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TNO report

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A literature review of individual, perceived physical and social environmental factors related to walking

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1 Introduction

This report has been written as part of the scientific programme Pedestrian Quality Needs of the cost 358 action. The scientific programme for the Pedestrian Quality Needs (PQN) Action is based on a comprehensive conceptual model, describing the general factors that influence the actual decisions by (potential) pedestrians, be it for a door-to-door trip, a trip to other travel modes or just staying in public space. This deductive 'back to basics' approach implies a study of the needs, tasks, competences, requirements of pedestrians, contexts and their performances in the various situations of the participating countries.

1.1 Overview of the scientific program Pedestrian Quality Needs

The general approach of the PQN-study is defined by the view that quality is the sum of three kinds of valuations¹ that together sketch a comprehensive picture of pedestrians' quality needs:

- Functional perspective:
Usage value, what is being offered = intrinsic quality supply, looking at the system from the 'head'. With regard to urgency these needs can be seen as first order needs.
- Perception perspective:
What is being requested = subjective quality demand, looking at the system from the 'heart', including attitudes towards and of pedestrians. With regard to urgency these needs can be seen as second order needs.
- Durability and Future Prospects:
Whilst the 'functional' and 'perception perspective' are static quality descriptions, 'durability and future prospects' refers to a dynamic perspective. With regard to urgency these needs can be seen as third order needs.

Quality needs can be identified at several abstraction levels², see Figure 1. The most concrete level is the *operational* level. On this level the pedestrians perform the physical task of walking or standing up and react directly to impulses, i.e. from other road users, and qualities on the spot. The second level is the so called *tactical* level. On this level the pedestrian decides on the direction he takes, whether or not to cross, where to cross, and walking speed. For the physical environment this corresponds with connectivity; for the social context the level corresponds with norms of fellow road and public space users; for the transport system it corresponds with the abstraction level of transport concepts. The third level is the *strategic* level. Here the pedestrian decides whether or not he will travel (motive), where to (destination) and which modes will be used. For the physical context this level corresponds with land use and urban planning, including 'green' and 'blue' zones; the social context on this abstraction level implies social values; the transport system on this abstraction level is typified by facilities for accommodating travel and transportation needs, including information needs.

¹ based on the RARO publication on Spatial Quality (Dutch Advisory Council on Land Use Planning RARO [Raad van advies voor de ruimtelijke ordening]) '*Naar ruimtelijke kwaliteit*', SDU uitgeverij, Den Haag 1990.

² See: 'Dealing with dangers', J.A. Michon, Groningen 1979 and 'Vulnerable Road Users', Methorst, Rotterdam 2003 regarding the Pizza-model.

