ResearchOnline@JCU

This is the **Accepted Version** of a paper published in the Journal of Physical Activity and Health:

Plotnikoff, Ronald C., Gebel, Klaus, and Lubans, David R. (2014) *Self-efficacy, physical activity and sedentary behavior in adolescent girls: testing mediating effects of the perceived school and home environment.* Journal of Physical Activity and Health, 11 (8). pp. 1579-1586.

http://dx.doi.org/10.1123/jpah.2012-0414

JAMES COOK UNIVERSITY AUSTRALIA

"Self-Efficacy, Physical Activity and Sedentary Behavior in Adolescent Girls: Testing Mediating Effects of the Perceived School and Home Environment" by Plotnikoff RC, Gebel K, Lubans DR
Journal of Physical Activity & Health
© 2014 Human Kinetics, Inc.

Note: This article will be published in a forthcoming issue of the *Journal of Physical Activity & Health*. This article appears here in its accepted, peer-reviewed form, as it was provided by the submitting author. It has not been copy edited, proofed, or formatted by the publisher.

Section: Original Research

Article Title: Self-Efficacy, Physical Activity and Sedentary Behavior in Adolescent Girls: Testing Mediating Effects of the Perceived School and Home Environment

Authors: Ronald C. Plotnikoff, Klaus Gebel, and David Revalds Lubans

Affiliations: The authors are with Priority Research Centre in Physical Activity and Nutrition, University of Newcastle, Newcastle NSW, Australia.

Running Head: Environment mediators of PA

Journal: *Journal of Physical Activity & Health*

Acceptance Date: September 21, 2013

©2014 Human Kinetics, Inc.

DOI: http://dx.doi.org/10.1123/jpah.2012-0414

"Self-Efficacy, Physical Activity and Sedentary Behavior in Adolescent Girls: Testing Mediating Effects of the Perceived School and Home Environment" by Plotnikoff RC, Gebel K, Lubans DR
Journal of Physical Activity & Health
© 2014 Human Kinetics, Inc.

Self-efficacy, physical activity and sedentary behavior in adolescent girls: Testing mediating effects of the perceived school and home environment

Running Heading: Environment mediators of PA

Original Research

Abstract Word Count: 196

Manuscript Word Count (excluding abstract and title): 3354

"Self-Efficacy, Physical Activity and Sedentary Behavior in Adolescent Girls: Testing Mediating Effects of the Perceived School and Home Environment" by Plotnikoff RC, Gebel K, Lubans DR
Journal of Physical Activity & Health
© 2014 Human Kinetics, Inc.

Abstract

Background: According to social-cognitive theory (SCT), self-efficacy affects health behavior both directly and indirectly by influencing how individuals perceive their environment. This study examines whether perceptions of home and school environment mediate the association between self-efficacy and physical activity (PA) and sedentary behavior in adolescent girls. **Methods**: Baseline data from the Nutrition and Enjoyable Activities for Teen Girls (NEAT) was used for this study. Grade 8 female students (n=357) were recruited from 12 secondary schools located in low-income communities in the Hunter Region, New South Wales, Australia. PA was assessed using accelerometers, and sedentary behavior by self-report and accelerometers. Self-reported measures were used for perceived home and school environment and self-efficacy. Multi-level regression models were calculated to determine if the perceived environment mediated the relationship between self-efficacy with both PA and sedentary behavior. **Results**: The perceptions of the school and home environment did not mediate the relationship between PA self-efficacy and PA behavior or sedentary behavior. **Conclusion**: The mediated models were not supported for PA or sedentary behavior. However, other results of this paper may be helpful for future theory development and practice. More research is needed to understand behaviors in unique populations such as this.

Keywords: Physical activity, sedentary behavior, environment, social-cognitive theory

"Self-Efficacy, Physical Activity and Sedentary Behavior in Adolescent Girls: Testing Mediating Effects of the Perceived School and Home Environment" by Plotnikoff RC, Gebel K, Lubans DR
Journal of Physical Activity & Health
© 2014 Human Kinetics, Inc.

Background

Physical Activity (PA) is associated with numerous health benefits.[1] For children and adolescents it is of particular relevance that PA promotes healthy growth and positively affects social[2] and cognitive development.[3] However, in most countries a vast majority of children and adolescents are not sufficiently active.[4-6]

Sedentary behavior is a unique health risk factor (independent of PA)[7] and refers to sitting behavior that requires very little energy expenditure. It occurs in different settings throughout the day such as at home, for transport, at work or at school.[8] Over the last few decades, sedentary behavior among young people has increased dramatically,[9] posing a public health risk in both developed and developing countries. Sedentary behavior is an emerging risk factor of compromised metabolic health and chronic diseases.[10] Perhaps the most serious immediate consequences of increased sedentary behavior in youth are psychosocial, as high screen use has been linked to low self-esteem[11,12] poor quality of life[13] and depression[12] in young people.

PA declines and sedentary behavior increases during adolescence,[14] and both trends are more pronounced in adolescent girls.[4,14] Further, health behaviors that develop during childhood and adolescence are likely to continue into adulthood.[15,16] There is also evidence that socioeconomic status is related to levels of PA in young people.[17,18] In particular, adolescent girls living in low income communities are less active than girls residing in mid and high income areas.[19] Hence, there is an urgent need for interventions to increase PA and decrease sedentary behavior in youth, especially for girls from low socioeconomic backgrounds.

