by a change in your physical activity?
☐	☐	6.	Is your doctor currently prescribing drugs (for example, water pills) for your blood pressure or heart condition?
☐	☐	7.	Do you know of any other reason why you should not do physical activity?

If you answered

YES to one or more questions

Talk with your doctor by phone or in person BEFORE you start becoming much more physically active or BEFORE you have a fitness appraisal. Tell your doctor about the PAR-Q and which questions you answered YES.

- You may be able to do any activity you want — as long as you start slowly and build up gradually. Or, you may need to restrict your activities to those which are safe for you. Talk with your doctor about the kinds of activities you wish to participate in and follow his/her advice.
- Find out which community programs are safe and helpful for you.

NO to all questions

If you answered NO honestly to all PAR-Q questions, you can be reasonably sure that you can:

- start becoming much more physically active — begin slowly and build up gradually. This is the safest and easiest way to go.
- take part in a fitness appraisal — this is an excellent way to determine your basic fitness so that you can plan the best way for you to live actively.

DELAY BECOMING MUCH MORE ACTIVE:

- if you are not feeling well because of a temporary illness such as a cold or a fever — wait until you feel better; or
- if you are or may be pregnant — talk to your doctor before you start becoming more active.

Informed Use of the PAR-Q: The Canadian Society for Exercise Physiology, Health Canada, and their agents assume no liability for persons who undertake physical activity, and if in doubt after completing this questionnaire, consult your doctor prior to physical activity.

You are encouraged to copy the PAR-Q but only if you use the entire form

NOTE: If the PAR-Q is being given to a person before he or she participates in a physical activity program or a fitness appraisal, this section may be used for legal or administrative purposes.

I have read, understood and completed this questionnaire. Any questions I had were answered to my full satisfaction.

NAME ______________________________

SIGNATURE ______________________________ DATE ______________________________

SIGNATURE OF PARENT ______________________________ WITNESS ______________________________
or GUARDIAN (for participants under the age of majority)

Supported by: Health Canada Santé Canada

Appendix C

Self-report exercise history questionnaire

About you Respondent no. ______

1. **How old are you?** ________ years

2a. **Where were you born?** (circle the letter beside one answer)

a. Australia
b. New Zealand
c. United Kingdom
d. Europe
e. Asia
f. North America
g. Other (please specify) __________________

2b. **If you circled (a), where in Australia were you born?**

____

3. **How long did you live there?**

____

4a. **Do you currently live in Townsville or Cairns?**

a. No → go straight to question 5
b. Yes

4b. **How long have you lived there?**

____

5. **What is your present marital status?** (circle the letter beside one answer)

a. Never married
b. Defacto
c. Now married
d. Separated but not divorced
e. Divorced
f. Widowed

6. **What is your highest level of schooling?** (circle the letter beside one answer)

a. Never attended school
b. Primary school
c. Some high school
d. Completed high school
e. Technical or trade school certificate/apprenticeship
f. University or tertiary qualification

7a. **Do you have a full-time or part-time job of any kind?** (either for payment or profit, or unpaid work in a family business)

a. No → go straight to question 8
c. Yes

7b. **In your main job, what is your occupation?** (eg. Sales assistant, accounts clerk, etc.)

____

7c. **What are the main tasks or duties that you usually perform in that occupation?** Please describe as fully as possible (eg. selling clothes, recording and paying accounts)

____

8. **How much do you currently weigh?** (without clothes and shoes)

___________ kilograms or ________ stone and _______ pounds

9. **What height are you?** (without clothes and shoes)

___________ centimetres or _______ feet and ________ inches

10. **Which of the following best describes your menopausal status in the past 12 months?** (circle the letter beside one answer)

a. You have experienced no change in menstrual flow
b. You have experienced change in frequency, flow or both
c. You have experienced no menses and have not undergone a hysterectomy
d. You have experienced no menses due to surgical reasons

11. **Are you currently on hormone replacement therapy (HRT)?** (circle the letter beside one answer)

a. Yes
b. No

12. **Please indicate (by circling)** w**hich of the following put you at risk for heart disease?**

a. smoking
b. high-sugar diet
c. high-fat diet
d. low levels of physical activity
e. family history of heart disease
f. obesity
g. history of cancer