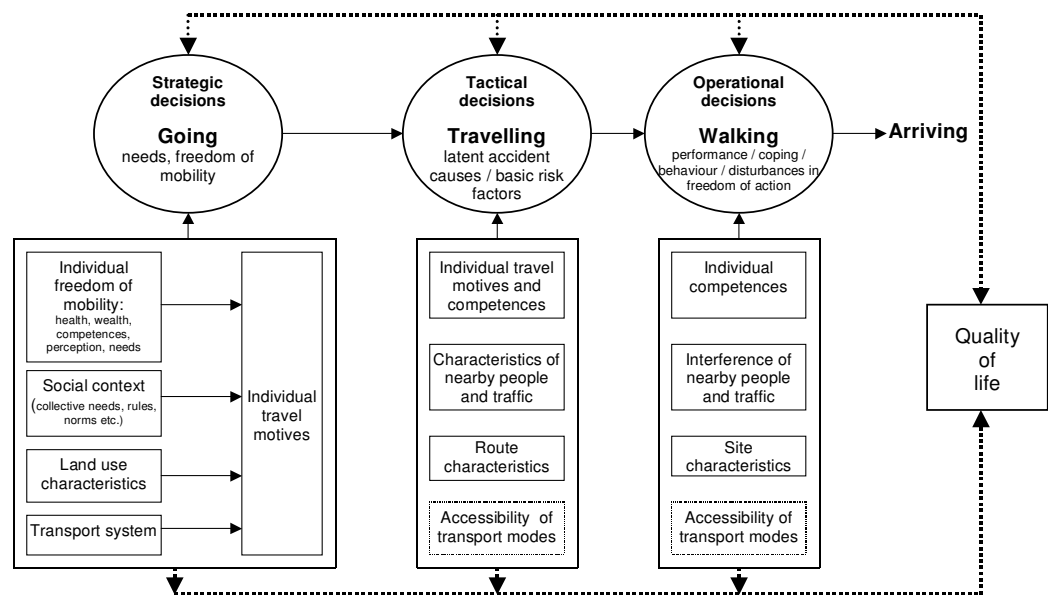


Figure 1 PQN Conceptual Model.

Walking has faded to the background of the transport system. For the elderly the walking environment poses specific problems; they require better quality pedestrian facilities. Also, walking is a solution to many health problems. Earlier research on walking has been done by, for instance, the COST Actions C6 and C11, WALCYNG, ADONIS, PROMPT, and WALK21.

Most public space and transport authorities do not yet recognize the importance of systematically meeting pedestrians' quality needs. Contributions from disciplines like psychology, sociology, ergonomics, geography and law are still rare. At the ICTCT 2004 in Tartu it was decided to form a task force. This led to extensive support from the scientific community. COST offers an effective and efficient framework for international and interdisciplinary research. This COST Action is a practical solution to join forces internationally and to benefit from individual qualities.

The scientific fundament for this COST Action is worked out in a conceptual model (see Figure 1). This model is not rigid at all, but is used for structuring all relevant components and interrelations. It is a starting point, and it can evolve. It is also a helpful tool to show what we are doing. The main objective of this COST Action is to improve the pedestrians' situation and provide an essential contribution to systems approach. The main research question is: what facilities and qualities do pedestrians need for their safe mobility and staying in public space, now and in the foreseeable future. There are also several sub-questions.

Four Working groups are dealing with the work to be done. Working group 1 focusses on Functional Needs (physical needs, visible and objective behaviour, 'technical' ergonomics); Working group 2 focusses on Perceived Needs ('emotional' perspective: perceived needs, attitudes, expectations, motivations); Working group 3 focusses on Durability and Future Prospects (durability of interventions, designs and policy measures, forecasting of usability and perceived qualities); Working group 4 focusses on Coherence and Integration (content and cohesion of research programme, interrelationships determinants and activities, integration of results). Working Groups 1, 2 and 3 deal with the pedestrian issues (needs and prospects).

Working group 4 deals with the interrelation at the operational, tactical and strategic level. As a result the directions of analysis will be as broad as possible.

1.2 Structure of the report

This report has been written for Working group 2 Perceived Needs. People's behaviour emerges in interaction from the person and the environment. The decision to walk or not to walk is influenced by individual factors as well as by perceptions of the physical and social environment. This report summarises scientific research concerning individual and perceived physical and social environmental factors related to walking. Chapter 2 gives an overview of these determinants. For each group of determinants (individual, perceived physical and social environmental factors) we describe first the findings of the studies, followed by the patterns of findings related to these groups of determinants.

1.3 Method

The databases Scopus and ScienceDirect were searched in November 2007 using the keywords attitude, belief, motivation, motive, goal, habit, safety, health, social support, social climate, aesthetics, barriers, experiences, walking, physical activity, and transport. Additional reports were manually identified from the reference lists of retrieved studies. Unpublished studies were not sought. The author reviewed abstracts and consequently selected publications for inclusion. Abstracts describing studies that investigated individual, perceived physical and social environmental aspects and assessed walking³ were selected. Publications were not selected if one or more of the following characteristics were applicable: published before 2000, opinion articles, publications the author could not access, and publications in other than English or Dutch.