A prerequisite for effective design and implementation of health promotion interventions is the identification of factors and underlying mechanisms that influence targeted health behaviors.[20] Research has shown that aspects of home, neighborhood, and

© 2014 Human Kinetics, Inc.

school environments are associated with PA in young people.[21-23] A few studies have also investigated the relationship between the built environment and sedentary behavior. However, this area is understudied and in the few studies that have been conducted, most of the associations were not significant.[24-26] The lack of significant association might be a result of unmatched environmental attributes and sedentary behavior outcomes. Another limitation of current research on environment and PA/sedentary behavior is the lack of understanding of the mechanism of association. Previous syntheses of the literature recommend better specified conceptual and statistical models that test the mechanisms of relationships, such as mediation models.[27]

The importance of the environment is highlighted by the Social Cognitive Theory (SCT). One of the principles of SCT is 'reciprocal determinism' which states that the environment, the person and the behavior continuously influence each other.[28] SCT differentiates between the objective environment and situations, whereby the cognitive representation of the environment may affect behavior.[28,29] The literature on spatial cognition and environmental psychology emphasizes that while people process, code and store information about their environment in cognitive maps, these are not necessarily accurate representations of their actual surroundings.[30-33] Several studies found that in adults, there is a low agreement between perceived and objective measures of the environment[34-37] and that environmental perceptions are more strongly associated with PA than objective measures.[36,37] A recent study from the Netherlands also had similar findings for adolescents.[38]

Self-efficacy has been proposed as the most important prerequisite of behavior change in SCT. The measurement of self-efficacy must be specific to the target behavior and to the barriers faced by the target group.[29] Self-efficacy is considered to be the most widely studied individual-level correlate of PA[39] and has been shown to be associated with both PA[40,41] and sedentary behavior in children and adolescents.[24] Further, this construct is one of the only

© 2014 Human Kinetics, Inc.

longitudinal determinants to be consistently associated with physical activity in youth.[42] Bandura proposes that self-efficacy influences how people perceive obstacles and facilitators in their environment. Those with low self-efficacy are more likely to have negative views of their environment, while people with high self-efficacy are more likely to have positive environmental perceptions.[43] For example, two studies from Australia showed that adults with low self-efficacy for PA were more likely to have negative perceptions of an objectively measured high walkable neighborhood environment than those with high self-efficacy.[34,36] Similarly, a study from Canada found that adolescents with low self-efficacy were more likely to perceive fewer opportunities for PA in their school environment compared to objective assessments.[44] Furthermore, Bandura states that self-efficacy affects health behavior both directly, and indirectly through its impact on perceptions of obstacles and facilitators in the environment. In other words, perceptions of the environment may mediate the relationship between self-efficacy and behavioral outcomes such as PA.[43]

Examining the role of potential mediators has been one of the most cited future research directions in the relationship between environments and PA.[21,45-49] Similarly, Baranowski and colleagues argue a need for a better evidence-base regarding mediators for PA change for interventions targeting children and adolescents.[50,51] Most studies to date in this population have examined cognitive, behavioral and interpersonal mediators for PA.[49] Moreover, while self-efficacy and the built environment are some of the most widely studied correlates of PA, the interrelationship between the two has rarely been explored.[39] As previously mentioned, self-efficacy is hypothesized to influence perceptions of the environment which in turn are associated with PA. However, we are not aware of any other studies that have examined whether perceptions of the environment mediate the relationship between self-efficacy and PA.

© 2014 Human Kinetics, Inc.

The first aim of this paper was to determine if perceptions of the (i) home and (ii) school environment (examined separately) mediate the cross-sectional relationship between self-efficacy and PA in a sample of adolescent girls from low socioeconomic backgrounds. The second aim was to examine if perceptions of the environment ((i) home; (ii) school) mediate the relationship between self-efficacy and sedentary behavior in this target population.

Methods

Design

Data were used from the baseline survey of the Nutrition and Enjoyable Activities for Teen Girls (NEAT) study conducted in Newcastle, Australia. A detailed description of this study has been provided elsewhere.[52] Briefly, NEAT Girls was a group-based randomized controlled trial (RCT) examining the effects of a 12-month school based intervention, targeting PA and nutrition behaviors of grade 8 female students from economically disadvantaged schools.[52-54] Ethical approval for the study was given by the University of Newcastle and the New South Wales (NSW) Department of Education and Training Human Research Ethics Committees. School principals, parents and study participants provided written informed consent.

Participants

An index of socioeconomic disadvantage (Socio-Economic Indexes for Areas - SEIFA) was used to identify schools eligible for inclusion. SEIFA takes into account several socio-economic indicators of individuals and households in a specific area (e.g., employment, home ownership) and the score ranges from 1 (lowest SES) to 10 (highest SES). Public secondary schools in the Hunter Region and Central Coast areas of NSW with a SEIFA of ≤5 (bottom 50%) were considered for inclusion in the study. Twenty-six eligible schools were

© 2014 Human Kinetics, Inc.

identified. Of these, 18 were contacted and 12 successfully recruited. The range of SEIFA Indices (SI) were: SI-1 (n=1), SI-2 (n=4), SI-3 (n=3), SI4 (n=3), SI5 (n=1). The sizes of the 12 schools ranged from approximately 600-1300 students per school. Six schools were randomly allocated to the intervention and the other six served as control schools. Physical education teachers in the schools facilitated the recruitment of study participants. To be eligible students had to be females in grade 8 (12-14 years of age) who, as considered by their teachers, were disengaged in PE and/or not participating in organized sports. Physical education teachers at the study schools were asked to identify and invite 30 adolescent girls in Grade 8. Of the 12 study schools, 9 recruited 30 students while three schools recruited close to this quota with a final recruitment rate of 97.5%. Due to the recruitment protocol we are unable to report an accurate consent rate (i.e., percentage of consent letters returned divided by the number of consent letters distributed). Missing data were limited to less than 5%.

Measures

BMI

Height and weight were measured by trained research assistants. Weight was measured with a digital scale to the nearest 0.1kg and height was measured to the nearest 0.1cm using a portable stadiometer. BMI was calculated using the formula (weight[kg]/height[m]^2) and further classified using age-specific percentiles.