13. **Please indicate (by circling) which of the following are obesity-related diseases?**
   a. heart attacks
   b. arthritis
   c. stroke
   d. atherosclerosis
   e. diabetes
   f. angina
   g. breast cancer

14. **Please indicate (by circling) how much exercise you think that you would need to perform each week to lose weight?**
   a. 1 hour/week
   b. 2 hours/week
   c. 3 hours/week
   d. 4 hours/week
   e. 5 hours/week
   f. daily

Leisure time activities

15. **Please indicate which of the following best describes your exercise behaviour** (circle the letter beside one answer)
   a. I currently do not exercise, and I do not intend to start exercising in the next 6 months
   b. I currently do not exercise, but I am thinking about starting to exercise in the next 6 months
   c. I currently exercise some, but not regularly
   d. I currently exercise regularly, but I have only begun doing so in the last 6 months
   e. I currently exercise regularly, and have done so for longer than 6 months

16a. **During your school years (5-18 years) did you participate in sport or exercise**
   a. Very often
   b. Often
   c. Sometimes
   d. Not often
   e. Never

16b. **Was the experience**
   a. positive
   b. negative
   c. neutral

17a. **During the past week did you participate in any physical activity, exercise, recreation or sport? (circle the letter beside one answer)**
   a. No → go straight to question 18
   b. Yes

From the activities listed, please tick which ones you participated in and list the approximate time spent in this activity on each occasion.

	ACTIVITY	Did you perform this activity in the past week	Number of times you performed this activity	Approximate time spent in this activity per occasion
1	Walking for pleasure			
2	Walking to and from work &/or to and from shops			
3	Walking the dog			
4	Hiking, carrying pack (back packing)			
5	Dancing			
6	Cycling to work, &/or for pleasure			
7	Aquarobics			
8	Aerobics class (step, hi/lo)			
9	Aerobics class (pump)			
10	Resistance exercise (gym/home)			
11	Jogging			
12	Running			
13	Power walking			
14	Swimming in a pool or beach			
15	Sailing			
16	Paddling or rowing for pleasure			
17	Paddling or rowing in competition			
18	Horse riding			
19	Lawn bowling			
20	Ten pin bowling			
21	Volleyball			
22	Table tennis			
23	Tennis (singles)			
24	Tennis (doubles)			
25	Squash			
26	Badminton			
27	Yoga			
28	Basketball/netball (playing)			
29	Basketball/netball (umpiring)			
30	Hockey (playing)			
31	Hockey (umpiring)			
32	Golf (walking, pulling buggy)			
33	Weeding & cultivating garden			
34	Raking leaves			
35	Mowing lawn with power mower			
36	Mowing lawn pushing hand mower			
37	Other (please specify)			

17b. **Are the activities that you participated in the past week different from those you participated in the past 12 months? (circle the letter beside one answer)**

a. No → go straight to question 18
b. Yes

17c. What were the different activities?

___

17d. Why did you change activities?

___

Non-leisure time activities

18. From the occupational/household activities listed, please tick which ones best suit your job &/or daily activities.

	ACTIVITY	Tick the appropriate activity	Number of days/week	Number of hours/day
38	Sitting, light work			
39	Walking without carrying anything			
40	Climbing stairs during working day (no of flights)	flights		
41	Standing, light work			
42	Walking, lifting, carrying objects			
43	Standing, moderate to heavy work			
44	Housework (sweeping/cleaning)			
45	Other (please specify)			

Thank you for your time.

Appendix D

Self-efficacy for exercise scale

The following items reflect situations that are listed as common reasons for preventing individuals from participating in exercise sessions or, in some cases, dropping out. Using the scales below please indicate how confident you are that you could exercise in the event that any of the following circumstances were to occur.

Please indicate the degree to which you are confident that you could exercise in the event that any of the following circumstances were to occur by circling the appropriate %. Select the response that most closely matches your own, remembering that there are no right or wrong answers.

For example, in question 1 if you have complete confidence that you could exercise even if "the weather was very bad," you would circle 100%. **If, however, you had no confidence at all that you could exercise, if you failed to make or continue making progress (that is, confidence you would not exercise),** you would circle 0%.