³ Despite the fact that most studies did measure the amount of walking, relationships between individual and/or environmental aspects and walking were often not reported in the articles because in most cases a dichotomized outcome variable (such as sufficiently active or not sufficiently active) was used instead to relate to independent variables.

2 Results

The results of this literature review provide an overview of what is already published with regard to individual and perceived physical and social environmental factors related to walking.

2.1 Individual factors

Six studies examined relationships between individual variables and walking. One study used a qualitative approach to explore participants' experiences of walking, and five of these studies used Likert scales to assess attitudes, instrumental and affective beliefs, self efficacy, subjective norm, frequency of trying, perceived behavioural control, behavioural skills, and intentions. Despite the fact that three of these studies measured the amount of walking for exercise, for transport or for recreation (together with vigorous activities, moderate-intensity activities, and moderate to light activities), relationships between individual factors and walking were not reported in these studies. Instead a dichotomized outcome variable (sufficiently active or not sufficiently active) was used.

Table 1 (see Appendix A) presents the selection of studies examining the relationship between individual factors and walking. For each paper, we report the relevant items along with the scale used. The types of behaviour measured and in parentheses the specific outcome variable used in the analysis are listed. In the following subparagraphs we will describe the findings of studies that examined the relationships of individual factors, such as attitudes and self efficacy, and walking for different purposes (e.g. for transport or recreation).

2.1.1 *Walking*

Darker, Larkin & French (2007) provided a rich and detailed account of participants' experiences and attitudes of walking using the qualitative method of interpretative phenomenological analysis. Results showed that participants did not value walking as a form of exercise and reported that walking is not a goal in itself but primary a form of transport. Walking also influenced psychological well-being through associated social benefits. For most of the participants, a walk could serve as a medium for sharing experiences, seeing scenery and enjoying companionship. In addition, the environmental context of the walk was important. Walking in cities was not seen as pleasant as walking in the countryside due to the busyness and the noise of cars in the cities. Participants saw walking as a chance to relax and relief stress. Perceived lack of time was cited as an inhibitory barrier to walking. The traditional focus of walking promotion campaigns concerns beliefs about the benefits of walking on health, but it appears that people engage in healthy behaviour for reasons other than to be healthy. It was concluded that campaigns aimed at promoting walking should focus more on the experiences of psychological benefits from walking itself, such as the pleasure of shared experience and the psychological benefit of respite from the world, in addition to beliefs about health.

2.1.2 *Walking and cycling for transport*

Anable & Gatersleben (2005) examined how users of different travel modes evaluate their daily commute to work on various instrumental and affective attributes, such as cost, freedom, and predictability. Results showed that work journeys are experienced very differently depending on the mode used. Generally, it appeared that car and especially non-motorised journeys (cycling and walking) were evaluated most positively and journeys by public transport most negatively. Journeys by bike or on foot scored high on affective aspects such as no stress, relaxation and freedom compared to

journeys by car and especially public transport. Journeys by bicycle scored highest on excitement, whereas journeys on foot score highest on relaxation. Both also scored highly on the more collective long term instrumental factors such as health and environmental quality as well as instrumental factors such as predictability and cost. Troped, Saunders, Pate, Reininger, & Addy (2003) examined correlates of recreational and transportation physical activity. Their survey included measures of self-reported recreational and transportation-related physical activity and demographic, cognitive, interpersonal, and environmental variables potentially correlated with physical activity. Their primary interest was to determine the independent associations between environmental variables and activity, while using demographic, cognitive, and interpersonal factors as covariates. Of the individual factors that were measured, self-efficacy showed significant unadjusted associations with transportation physical activity.

2.1.3 *Walking for recreation*

Duncan & Mummery (2005) used a social–ecological framework to examine the relationships between self-reported psychosocial factors and GIS-derived measures of the environment and two selected measures of physical activity - a criterion level of activity participation for health and participation in any recreational walking. They found no association between self-efficacy and recreational walking among city inhabitants in regional Queensland (Australia).