Physical activity

Actigraph accelerometers (MTI models 7164, GT1M and GT3X) were worn by participants during waking hours for seven consecutive days, except while bathing and swimming. To improve compliance with the study protocols, participants were sent text messages each morning during the seven-day monitoring period to remind them to wear their accelerometers. Data were stored in 30-second epochs and the mean activity counts per

© 2014 Human Kinetics, Inc.

minute (CPM) were calculated. Age and gender specific cut-points were used to categorize PA into sedentary, light, moderate and vigorous intensity activity.[55]

Studies have demonstrated that the output generated from the different Actigraph devices is comparable when assessing habitual physical activity.[56;Dinesh, 2009 #2877} For example, a recent study by Dinesh and colleagues[57] demonstrated that there were no statistically significant differences between outputs from 7164, GT1M and GT3X accelerometers on walking and running tasks. Devices were subjected to inter- and intra-device reliability testing when first purchased, but not before they were used in the current study, as recently recommended.[58] Participants wore accelerometers, positioned on an elastic belt in front of the right hip, during waking hours for seven consecutive days. Trained research assistants explained the procedure and fitted the participants with accelerometers. Mobile phone text messages were sent to participants each morning to remind them to attach their accelerometers. Physical activity was categorized into sedentary, light, moderate and vigorous intensity activity using age and gender specific cut-points.[55] Participant data were included in the analyses if accelerometers were worn for ≥600 minutes on three or more days.[4] To define non-wear time an interval of 20 consecutive minutes of zero activity counts was predetermined, an interruption interval of one minute of counts between 0 and 100 was permitted.

Sedentary behaviors

The Adolescent Sedentary Activity Questionnaire (ASAQ) was used to provide a self-report of time spent in sedentary behaviors.[59] The ASAQ requires respondents to report time spent out of school hours in the following activities: watching television/videos/DVDs, computer use, e-games and e-communication, study, reading, sitting with friends, telephone

© 2014 Human Kinetics, Inc.

use, listening or playing music, motorized travel, hobbies and crafts. The ASAQ has good validity and reliability compared to other self-report screen-time measures.[59]

Self-efficacy

Scales of self-efficacy for PA based on SCT were designed for this study and reported elsewhere.[54] Self-efficacy was operationalized as an individual's confidence in personal ability to adopt and maintain PA behaviors and overcome barriers. The measure included eight items with a 6-point Likert scale ranging from 'strongly disagree' (1) to 'strongly agree' (6); for example, "I find it difficult to be physically active when I have no one to be active with". The mean for the six items was calculated to create a scale score (ranging from 1 to 6) for each individual. The psychometric properties of these scales were examined in a sample of Australian adolescents (N=171) which supported their validity and two-week test-retest reliability.[54]

Perceptions of the environment

The questionnaire included six questions with a six-point Likert scale (1=disagree; 6=agree a lot) related to the environment (higher mean scores indicated a greater supportive environment). Both school and outside of school environments are independently associated with physical activity in youth.[44,60] Therefore, three items were about aspects of the home and neighborhood environment, such as access to exercise equipment at home, access to places for PA (e.g. gym, backyard or garage), and safety from traffic. The other three items assessed the access to good PA facilities at school (e.g. gyms, ovals, dance studio, courts) and their availability during recess / lunch and after school hours. The survey items for the environment were validated and had good test-retest reliability.[54]

© 2014 Human Kinetics, Inc.

Data analysis

Descriptive and exploratory statistical analyses were completed using PASW Statistics 17 (SPSS Inc. Chicago, IL) software and alpha levels were set at $p < 0.05$. A series of multi-level regression models were calculated to explore the association between outcomes using MLwin (version 2.02). Missing data were limited to less than 5% for any study variable**.** To adjust for the clustering of effects at the school level, two levels were defined in all of the analyses: 1) student and 2) school). SES and age were tested as potential confounding variables and were subsequently included as covariates in all of the models. To determine if the perceived environment mediated the relationship between self-efficacy and PA and sedentary behavior, a series of regression models were calculated (Figure 1). First, the association between self-efficacy and hypothesized mediators (i.e. home and school environment) were calculated using separate regression models (A-coefficient). Second, the associations between the potential mediators and PA/sedentary behavior (i.e. counts/minute, MVPA minutes/day, sedentary %, screen time minutes/day, were explored (B-coefficient). Finally, the asymmetric confidence intervals were calculated to test the significance of the product-of-coefficients (AB) using MacKinnon and colleagues PROduct Confidence Limits for INdirect effects (PRODCLIN) program.[61] For a variable to satisfy the criteria for mediation, the 95% confidence intervals (CI) of the mediated effect (i.e. AB) must not include zero.

Results

Overview of study sample

Results are provided as means ± standard deviations, unless otherwise noted (Table 1). Participants were 357 adolescent girls (13.2±0.5 years) from 12 secondary schools. The majority of participants were born in Australia (97.8%), spoke English at home (98.6%), and

© 2014 Human Kinetics, Inc.

identified their cultural background as Australian (85.4%). A high percentage of participants were classified as overweight (26.1%) or obese (16.8%). The national prevalence of girls aged 14-16 years of age who are overweight or obese are 16 and 17 per cent respectively.[62] Two hundred and fifty seven participants wore accelerometers for ≥600 minutes on at least three days. There were no statistical differences ($p < 0.05$) on the study variables between those who wore accelerometers and those who did not.

Association between PA, sedentary behavior and self-efficacy (C and C´ coefficients)

Self-efficacy was not associated with PA (Table 2) or sedentary behavior (Table 3).

Association between self-efficacy and environment (A coefficient)

There was a positive significant association between self-efficacy and perceived home environment (A= 0.36, 95% CI = 0.24 to 0.48, $p < 0.05$) (Table 2). The association between self-efficacy and school environment was not significant.

Association between environment, PA and sedentary behavior (B coefficient)

The perceived environment was not associated with activity counts/minute or MVPA minutes/day (Table 2). Similarly, the home environment was not associated with self-reported screen time (Table 3), but there was a positive significant association between perceived school environment and sedentary behavior % (B = 1.10, 95% CI = 0.10 to 2.11, $p < 0.05$).

There were no statistically significant mediation effects for the cross-sectional relationship between self-efficacy and PA (Table 2) and sedentary behavior (Table 3).