0% 10% 20% 30% 40% 50% 60% 70% 80% 90% 100%

NOT AT ALL CONFIDENT — MODERATELY CONFIDENT — HIGHLY CONFIDENT

I BELIEVE THAT I COULD EXERCISE IF:

1. The weather was very bad (hot, humid, rainy, cold).

0% 10% 20% 30% 40% 50% 60% 70% 80% 90% 100%

2. I was bored by the program or activity.

0% 10% 20% 30% 40% 50% 60% 70% 80% 90% 100%

3. I was on vacation.

0% 10% 20% 30% 40% 50% 60% 70% 80% 90% 100%

4. I was not interested in the activity.

0% 10% 20% 30% 40% 50% 60% 70% 80% 90% 100%

5. I felt pain or discomfort when exercising.

0% 10% 20% 30% 40% 50% 60% 70% 80% 90% 100%

6. I had to exercise alone.

0% 10% 20% 30% 40% 50% 60% 70% 80% 90% 100%

Mark your answer by circling a %.

0% 10% 20% 30% 40% 50% 60% 70% 80% 90% 100%

NOT AT ALL CONFIDENT	MODERATELY CONFIDENT	HIGHLY CONFIDENT

I BELIEVE THAT I COULD EXERCISE IF:

7. It was not fun or enjoyable.

0% 10% 20% 30% 40% 50% 60% 70% 80% 90% 100%

8. It became difficult to get to the exercise location.

0% 10% 20% 30% 40% 50% 60% 70% 80% 90% 100%

9. I didn't like the particular activity program that I was involved in.

0% 10% 20% 30% 40% 50% 60% 70% 80% 90% 100%

10. My schedule conflicted with my exercise session.

0% 10% 20% 30% 40% 50% 60% 70% 80% 90% 100%

11. I felt self-conscious about my appearance when I exercised.

0% 10% 20% 30% 40% 50% 60% 70% 80% 90% 100%

12. An instructor does not offer me any encouragement.

0% 10% 20% 30% 40% 50% 60% 70% 80% 90% 100%

13. I was under personal stress of some kind.

0% 10% 20% 30% 40% 50% 60% 70% 80% 90% 100%

Appendix E

Health belief scale

Respondent No. _________

EXERCISE AND HEALTH BELIEFS

I am interested in your beliefs about exercise and obesity-related diseases (cardiovascular disease, diabetes). There are no “right” answers. Everyone has different experiences that will influence how he or she feels. I need the answer which best explains how you feel. Please tell me how much you agree or disagree with the following statements. You will answer each question with strongly agree (7), moderately agree (6), slightly agree (5), neutral (4) or if you slightly disagree (3), moderately disagree (2), or strongly disagree (1).

DIRECTIONS: Please circle the most appropriate number (1-7).

			Strongly agree	Moderately agree	Slightly agree	Neutral	Slightly disagree	Moderately disagree	Strongly disagree
SU	1	I am likely to develop an obesity-related disease sometime during my life	7	6	5	4	3	2	1
SU	2	I feel that I will get an obesity-related disease in the future	7	6	5	4	3	2	1
SU	3	There is a good probability that I will get an obesity-related disease	7	6	5	4	3	2	1
SU	4	My chances of getting an obesity-related disease are great	7	6	5	4	3	2	1
SU	5	I am more likely than a 50 year old person to get an obesity-related disease	7	6	5	4	3	2	1

The next group of questions concerns what you believe about the seriousness of obesity-related diseases. You will answer each question with strongly agree (7), moderately agree (6), slightly agree (5), neutral (4) or if you slightly disagree (3), moderately disagree (2), or strongly disagree (1).

			Strongly agree	Moderately agree	Slightly agree	Neutral	Slightly disagree	Moderately disagree	Strongly disagree
SE	1	The thought of an obesity-related disease if not treated promptly, scares me	7	6	5	4	3	2	1
SE	2	Feelings about myself would change if I got an obesity-related disease and it were not treated promptly	7	6	5	4	3	2	1
SE	3	When I think about an obesity-related disease which is not treated promptly my heart beats faster	7	6	5	4	3	2	1
SE	4	I am afraid to even think about an obesity-related disease if it is not treated promptly	7	6	5	4	3	2	1
SE	5	Problems experienced from an obesity-related disease which was not treated promptly would last a long time	7	6	5	4	3	2	1
SE	6	If I had an obesity-related disease which was not treated promptly my whole life would change	7	6	5	4	3	2	1
SE	7	If I developed an obesity-related disease and it was treated promptly, I would not live longer than 5 years	7	6	5	4	3	2	1

The next group of questions concerns what you believe are the benefits of exercise. You will answer each question with strongly agree (7), moderately agree (6), slightly agree (5), neutral (4) or if you slightly disagree (3), moderately disagree (2), or strongly disagree (1).