2.1.4 *Physical activity*

Booth, Owen, Bauman, Clavisi, & Leslie (2000) attempted to identify social-cognitive and perceived environmental influences associated with physical activity participation in older populations. They used constructs from the theory of planned behaviour, social cognitive theory, and ecologic models to design their measurements. Results from principal components analysis showed that a positive attitude towards the health benefits of physical activity is associated with physical activity participation. They also found that high self efficacy was associated with being physically active. Duncan & Mummery (2005) concluded from their research that people reporting high levels of self-efficacy were 93% more likely to attain sufficient activity than those people reporting low levels of self-efficacy when adjusting for age, income, gender, and Body Mass Index.

Giles-Corti & Donovan (2002b) examined the relative influence of individual, social environmental and physical environmental determinants of recreational physical activity (i.e. vigorous activity, light to moderate activity, walking for recreation and walking for transport). The individual factors examined in this study were based on Bagozzi and Warshaw's (1990) Theory of Trying (TT), Ajzen's (1985) perceived behavioural control and Bandura's (1997) conceptualisation of behavioural skills. Using a conditional logistic regression model, the likelihood of exercising as recommended increased in respondents the more frequently they had tried to exercise in the past three months and had used behavioural skills in the last month. Similarly, the higher the level of perceived behavioural control and intention to be physically active in the next two weeks, the more likely recommended levels of activity were achieved.

Troped et al. (2003) found in their study that examined correlates of recreational and transportation physical activity that self-efficacy showed significant unadjusted associations with transportation physical activity and recreational physical activity.

2.1.5 *Pattern of findings*

The findings of the studies relating to attitudes, instrumental and affective beliefs, self efficacy, subjective norm, frequency of trying, perceived behavioural control, behavioural skills, intentions, and experiences and the directions of these associations are summarized in Tables 1 through 4 in Appendix B.

The majority of individual variables have been found to be associated with physical activity and walking in general or for transport. A relationship between self efficacy and physical activity and walking was found for most of the studies that measured this variable. Remarkably, a relationship between attitudes and physical activity almost seems non-existent.

2.2 Perceived physical environmental factors

Thirteen studies examined relationships between perceived physical environmental variables and walking.

Table 2 (see Appendix A) presents the selection of studies examining the relationship between perceived physical environmental variables and physical activity and walking for exercise, recreation, or transport. For each paper, we report the relevant items along with the scale used. The types of behaviour measured and in parentheses the specific outcome variable used in the analysis are listed. In the following subparagraphs we will describe the findings of studies that examined the relationships of perceived physical environmental factors, such as aesthetics and accessibility, and walking for different purposes (e.g. for transport or recreation).

2.2.1 *Walking in general*

Addy, Wilson, Kirtland et al. (2004) evaluated perceived social and environmental supports for physical activity and walking using multivariable modeling.

Respondents were classified according to physical activity levels and walking behaviours. They concluded from their study that having access to sidewalks, and using malls were associated with regular walking. Traffic volume, unattended dogs, crime and safety concerns associated with recreation facilities, however, were not associated with walking.

Giles-Corti & Donovan (2002a) examined access to recreational facilities and perceptions of the neighbourhood environment and walking by the socio-economic status of area of residence (SES). They found that perceiving the neighborhood as being attractive, safe, and having interesting walks and supportive of walking locally were associated with walking as recommended.