Discussion

The first aim of this study, to examine whether perceptions of the school or the home environment mediated the relationship between PA self-efficacy and PA behavior, was not supported by the data. We hypothesized an association between PA self-efficacy and the

© 2014 Human Kinetics, Inc.

school environment. Interestingly, PA self-efficacy was associated with the home environment, but not with the school environment.

Research has found a positive relationship between home and school environments with PA in young people.[21] However, in the present study the perceived home and school environments were not associated with PA behavior. As mentioned above, the schools examined for this study were recruited from areas of low socioeconomic status. Studies have found that deprived neighborhoods tend to have fewer or less attractive resources for PA than more affluent areas and this can partly explain socioeconomic differences in PA levels.[63-69] Therefore, it could be that the lack of association with PA is attributable to an 'actual' and hence a 'perceived' low-level of resources in the disadvantaged schools and homes. Moreover, research has found that girls are generally less physically active than boys[70] and that this difference is particularly pronounced in adolescents from low SES backgrounds.[40,71] Therefore, the fact that the sample of this study consisted of girls who were identified by their teachers as disengaged in PE and/or not participating in organized sports and who were from low socioeconomic areas, could have also contributed to the lack of association between environments and PA.

The association between self-efficacy and PA behavior was not statistically significant. However, the relationship approached significance. Research has found that the association between self-efficacy and PA behavior is stronger for self-reported PA than for objectively measured PA.[72,73] This might partly be due to shared method variance which means that if two variables are measured the same way (i.e. both self-report) they are more likely to be correlated than if they are measured by two different methods (i.e. self-report vs. accelerometry).[74,75] As well, previous studies indicate that the effect of self-efficacy on PA is stronger in boys than in girls.[76,77] The present study used accelerometers to measure PA in

© 2014 Human Kinetics, Inc.

girls which might explain why the relationship between self-efficacy and PA did not reach statistical significance.

The second aim of this study, to examine whether perceptions of the home or school environment mediated the relationship between self-efficacy and sedentary behavior, was not supported by the data. Interestingly, there was a significant positive association between the perceived school environment and sedentary behavior (from accelerometry data). This seems counter-intuitive as poorer environments for PA would be expected to yield increased sedentary behavior time. As stated before, very little research has been conducted on the relationship between physical environments and sedentary behavior. However, similar to our finding, a recent study from Belgium reported neighborhood walkability was positively associated with self-reported and objectively measured sedentary behavior.[78] Further research is needed to explore the association between the environment and sedentary behavior and mechanisms that might operate in this relationship.

Several studies with youth have reported significant negative associations between screen time use and physical activity levels in children and youth.[79-81] The 'displacement hypothesis' has been offered as a potential explanation for such findings whereby time using screen devices may compete with, or be a substitute for, social and physical activities.[82] Although this hypothesis remains controversial, it may be the time period (e.g., immediately after school) at which individuals are sedentary that is of most concern.

Only a small proportion of studies using objective PA measures have been successful in showing the relationships between physical environments and PA and sedentary behaviors in young people.[22] Adolescent girls are a unique population as their PA declines and their sedentary behavior increases dramatically during this time of youth.[62,83] This sample was also unique as the group of girls was identified by their teachers as disengaged in PA. Furthermore, the participants were from socioeconomically disadvantaged areas; data from

© 2014 Human Kinetics, Inc.

this specific target group have been limited. Girls might not view their school environment as a place for PA and physical environments may be less important for adolescent girls. For this specific target group the social environment (peers, teachers, etc.) may be more important than the physical environment. School-based programs and policies may need to consider such factors in motivating girls to be physically active.

A number of study strengths, however, include: (1) the specificity of the target population i.e., adolescent girls disengaged in PA living in deprived areas; (2) the objective measurement of PA which provides higher validity than self-reported data; and, (3) the sophisticated analyses which adjusted for school-level clustering and explored cross-sectional mediators. However the use of single mediator models (i.e., examining each of the environmental constructs independently rather than including both environmental measures in the analyses) is a potential limitation which may have biased the findings. The cross-sectional design is a further limitation. Although the temporal sequencing architecture of Bandura's SCT is well-supported[28] it could be argued from a social-ecological perspective, that the tested models may work the other way i.e., self-efficacy could mediate the relationship between the perceived environment and PA; and/or these relationships may be bidirectional in nature. Longitudinal designs are warranted to further understand the mechanisms between these constructs in this target population.

In summary, the mediated model was not supported for PA or sedentary behavior. However, other results of this paper may be helpful for future theory development and practice. More research is needed to understand behaviors in unique populations such as disengaged adolescent girls from low SES environments.

© 2014 Human Kinetics, Inc.

References

1. Bouchard C, Blair SN, Haskell WL, eds. *Physical activity and health.* 2nd ed. Champaign: Human Kinetics; 2012.

2. Malina R, Bouchard C, Bar-Or O. *Growth, maturation, and physical activity.* 2nd ed. ed. Champaign, Ill.: Human Kinetics; 2004.

3. Biddle SJ, Asare M. Physical activity and mental health in children and adolescents: a review of reviews. *Br J Sports Med.* 2011;45(11):886-895.

4. Troiano RP, Berrigan D, Dodd KW, Masse LC, Tilert T, McDowell M. Physical activity in the United States measured by accelerometer. *Med Sci Sports Exerc.* 2008;40(1):181-188.

5. Guthold R, Cowan MJ, Autenrieth CS, Kann L, Riley LM. Physical activity and sedentary behavior among schoolchildren: a 34-country comparison. *J Pediatr.* 2010;157(1):43-49 e41.

6. Hallal PC, Andersen LB, Bull FC, et al. Global physical activity levels: surveillance progress, pitfalls, and prospects. *Lancet.* 2012;380(9838):247-257.

7. Dunstan DW, Barr EL, Healy GN, et al. Television viewing time and mortality: the Australian Diabetes, Obesity and Lifestyle Study (AusDiab). *Circulation.* 2010;121(3):384-391.

8. Salmon J, Tremblay MS, Marshall SJ, Hume C. Health risks, correlates, and interventions to reduce sedentary behavior in young people. *Am J Prev Med.* 2011;41(2):197-206.