			Strongly agree	Moderately agree	Slightly agree	Neutral	Slightly disagree	Moderately disagree	Strongly disagree
BE	1	Exercise on a regular basis will allow an obesity-related disease to be detected before it can seriously affect me	7	6	5	4	3	2	1
BE	2	Exercise on a regular basis will reduce my chance of dying of an obesity-related disease	7	6	5	4	3	2	1
BE	3	Exercise on a regular basis will reduce my chance of requiring surgery for an obesity-related disease	7	6	5	4	3	2	1
BE	4	Exercise will reduce my anxiety about an obesity-related disease	7	6	5	4	3	2	1

The next group of questions concerns what you believe are consequences resulting from regular exercise. You will answer each question with strongly agree (7), moderately agree (6), slightly agree (5), neutral (4) or if you slightly disagree (3), moderately disagree (2), or strongly disagree (1).

			Strongly agree	Moderately agree	Slightly agree	Neutral	Slightly disagree	Moderately disagree	Strongly disagree
BA	1	Exercise will make me worry about an obesity-related disease	7	6	5	4	3	2	1
BA	2	It is embarrassing for me to exercise	7	6	5	4	3	2	1
BA	3	Exercise will take too much time	7	6	5	4	3	2	1
BA	4	Exercise is very expensive	7	6	5	4	3	2	1
BA	5	Exercise is frightening to me	7	6	5	4	3	2	1
BA	6	It takes a long time to get to my facility for exercise activity	7	6	5	4	3	2	1
BA	7	Exercise can be painful	7	6	5	4	3	2	1
BA	8	Exercise exposes me to the risk of a heart attack	7	6	5	4	3	2	1

The following questions ask about cues that may influence your decision to exercise. You will answer each question with strongly agree (7), moderately agree (6), slightly agree (5), neutral (4) or if you slightly disagree (3), moderately disagree (2), or strongly disagree (1).

			Strongly agree	Moderately agree	Slightly agree	Neutral	Slightly disagree	Moderately disagree	Strongly disagree
CU	1	A TV show featuring a well known personality urging people my age to exercise would influence my decision to exercise	7	6	5	4	3	2	1
CU	2	If my doctor recommended exercise	7	6	5	4	3	2	1
CU	3	If my chest felt different to me	7	6	5	4	3	2	1
CU	4	If I saw a film that showed a person exercising	7	6	5	4	3	2	1
CU	5	If I read pamphlets recommending regular exercise	7	6	5	4	3	2	1
CU	6	If a family member or friend is diagnosed with an obesity-related disease	7	6	5	4	3	2	1
CU	7	If a family member urged me to exercise regularly	7	6	5	4	3	2	1

The following questions ask about your health behaviour and about how well you feel you can control obesity-related diseases. You will answer each question with strongly agree (7), moderately agree (6), slightly agree (5), neutral (4) or if you slightly disagree (3), moderately disagree (2), or strongly disagree (1).

			Strongly agree	Moderately agree	Slightly agree	Neutral	Slightly disagree	Moderately disagree	Strongly disagree
HM	1	Maintaining good health is extremely important to me	7	6	5	4	3	2	1
HM	2	I search for new information related to my health	7	6	5	4	3	2	1
HM	3	I frequently do things to improve my health	7	6	5	4	3	2	1
HM	4	I eat a well-balanced diet	7	6	5	4	3	2	1
HM	5	I will exercise regularly this year	7	6	5	4	3	2	1
HM	6	I work hard to discover an obesity-related disease early	7	6	5	4	3	2	1

Appendix F

Subjective exercise experiences scale

How do you feel right now?