Humpel, Owen, Iverson, Leslie & Bauman (2004) examined associations of perceived environmental attributes (weather, aesthetics, accessibility, and location) with walking for different purposes. Participants reported place of residence, perceptions of neighbourhood environmental attributes and walking behaviors (i.e. general neighbourhood walking, walking for exercise, walking for pleasure, and walking to get to and from places). Results showed that positive perceptions about the aesthetic nature of the environment, reporting weather as not inhibiting, and perceiving a beach or lake within walking distance were associated with neighbourhood walking. For men, accessibility of facilities for walking was negatively associated with neighbourhood walking. No evidence of a relationship between safety and neighbourhood walking was found. McGinn, Evenson, Herring & Huston (2007) quantified the agreement between perceived and objective measures of the natural environment and assessed associations with leisure time physical activity, walking, and walking or cycling for transportation. Perceptions of the natural environment (weather, lack of trees, exhaust fumes, and hills) were obtained through survey data. Objective measures of weather and hills were created using Geographic Information Systems (GIS). They found little agreement when comparing objective measures to respondents' perceptions. Objective measures of the physical environment were not associated with any physical activity outcomes. But, people who perceived hills as not being common in their neighbourhood were more likely to walk than those who reported hills were common in their neighbourhood.

2.2.2 *Walking for exercise, recreation and pleasure*

Ball, Bauman, Leslie, & Owen (2001) investigated relationships between environmental aesthetics, convenience (i.e. access to facilities), walking companions and walking for exercise. Logistic regression analyses of self-report data showed that people reporting a less aesthetically pleasing or less convenient environment were less likely to report walking for exercise in the past two weeks.

Duncan & Mummery (2005) used social-ecological models to study physical activity and recreational walking. They found that, when adjusting for income, educational achievement, age, gender, BMI, self efficacy and social support, people who did not agree that the neighbourhood footpaths were in good condition were more likely to participate in recreational walking than those who thought the footpaths were in good condition. The authors hypothesized that people who regularly used the footpaths might be more aware of their condition and report the footpath condition accordingly.

Other plausible explanations given for these associations were that people with unclean or poorly maintained footpaths found locations outside of the neighbourhood to perform their activity in. No associations between safety, accessibility, opportunities for physical activity and recreational walking were found.

Hoehner, Brennan Ramirez, Elliott, Handy & Brownson (2005) assessed perceptions and objectively measured environmental factors and their relative association with transportation activity and recreational physical activity. They found that reporting many places to exercise in the community, reporting more facilities and destinations within a 5-minute walk, and more attractive features of the neighbourhood were associated with recreational activity. No associations were found between transportation environment and recreational activity.

Humpel et al. (2004) found in their study about walking for different purposes that walking for exercise was associated with aesthetics and perceptions that weather did not inhibit their walking habits. Perceiving the environment as highly safe was associated with less walking for pleasure. Accessibility of facilities for walking was associated with walking for pleasure. Perceiving a beach or lake within walking distance was associated with increased walking for exercise and pleasure.

Suminski, Poston, Petosa, Stevens & Katzenmoyer (2005) examined the relationships between features of the neighborhood environment (functional, safety, aesthetics, destinations) and walking for transportation, walking a dog, and walking for exercise. The first environmental feature was labelled "functional," and represented the construction/integrity of neighbourhood sidewalks and streets. The second feature was termed "safety", and described neighbourhood traffic volume and speed, lighting, and crime. The third feature was called the "aesthetic" feature, and described neighbourhood cleanliness and views of buildings and scenery. The fourth feature was labelled "destinations," and represented the availability of places in and around the participant's neighbourhood to which they could walk such as shops, parks, work, or schools. They found that for women neighborhood safety was positively associated with walking for exercise and walking a dog. In men, none of the neighbourhood features were significantly associated with walking for exercise or walking a dog. Giles-Corti & Donovan (2002a), however, found that perceiving the neighbourhood as being attractive, safe, and having interesting walks was associated with walking for recreation.

Troped et al. (2003) found no associations between the physical environmental factors (unattended dogs, hills in neighborhood, streetlights, enjoyable scenery, sidewalks, heavy traffic) and walking and cycling for recreation.

2.2.3 *Walking and cycling for transport*

Cerin, Leslie, Toit, Owen, & Frank (2007) examined associations between access to destinations and walking for transport. A positive linear relationship was found between the reported number of different types of destinations within a 5-min walk from home and weekly minutes of walking.

Especially among women, proximity of workplace was associated with transport-related walking. No significant relationships were found between walking and proximity of home/car commercial destinations, schools, bus/train stops, beach/river, and recreational destinations.