9. Brodersen NH, Steptoe A, Boniface DR, Wardle J. Trends in physical activity and sedentary behaviour in adolescence: Ethnic and socioeconomic differences. *Br J Sports Med.* 2007;41:140-144.

10. Tremblay MS, Colley RC, Saunders TJ, Healy GN, Owen N. Physiological and health implications of a sedentary lifestyle. *Appl Physiol Nutr Metab.* 2010;35(6):725-740.

11. Nihill GFJ, Lubans DR, Plotnikoff RC. Associations between sedentary behavior and self-esteem in adolescent girls from schools in low-income communities. *Ment Health Phys Act.* 2013;6(1):30-35.

12. Costigan SA, Barnett L, Plotnikoff RC, Lubans DR. The Health Indicators Associated With Screen-Based Sedentary Behavior Among Adolescent Girls: A Systematic Review. *J Adolesc Health.* 2013;52(4):382-392.

13. Gopinath B, Hardy LL, Baur LA, Burlutsky G, Mitchell P. Physical activity and sedentary behaviors and health-related quality of life in adolescents. *Pediatrics.* 2012;130(1):e167-174.

14. Nader PR, Bradley RH, Houts RM, McRitchie SL, O'Brien M. Moderate-to-vigorous physical activity from ages 9 to 15 years. *JAMA.* 2008;300(3):295-305.

© 2014 Human Kinetics, Inc.

15. Malina RM. Tracking of physical activity and physical fitness across the lifespan. *Res Q Exerc Sport.* 1996;67(3 Suppl):S48-57.

16. Venn AJ, Thomson RJ, Schmidt MD, et al. Overweight and obesity from childhood to adulthood: a follow-up of participants in the 1985 Australian Schools Health and Fitness Survey. *Med J Aust.* 2007;186(9):458-460.

17. Butcher K, Sallis JF, Mayer JA, Woodruff S. Correlates of physical activity guideline compliance for adolescents in 100 U.S. Cities. *J Adolesc Health.* 2008;42(4):360-368.

18. Stalsberg R, Pedersen AV. Effects of socioeconomic status on the physical activity in adolescents: a systematic review of the evidence. *Scand J Med Sci Sports.* 2010;20(3):368-383.

19. Hardy LL, King L, Espinel P, Cosgrove C, Bauman A. NSW Schools Physical Activity and Nutrition Survey (SPANS) 2010: Full Report. *NSW Ministry of Health.* 2010:Sydney.

20. Gebel K, Bauman AE, Petticrew M. The physical environment and physical activity: a critical appraisal of review articles. *Am J Prev Med.* 2007;32(5):361-369.

21. Ferreira I, van der Horst K, Wendel-Vos W, Kremers S, van Lenthe FJ, Brug J. Environmental correlates of physical activity in youth - a review and update. *Obes Rev.* 2007;8(2):129-154.

22. Ding D, Sallis JF, Kerr J, Lee S, Rosenberg DE. Neighborhood environment and physical activity among youth: a review. *Am J Prev Med.* 2011;41(4):442-455.

23. de Vet E, de Ridder DTD, de Wit JBF. Environmental correlates of physical activity and dietary behaviours among young people: a systematic review of reviews *Obes Rev.* 2011;12(501):e130-e142.

24. Norman GJ, Schmid BA, Sallis JF, Calfas KJ, Patrick K. Psychosocial and environmental correlates of adolescent sedentary behaviors. *Pediatrics.* 2005;116(4):908-916.

25. Evenson KR, Murray DM, Birnbaum AS, Cohen DA. Examination of perceived neighborhood characteristics and transportation on changes in physical activity and sedentary behavior: The Trial of Activity in Adolescent Girls. *Health Place.* 2010;16(5):977-985.

26. Durant N, Harris SK, Doyle S, et al. Relation of school environment and policy to adolescent physical activity. *J Sch Health.* 2009;79(4):153-159.

27. Rhodes RE, Nigg CR. Advancing physical activity theory: a review and future directions. *Exerc Sport Sci Rev.* 2011;39(3):113-119.

28. Bandura A. *Social foundations of thought and action. A social cognitive theory.* Englewood Cliffs, NJ: Prentice Hall; 1986.

29. Baranowski T, Perry CL, Parcel GS. How individuals, environments, and health behavior interact: social cognitive theory. In: Glanz K, ed. *Health behavior and health*

© 2014 Human Kinetics, Inc.

education: theory, research, and practice San Francisco: Jossey-Bass, Wiley; 2002:165-178.

30. Golledge RG. Environmental cognition. In: Stokols D, Altman I, eds. *Handbook of environmental psychology*. New York: Wiley; 1987:131-174.

31. Golledge RG. Cognition of physical and built environments. In: Gärling T, Evans GW, eds. *Environment, cognition, and action - an integrated approach*. New York, Oxford: Oxford University Press; 1991:35-62.

32. Lloyd R. *Spatial cognition - geographic environments.* Boston: Kluwer Academic; 1997.

33. Gebel K, Bauman AE, Sugiyama T, Owen N. Mismatch between perceived and objectively assessed neighborhood walkability attributes: prospective relationships with walking and weight gain. *Health Place.* 2011;17(2):519-524.

34. Ball K, Jeffery RW, Crawford DA, Roberts RJ, Salmon J, Timperio AF. Mismatch between perceived and objective measures of physical activity environments. *Prev Med.* 2008;47(3):294-298.

35. McCormack GR, Cerin E, Leslie E, Du Toit L, Owen N. Objective versus perceived walking distances to destinations: correspondence and predictive validity. *Environ Behav.* 2008;40(3):401-425.

36. Gebel K, Bauman A, Owen N. Correlates of non-concordance between perceived and objective measures of walkability. *Ann Behav Med.* 2009;37(2):228-238.

37. Kirtland KA, Porter DE, Addy CL, et al. Environmental measures of physical activity supports: perception versus reality. *Am J Prev Med.* 2003;24(4):323-331.