I FEEL:

1. Great

1	2	3	4	5	6	7
Not at all			Moderately			Very much so

2. Awful

1	2	3	4	5	6	7
Not at all			Moderately			Very much so

3. Drained

1	2	3	4	5	6	7
Not at all			Moderately			Very much so

4. Positive

1	2	3	4	5	6	7
Not at all			Moderately			Very much so

5. Crummy

1	2	3	4	5	6	7
Not at all			Moderately			Very much so

6. Exhausted

1	2	3	4	5	6	7
Not at all			Moderately			Very much so

7. Strong

1	2	3	4	5	6	7
Not at all			Moderately			Very much so

8. Discouraged

1	2	3	4	5	6	7
Not at all			Moderately			Very much so

9. Fatigued

1	2	3	4	5	6	7
Not at all			Moderately			Very much so

10. Terrific

1	2	3	4	5	6	7
Not at all			Moderately			Very much so

11. Miserable

1	2	3	4	5	6	7
Not at all			Moderately			Very much so

12. Tired

1	2	3	4	5	6	7
Not at all			Moderately			Very much so

Appendix G

Rating of perceived exertion (RPE) scale

<u>Category Scale</u>

6	
7	Very, very light
8	
9	Very light
10	
11	Fairly light
12	
13	Somewhat hard
14	
15	Hard
16	
17	Very hard
18	
19	Very, very hard
20	

Appendix H

Skewness and Kurtosis values for variables.

Variable	Skewness	Kurtosis
RHR	0.27	0.08
RBP_{sys}	0.27	-0.55
RBP_{dias}	-0.20	0.08
BMI	1.07	2.17
WHR	0.46	0.66
VO_{2max}	0.11	-0.27
ex self-efficacy 1	-.24	-1.41
ex self-efficacy 2	0.08	-1.12
ex self-efficacy 3	-0.30	-1.37
ex self-efficacy 4	0.50	-1.03
ex self-efficacy 5	0.80	-0.42
ex self-efficacy 6	-0.94	-0.23
ex self-efficacy 7	0.08	-1.30
ex self-efficacy 8	0.20	-1.36
ex self-efficacy 9	0.54	-1.01
ex self-efficacy 10	0.44	-1.27
ex self-efficacy 11	-0.53	-1.04
ex self-efficacy 12	-0.35	-1.19
ex self-efficacy 13	-0.22	-1.36
total ex self-efficacy score	0.19	-0.73
SU	1.18	0.25
SE	-0.63	0.62
BE	-1.37	3.03*
BA	1.24	1.76
CU	-0.24	0.34
HM	-0.66	-0.11

SEESa prior	-0.99	1.35
SEESb prior	2.34**	5.60*
SEESc prior	1.49	2.40
HR prior	0.08	-0.27
SEESa 5mins	-0.55	-0.65
SEESb 5mins	2.56**	6.56*
SEESc 5mins	1.14	0.70
HR 5mins	0.32	-0.26
RPE 5mins	-0.16	0.53
SEESa 10mins	-0.55	-0.36
SEESb 10mins	3.01**	9.91*
SEESc 10mins	1.21	0.73
HR 10mins	0.20	-0.03
RPE 10mins	-0.34	0.01
SEESa 15mins	-0.80	0.37
SEESb 15mins	2.67**	6.88*
SEESc 15mins	1.20	0.83
HR 15mins	0.03	-0.25
RPE 15mins	-0.43	0.31
SEESa 20mins	-1.08	1.52
SEESb 20mins	3.23**	11.24*
SEESc 20mins	1.11	0.57
HR 20mins	0.07	-0.23
RPE 20mins	-0.13	1.00
SEESa post	-1.15	1.93
SEESb post	3.18**	9.85*
SEESc post	1.38	1.29
HR post	0.41	0.09

** Skewness which exceeds 2.00

* Kurtosis which exceeds 3.00

Appendix I

Minimum and maximum Z scores of variables.

Variable	Min z score	Max z score
RHR	-2.51	2.60
SBP_{rest}	-2.29	2.40
DBP_{rest}	-2.37	2.05
BMI	-2.13	3.82
WHR	-2.17	3.21
$estVO_{2max}$	-2.18	2.58
ex self-efficacy 1	-1.54	1.25
ex self-efficacy 2	-1.54	1.54
ex self-efficacy 3	-1.69	1.14
ex self-efficacy 4	-1.14	1.90
ex self-efficacy 5	-1.03	2.16
ex self-efficacy 6	-2.65	0.88
ex self-efficacy 7	-1.50	1.61
ex self-efficacy 8	-1.33	1.53
ex self-efficacy 9	-1.23	1.88
ex self-efficacy 10	-1.12	1.76
ex self-efficacy 11	-2.02	1.08
ex self-efficacy 12	-1.75	1.17
ex self-efficacy 13	-1.64	1.27
total ex self-efficacy score	-1.89	2.08
mean SU score	-0.82	2.30
mean SE score	-3.30	1.77
mean BE score	-4.49	0.98
mean BA score	-1.04	3.66
mean CU score	-2.87	2.29
mean HM score	-2.79	1.33