Hoehner et al. (2005) found that perceiving more destinations within walking distance of one's home and perceiving neighbourhoods free from garbage, litter, or broken glass, and well maintained were associated with transportation activity. No associations were found between transportation environment and transportation activity.

Humpel et al. (2004) concluded from their study that no association existed between perceived environmental attributes (accessibility of facilities for walking, aesthetics, safety, weather) or location (perceiving beach or lake within walking distance) and walking to get to and from places.

McGinn, Evenson, Herring & Huston (2007) discovered that people who perceived hills as not being common in their neighbourhood were more likely to engage in walking and cycling for transport than those who reported hills were common in their neighbourhood. Unexpectedly they also found that perceiving weather as not being a problem in the neighbourhood was associated with less walking and cycling for transportation.

Suminski et al. (2005) reported that women perceiving destinations in the neighbourhood were more likely to walk for transportation in the neighbourhood. Functional and aesthetic features of the neighbourhood were negatively associated with walking for transportation in men.

Timperio, Crawford, Telford & Salmon (2004) examined associations between perceptions of the local neighbourhood (traffic density, road safety, strangers, traffic lights/ crossings, sporting facilities and public transport) and walking and cycling among children as a means of transport. Parents reported their child's (five- to six-year old and ten- to twelve-year-olds) usual walking or cycling to local destinations and their perceptions of their neighbourhood. Ten- to twelve-year-olds were also asked their perceptions of traffic, strangers, road safety and sporting venues, and their perceptions of their parent's views on these issues. Results showed that few parental beliefs about the local neighbourhood were related to five- to six-year-old children's walking or cycling. Also it appeared that a perception of limited public transport was a significant predictor of walking and cycling among five- to six-year-old girls. For ten- to twelve-year-old children, multivariate logistic regression analyses showed that boys whose parents believed there were no lights or crossings for their child to use were 60% less likely to walk or cycle. Also girls who held the view that there were no parks near where they live and whose parents believed that their child needed to cross several roads to reach play areas and that there was limited public transport in their area were less likely to walk or cycle. Perceptions of heavy traffic and road safety concerns were, however, not associated with walking and cycling among children as a means of transport.

Timperio, Ball, Salmon, Roberts, Giles-Corti & Simmons (2006) examined personal, family, social, and environmental correlates of active commuting to school among children. Self-administered questionnaires were completed by parents, and the older children from 19 elementary schools in Melbourne, Australia. Results showed that among both age groups (5- to 6-year-old and 10- to 12-year-old children), negative correlates of active commuting to school included parental perception of no lights or crossings for their child to use. Traffic density, road safety, sporting facilities and public transport, on the other hand, were not associated with walking and cycling to school. Troped et al. (2003) results showed that three perceived environmental variables (presence of streetlights, enjoyable scenery, and neighborhood sidewalks) and one objective environmental variable each showed associations with transportation-related

physical activity. Unattended dogs, hills in the neighbourhood and heavy traffic, though, were not associated with walking and cycling for transport.

Giles-Corti & Donovan (2002) found that, after adjustment for demographic variables and motor vehicle ownership, perceiving sidewalks in the neighbourhood, having a shop within walking distance, and more traffic and busy roads were independently associated with walking for transport.

2.2.4 *Physical activity*

Booth et al. (2000) attempted to identify social-cognitive and perceived environmental influences associated with physical activity participation in older populations.

They assessed self-reported physical activity and a range of social-cognitive and perceived environmental factors in a randomly selected sample of 449 Australian adults age 60 and older. Using logistic regression models, perceiving little difficulty using footpaths (safe for walking: no uneven paths, hills, dogs) and access to local facilities were significantly associated with being physically active.