38. Prins RG, Oenema A, van der Horst K, Brug J. Objective and perceived availability of physical activity opportunities: differences in associations with physical activity behavior among urban adolescents. *Int J Behav Nutr Phys Act.* 2009;6:70.

39. Kaczynski AT, Robertson-Wilson J, Decloe M. Interaction of perceived neighborhood walkability and self-efficacy on physical activity. *J Phys Act Health.* 2012;9(2):208-217.

40. Biddle S, Whitehead S, O'Donovan T, Nevill M. Correlates of participation in physical activity for adolescent girls: a systematic review of recent literature. *J Phys Act Health.* 2005;2:423-424.

41. van der Horst K, Paw MJ, Twisk JW, van Mechelen W. A brief review on correlates of physical activity and sedentariness in youth. *Med Sci Sports Exerc.* 2007;39(8):1241-1250.

42. Craggs C, Corder K, van Sluijs EMF, Griffin SJ. Determinants of change in physical activity in children and adolescents: a systematic review. *Am J Prev Med.* 2011;40:645-658.

43. Bandura A. Health promotion by social cognitive means. *Health Educ Behav.* 2004;31(2):143-164.

© 2014 Human Kinetics, Inc.

44. Fein AJ, Plotnikoff RC, Wild TC, Spence JC. An examination of adolescents' perceptions of the school physical environment related to physical activity. *Int J Sport Exerc Psychol.* 2005;3(2):179-195.

45. Ding D, Gebel K. Built environment, physical activity, and obesity: what have we learned from reviewing the literature? *Health Place.* 2012;18(1):100-105.

46. Brug J, van Lenthe F, eds. *Environmental determinants and interventions for physical activity, nutrition and smoking: a review.* Rotterdam: Erasmus University; 2005.

47. Kaczynski AT, Henderson KA. Parks and recreation settings and active living: a review of associations with physical activity function and intensity. *J Phys Act Health.* 2008;5(4):619-632.

48. Panter JR, Jones A. Attitudes and the environment as determinants of active travel in adults: what do and don't we know? *J Phys Act Health.* 2010;7(4):551-561.

49. Lubans DR, Foster C, Biddle SJ. A review of mediators of behavior in interventions to promote physical activity among children and adolescents. *Prev Med.* 2008;47(5):463-470.

50. Baranowski T, Anderson C, Carmack C. Mediating variable framework in physical activity interventions. How are we doing? How might we do better? *Am J Prev Med.* 1998;15(4):266-297.

51. Baranowski T, Jago R. Understanding the mechanisms of change in children's physical activity programs. *Exerc Sport Sci Rev.* 2005;33(4):163-168.

52. Lubans DR, Morgan PJ, Dewar D, et al. The Nutrition and Enjoyable Activity for Teen Girls (NEAT girls) randomized controlled trial for adolescent girls from disadvantaged secondary schools: rationale, study protocol, and baseline results. *BMC Public Health.* 2010;10:652.

53. Lubans DR, Morgan PJ, Okely AD, et al. Preventing Obesity among Adolescent Girls: One Year Outcomes of the Nutrition and Enjoyable Activity for Teen Girls Cluster Randomized Controlled Trial. *Arch Pediatr Adolesc Med.* 2012;166(9):821-827.

54. Dewar DL, Lubans DR, Morgan PJ, Plotnikoff RC. Development and evaluation of social cognitive measures related to adolescent physical activity. *J Phys Act Health.* 2013;10(4):544-555.

55. Freedson P, Pober D, Janz KF. Calibration of accelerometer output for children. *Med Sci Sports Exerc.* 2005;37(11 Suppl):S523-530.

56. Kozey SL, Staudenmayer JW, Troiano RP, Freedson PS. Comparison of the ActiGraph 7164 and the ActiGraph GT1M during self-paced locomotion. *Med Sci Sports Exerc.* 2010;42(5):971-976.

57. John D, Tyo B, Bassett DR. Comparison of four ActiGraph accelerometers during walking and running. *Med Sci Sports Exerc.* 2010;42(2):368-374.

© 2014 Human Kinetics, Inc.

58. Colley R, Connor Gorber S, Tremblay MS. Quality control and data reduction procedures for accelerometry-derived measures of physical activity. Quality control and data reduction procedures for accelerometry-derived measures of physical activity. *Statistics Canada.* 2010;21(1):Catalogue no. 82-003-XPE.

59. Hardy LL, Booth ML, Okely AD. The reliability of the Adolescent Sedentary Activity Questionnaire (ASAQ). *Prev Med.* 2007;45(1):71-74.

60. Sallis JF, Johnson MF, Calfas KJ, Caparosa S, Nichols JF. Assessing perceived physical environmental variables that may influence physical activity. *Res Q Exerc Sport.* 1997;68(4):345-351.

61. MacKinnon DP, Fritz MS, Williams J, Lockwood CM. Distribution of the product confidence limits for the indirect effect: program PRODCLIN. *Behav Res Methods.* 2007;39(3):384-389.

62. Commonwealth Scientific Industrial Research Organisation (CSIRO) Preventative Health National Research Flagship and the University of South Australia. *2007 Australian National Children's Nutrition and Physical Activity Survey - Main findings.* Canberra: CSIRO; 2008.

63. Macintyre S. The social patterning of exercise behaviours: the role of personal and local resources. *Br J Sports Med.* 2000;34(1):6.

64. Estabrooks PA, Lee RE, Gyurcsik NC. Resources for physical activity participation: does availability and accessibility differ by neighborhood socioeconomic status? *Ann Behav Med.* 2003;25(2):100-104.

65. Gordon-Larsen P, Nelson MC, Page P, Popkin BM. Inequality in the built environment underlies key health disparities in physical activity and obesity. *Pediatrics.* 2006;117(2):417-424.

66. Moore LV, Diez Roux AV, Evenson KR, McGinn AP, Brines SJ. Availability of recreational resources in minority and low socioeconomic status areas. *Am J Prev Med.* 2008;34(1):16-22.