SEESa prior	-3.13	1.28
SEESb prior	-0.56	4.42
SEESc prior	-0.94	3.65
HR prior	-2.27	2.57
SEESa 5mins	-2.45	1.33
SEESb 5mins	-0.47	4.34
SEESc 5mins	-0.97	3.13
HR 5mins	-2.04	2.28
RPE 5mins	-2.28	3.16
SEESa 10mins	-2.70	1.30
SEESb 10mins	-0.44	4.77
SEESc 10mins	-0.96	2.78
HR 10mins	-2.25	2.77
RPE 10mins	-2.52	2.38
SEESa 15mins	-3.20	1.20
SEESb 15mins	-0.46	4.35
SEESc 15mins	-0.98	2.98
HR 15mins	-2.26	2.42
RPE 15mins	-2.63	2.60
SEESa 20mins	-3.50	1.09
SEESb 20mins	-0.41	5.34
SEESc 20mins	-0.98	2.79
HR 20mins	-2.34	2.40
RPE 20mins	-2.59	3.29
SEESa post	-4.09	1.06
SEESb post	-0.38	4.58
SEESc post	-0.85	3.18
HR post	-2.31	2.86

Appendix J

Occupations of exercisers

Occupation	Frequency	Percent
not employed	27	50.9
accountant	1	1.9
admin officer	1	1.9
assoc professor	1	1.9
family business	1	1.9
itr manager	1	1.9
lecturer	1	1.9
librarian	1	1.9
mgr real estate	1	1.9
nurse	1	1.9
personal assistant	1	1.9
principle	1	1.9
property manager	1	1.9
psychologist	1	1.9
retail assistant	1	1.9
sales	1	1.9
secretary	1	1.9
senior info officer	1	1.9
senior lecturer	1	1.9
social worker	2	3.8
teacher	2	3.8
technician	1	1.9
training consultant	1	1.9
tutor	1	1.9
volunteer	1	1.9
Total	53	100.0

Appendix J continued

Occupations of non-exercisers

Occupation	Frequency	Percent
not employed	16	33.3
academic	1	2.1
admin assistant	1	2.1
admin/sexual assault	1	2.1
administrator	2	4.2
book keeper	1	2.1
carer	1	2.1
carer/nurse	1	2.1
childcare worker	1	2.1
client service officer	1	2.1
clinical scientist	1	2.1
CU manager	1	2.1
discharge co-ord	1	2.1
facilitator	1	2.1
kitchen assistant	1	2.1
librarian	1	2.1
library assistant	1	2.1
library manager	1	2.1
library tech	1	2.1
library technician	1	2.1
professor	1	2.1
receptionist	1	2.1
registered nurse	2	4.2
sales assist	1	2.1
sales assistant	3	6.3
secretary	1	2.1
student supervisor	1	2.1
teacher	1	2.1
yoga teacher	1	2.1
Total	48	100.0

Appendix K

Reasons for a change in leisure-time activities in the past seven days for exercisers.

Reason	Frequency	Percent
Did not change	25	47.2
access to pool	1	1.9
advice of doctor	1	1.9
fund raising	1	1.9
holidays	1	1.9
husband ill,too hot	1	1.9
just started	1	1.9
knee surgery	1	1.9
no time	1	1.9
no time with family	1	1.9
other things on	1	1.9
overseas visitors	1	1.9
part-time studying	1	1.9
renew interest	1	1.9
season	1	1.9
season & time	1	1.9
sick/moving house	1	1.9
surgery, too dark	1	1.9
time, sickness	1	1.9
to feel better	1	1.9
too cold	1	1.9
too hot, no time	1	1.9
unavail/bored	1	1.9
visiting grandkids	1	1.9
weather	1	1.9
weather, no time	1	1.9
weather/buddy inj'd	1	1.9
work commitments	1	1.9
xmas/instruct ill	1	1.9
Total	53	100.0

Appendix K continued

Reasons for a change in leisure-time activities in the past seven days for non-exercisers

Reason	Frequency	Percent
Did not change	15	31.3
dry season	1	2.1
got horse	1	2.1
health	1	2.1
heat/rain	1	2.1
holidays	1	2.1
hols;too cold	1	2.1
ill health	1	2.1
illness/too busy	1	2.1
infections from pool	1	2.1
more work around home	1	2.1
moved house/less gar	1	2.1
no time	2	4.2
no vol work now	1	2.1
no walking partner	1	2.1
not at city campus	1	2.1
not motivated	1	2.1
not safe	1	2.1
one off/share husband	1	2.1
schedule conflict	1	2.1
sciatica	1	2.1
season	1	2.1
sickness in family	1	2.1
sporadic acts	1	2.1
swim season, schedule	1	2.1
too busy-work	1	2.1
too busy	2	4.2
too cold/no partner	1	2.1
water too cold	1	2.1
weather/no access	1	2.1
work & study	1	2.1
work/club commit	1	2.1
Total	48	100.0

Appendix L

Waist circumference of exercisers

Circumference	Frequency	Percent
60.50	1	1.9
64.20	1	1.9
66.50	1	1.9
67.00	2	3.8
68.00	1	1.9
68.40	1	1.9
69.00	1	1.9
69.40	1	1.9
69.50	1	1.9
70.00	1	1.9
70.50	2	3.8
71.10	1	1.9
71.50	2	3.8
72.00	1	1.9
73.50	1	1.9
73.60	1	1.9
74.00	2	3.8
74.40	1	1.9
74.50	2	3.8
75.50	1	1.9
75.60	1	1.9
76.20	1	1.9
76.50	4	7.5
76.70	1	1.9
77.40	1	1.9
77.50	1	1.9
78.00	1	1.9
79.00	2	3.8
79.50	1	1.9
80.00	1	1.9
81.00	1	1.9
81.40	1	1.9
81.50	1	1.9
81.70	1	1.9
81.80	1	1.9
82.00	1	1.9
85.50	1	1.9
89.00	2	3.8
89.30	1	1.9
89.50	1	1.9
90.00	1	1.9
91.50	1	1.9
92.50	1	1.9
Total	53	100.0

Appendix L continued

Waist circumference of non-exercisers

Circumference	Frequency	Percent
66.00	1	2.1
67.00	1	2.1
69.50	1	2.1
70.00	1	2.1
73.00	2	4.2
74.50	1	2.1
76.40	1	2.1
76.50	1	2.1
77.00	1	2.1
79.00	3	6.3
80.00	1	2.1
80.30	1	2.1
80.50	1	2.1
81.50	1	2.1
82.00	2	4.2
82.50	2	4.2
83.50	1	2.1
84.00	1	2.1
84.50	1	2.1
84.80	1	2.1
85.40	1	2.1
85.50	1	2.1
86.60	1	2.1
87.00	1	2.1
87.50	1	2.1
89.00	2	4.2
90.00	1	2.1
91.50	1	2.1
91.70	1	2.1
91.90	1	2.1
92.20	1	2.1
93.50	2	4.2
94.00	1	2.1
97.00	2	4.2
100.00	1	2.1
100.50	1	2.1
104.00	2	4.2
104.50	1	2.1
Total	48	100.0

Appendix M

Test of equality of group means for barrier items.

Independent variable	Wilks Lambda	F	df1	df2	P
1. Weather was very bad	0.80	24.52	1	99	0.00
3. I was on vacation	0.92	8.52	1	99	0.00
5. I felt pain/discomfort	0.87	13.82	1	99	0.00
6. I had to exercise alone	0.93	7.04	1	99	0.01
7. It was not fun/enjoyable	0.92	8.77	1	99	0.00
8. Difficult to get to location	0.77	28.93	1	99	0.00
10. Schedule conflicted	0.72	38.78	1	99	0.00
11. I felt self-conscious	0.86	16.08	1	99	0.00
12. Instructor didn't offer encouragement	0.84	18.49	1	99	0.00
13. Under personal stress	0.82	21.71	1	99	0.00

Appendix N

Test of equality of group means for HBM variables.

Predictor variable	Wilks Lambda	F	df1	df2	P
SU	0.81	23.45	1	99	0.00
SE	0.99	0.33	1	99	0.56
BE	1.00	0.00	1	99	0.95
BA	0.85	17.50	1	99	0.00
CU	0.96	3.67	1	99	0.05
HM	0.89	11.87	1	99	0.00