67. Lovasi GS, Hutson MA, Guerra M, Neckerman KM. Built environments and obesity in disadvantaged populations. *Epidemiol Rev.* 2009;31:7-20.

68. Crawford D, Timperio A, Giles-Corti B, et al. Do features of public open spaces vary according to neighbourhood socio-economic status? *Health Place.* 2008;14(4):889-893.

69. Turrell G, Haynes M, Burton NW, et al. Neighborhood disadvantage and physical activity: baseline results from the HABITAT multilevel longitudinal study. *Ann Epidemiol.* 2010;20(3):171-181.

70. Sallis JF, Prochaska JJ, Taylor WC. A review of correlates of physical activity of children and adolescents. *Med Sci Sports Exerc.* 2000;32(5):963-975.

© 2014 Human Kinetics, Inc.

71. Kristjansdottir G, Vilhjalmsson R. Sociodemographic differences in patterns of sedentary and physically active behavior in older children and adolescents. *Acta Paediatr.* 2001;90(4):429-435.

72. Trost SG, Pate RR, Dowda M, Ward DS, Felton G, Saunders R. Psychosocial correlates of physical activity in white and African-American girls. *J Adolesc Health.* 2002;31(3):226-233.

73. Klesges LM, Baranowski T, Beech B, et al. Social desirability bias in self-reported dietary, physical activity and weight concerns measures in 8- to 10-year-old African-American girls: results from the Girls Health Enrichment Multisite Studies (GEMS). *Prev Med.* 2004;38 Suppl:S78-87.

74. Trost SG, Saunders R, Ward DS. Determinants of physical activity in middle school children. *Am J Health Behav.* 2002;26(2):95-102.

75. Springer AE, Kelder SH, Hoelscher DM. Social support, physical activity and sedentary behavior among 6th-grade girls: a cross-sectional study. *Int J Behav Nutr Phys Act.* 2006;3:8.

76. DiLorenzo TM, Stucky-Ropp RC, Vander Wal JS, Gotham HJ. Determinants of exercise among children. II. A longitudinal analysis. *Prev Med.* 1998;27(3):470-477.

77. Cardon G, Philippaerts R, Lefevre J, et al. Physical activity levels in 10- to 11-year-olds: clustering of psychosocial correlates. *Public Health Nutr.* 2005;8(7):896-903.

78. van Dyck D, Cardon G, Deforche B, Owen N, Sallis JF, De Bourdeaudhuij I. Neighborhood walkability and sedentary time in Belgian adults. *Am J Prev Med.* 2010;39(1):25-32.

79. Cummings HM, Vandewater EA. Relation of adolescent video game play to time spent in other activities. *Arch Pediatr Adolesc Med.* 2007;161(7):684-689.

80. Jago R, Baranowski T, Zakeri I, Harris M. Observed environmental features and the physical activity of adolescent males. *Am J Prev Med.* 2005;29(2):98-104.

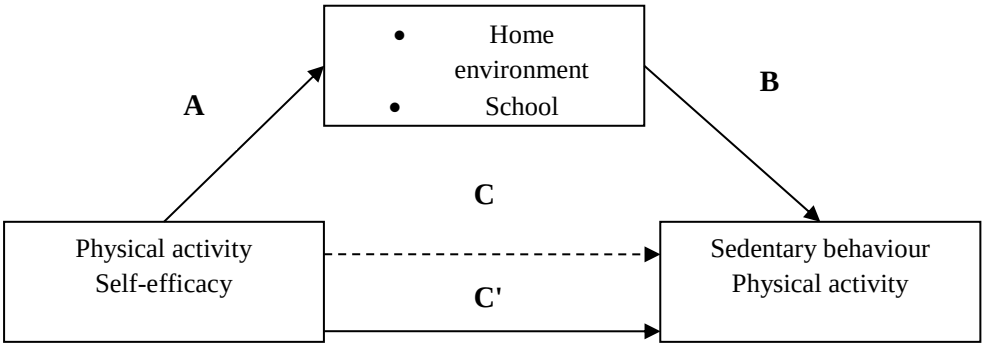
81. Koezuka N, Koo M, Allison KR, et al. The relationship between sedentary activities and physical inactivity among adolescents: results from the Canadian Community Health Survey. *J Adolesc Health.* 2006;39(4):515-522.

82. Kraut R, Kiesler S, Boneva B, Cummings J, Helgeson V, Crawford A. Internet paradox revisited. *J Soc Issues.* 2002;58(1):49-74.

83. Kimm SY, Glynn NW, Kriska AM, et al. Decline in physical activity in black girls and white girls during adolescence. *N Engl J Med.* 2002;347(10):709-715.

"Self-Efficacy, Physical Activity and Sedentary Behavior in Adolescent Girls: Testing Mediating Effects of the Perceived School and Home Environment" by Plotnikoff RC, Gebel K, Lubans DR
Journal of Physical Activity & Health
© 2014 Human Kinetics, Inc.

Figure 1: Conceptual model: School and home environment as mediators of the relationship between PA self-efficacy and sedentary behavior and PA



Adapted from Bandura et al. (2004) (87)

© 2014 Human Kinetics, Inc.

Table 1: Characteristics of the study population (N = 357)

Variable	Mean	SD
Demographics		
Age (years)	13.2	0.5
Country of birth, *n* (%)[1]	349	97.80%
SES[2]	4.3	1.8
Language spoken at home, *n* (%)[3]	352	98.60%
Cultural background[4]		
Australian, *n* (%)	305	85.40%
Asian, *n* (%)	4	1.10%
European, *n* (%)	36	10.10%
Other, *n* (%)	11	3.10%
Anthropometrics		
Weight (kg)	58.4	13.9
Height (m)	1.6	0.07
BMI (kg/m^2)	22.6	4.6
BMI *z*-score	0.8	1.14
BMI Category		
Underweight, *n* (%)	2	0.60%
Healthy weight, *n* (%)	202	56.60%
Overweight, *n* (%)	93	26.10%
Obese, *n* (%)	60	16.80%
BIA (body fat %)	28.9	6.7
Physical activity and sedentary behavior		
Counts per minute (mean/day)	402.6	131.8
Sedentary time (%)	62.1	7.6
Screen time (mins/day)	273.2	166.6
TV (mins/day)	125.4	82.2
DVD (mins/day)	53.7	51.7
Computer (mins/day)	93.7	95.5
Self-reported variables		
Physical activity self-efficacy	3.86	0.97
Perceived home environment	4.67	0.92
Perceived school environment	3.73	0.90

Note. SD = standard deviation; BMI = body mass index; BIA = bioelectrical impedance analysis; MVPA = moderate-to-vigorous PA minutes per day; mins = minutes.

[1]Participants born in Australia

[2]SES = socio-economic status based on the Socio-Economic Indexes for Areas (SEIFA) index of relative socioeconomic advantage and disadvantage (scale 1 = lowest to 10 = highest).

[3]Participants who speak English at home.

[4]One participant did not report their cultural background.

[5]N = 252 participants wore accelerometers for ≥ 600 minutes on ≥ 3 days

"Self-Efficacy, Physical Activity and Sedentary Behavior in Adolescent Girls: Testing Mediating Effects of the Perceived School and Home Environment" by Plotnikoff RC, Gebel K, Lubans DR
Journal of Physical Activity & Health
© 2014 Human Kinetics, Inc.

Table 2: Cross-sectional mediation analysis for the association between self-efficacy, perceived environment and physical activity

	Self-efficacy and environment				**Environment and physical activity**				**Self-efficacy and physical activity***				**Mediated effect**		
			95% CI				**95% CI**				**95% CI**			**95% CI**	
	A	**SE**	**Lower**	**Upper**	**B**	**SE**	**Lower**	**Upper**	**C'**	**SE**	**Lower**	**Upper**	**AB**	**Upper**	**Lower**
Activity (counts/min)															
Home environment	0.36	0.06	**0.24**	**0.48**	-13.85	9.39	-18.17	4.55	16.26	9.24	-1.85	34.37	-4.92	-12.09	1.50
School environment	0.06	0.06	-0.06	0.19	-16.41	8.68	-17.07	0.60	12.58	8.62	-4.32	29.48	-1.06	-3.85	0.83
MVPA (min/day)															
Home environment	0.36	0.06	**0.24**	**0.48**	-1.94	1.24	-2.20	0.49	1.95	1.22	-0.44	4.34	-0.69	-1.64	0.16
School environment	0.06	0.06	-0.06	0.19	-1.30	1.15	-2.31	0.95	1.35	1.14	-0.88	3.59	-0.08	-0.36	0.09

Note. All models adjusted for age and SES.

[a] A = unstandardized regression coefficient of self-efficacy predicting hypothesized mediators (i.e. perceived environment).

[b] B = unstandardized regression coefficient of the hypothesized mediator predicting PA with treatment self-efficacy included in the model

[c] C´ = unstandardized regression coefficient of self-efficacy predicting PA with mediator in the model.

[d] 95% CI = 95% confidence interval of the mediated effect from PRODCLIN ; AB = product-of-coefficients estimate.

MVPA (%) = percentage time spent in moderate-to-vigorous PA.

Results in bold are significant at the $p < 0.05$ level.

* Total effect of self-efficacy on PA: MVPA mins per day C=1.27, SE=1.42 (95% CI=4.05,-1.52); Activity counts per min C=11.39, SE=8.65 (95% CI=28.33,-5.55)

"Self-Efficacy, Physical Activity and Sedentary Behavior in Adolescent Girls: Testing Mediating Effects of the Perceived School and Home Environment" by Plotnikoff RC, Gebel K, Lubans DR
Journal of Physical Activity & Health
© 2014 Human Kinetics, Inc.

Table 3: Cross-sectional mediation analysis for the association between self-efficacy, perceived environment and sedentary behavior

	Self-efficacy & environment				**Environment & sedentary behavior**				**Self-efficacy & sedentary behavior***				**Mediated effect**		
			95% CI				**95% CI**				**95% CI**			**95% CI**	
	A	**SE**	**Lower**	**Upper**	**B**	**SE**	**Lower**	**Upper**	**C'**	**SE**	**Lower**	**Upper**	**AB**	**Upper**	**Lower**
Sedentary (%)															
Home environment	0.36	0.06	**0.24**	**0.48**	0.60	0.55	-0.48	1.68	-0.62	0.54	-1.68	0.44	0.21	-0.16	0.62
School environment	0.06	0.06	-0.06	0.19	**1.10**	**0.51**	**0.10**	**2.11**	-0.46	0.51	-1.45	0.54	0.07	-0.06	0.25
Screen time (mins/day)															
Home environment	0.36	0.06	**0.24**	**0.48**	-1.74	11.35	-23.98	20.51	-20.65	11.12	-42.45	1.15	-0.62	-8.68	7.35
School environment	0.06	0.06	-0.06	0.19	-12.79	10.43	-33.23	7.65	-20.29	10.40	-40.67	0.09	-0.83	-3.42	0.79

Note. All models adjusted for age and SES.

[a] A = unstandardized regression coefficient of self-efficacy predicting hypothesized mediators (i.e. perceived environment).

[b] B = unstandardized regression coefficient of the hypothesized mediator predicting sedentary behavior with treatment self-efficacy included in the model.

[c] C´ = unstandardized regression coefficient of self-efficacy predicting sedentary behavior with mediator in the model.

[d] 95% CI = 95% confidence interval of the mediated effect from PRODCLIN. ; AB = product-of-coefficients estimate.

Models adjusted for age and SES.

Results in bold are significant at the $p < 0.05$ level.

* Total effect of self-efficacy on PA: Sedentary time (%) C=-0.41, SE=0.50 (95% CI=0.58,-1.40); Screen-time mins/day C=-20.90, SE=10.45 (95% CI=-0.42,-41.38)