Duncan & Mummery (2005) used social-ecological models to study physical activity. They found that, when adjusting for income, level of educational achievement, age, gender, BMI, self efficacy, and social support, people not agreeing that their neighbourhood was clean and tidy were more likely to attain sufficient levels of activity than those people who agreed with the statement. The authors suggested that this counterintuitive finding may have been a result of active people being more aware of dirt and untidiness in the neighbourhood and reporting their perceptions of the environment accordingly. No associations between safety, accessibility, opportunities for physical activity and being sufficiently active were found.

Addy et al. (2004) found only good street lighting to be associated with being regularly active. Sidewalks, public recreation facilities (walking/bike trails, swimming pools, recreation facilities, parks, playgrounds, sports fields, schools, malls, places of worship, and waterways), pleasant neighbourhood, traffic volume, unattended dogs, crime and safety concerns were, however, not associated with being regularly active.

2.2.5 *Pattern of findings*

The findings of the studies relating to perceived physical environmental factors and the directions of these associations are summarized in Tables 5 through 8 in Appendix B. All studies that measured weather, aesthetics, and walking found a positive relationship with walking in general. This means that people reporting that weather is not inhibiting their walking and that their neighbourhood is nice are more likely to walk.

Remarkably, a relationship between safety and walking seems non-existent. In addition, facilities for walking seem to be more important for walking than destinations in the neighbourhood.

Both facilities for walking and destinations within walking distance and aesthetics seem to be equally important for walking for exercise, recreation or pleasure. The relationship with, however, is less strong and more ambiguous.

In half of the cases, the perceived physical environmental variables have been found to be associated with walking and cycling for transport. The study that measured weather did not find an association with walking and cycling for transport. Aesthetics shows a stronger positive relationship with walking and cycling for transport than facilities for walking, destinations within walking distance, weather and safety.

In most cases, the physical environmental variables have not been found to be associated with physical activity. Facilities for walking and safety seem to be a bit more important for physical activity than destinations within walking distance and aesthetics, which are not associated with physical activity.

2.3 Perceived social environmental factors

Eleven studies examined the relationship between perceived social environmental variables and walking. Table 3 (see Appendix A) presents the selection of studies examining the relationship between perceived social environmental variables and physical activity and active transport. For each paper, we report the relevant items along with the scale used. The types of behaviour measured and in parentheses the specific outcome variable used in the analysis are listed. In the following subparagraphs we will describe the findings of studies that examined the relationships of perceived social environmental factors, such as social support and walking companions, and walking for different purposes (e.g. for transport or recreation).

2.3.1 *Walking in general, for exercise and recreation*

Addy et al. (2004) classified respondents according to physical activity levels and walking behaviours. They found in their study that perceiving neighbours as being active was associated with regular walking.

Ball et al. (2001) concluded that respondents, particularly women, reporting no company or pet to walk with were less likely to walk for exercise or recreation.

Duncan and Mummery (2005) investigated the associations between demographic, psychosocial, and environmental variables with self-reported physical activity and self-reported participation in recreational walking. They found that, when adjusting for age, gender income, educational level, and BMI, high levels of social support for activity were associated with recreational walking.

Hoehner et al. (2005) examined perceived and objective environmental measures and physical activity among urban adults. No associations were found between feeling safe from crime and perceiving active neighbours and recreation-based activity.

Troped et al. (2003) attempted to identify environmental correlates of both recreational and transportation-related physical activity among a community sample of adults.

From the results of their survey they concluded that social support for physical activity from family and friends was positively associated with recreational physical activity.

2.3.2 *Walking and cycling for transport*

Hoehner et al. (2005) found no associations between feeling safe from crime and perceiving active neighbours and transportation-based activity.

Timperio et al. (2004) examined associations between perceptions of the local neighbourhood and walking or cycling for transport among children. They found no associations between parents' concerns about strangers and children's walking or cycling in the neighbourhood.

Timperio et al. (2006) investigated aspects of the social and physical neighbourhood environment that may influence children's active commuting to school. They concluded from their study that parents' perceptions of few other children in the neighbourhood for their child to play with were associated with less active commuting to school.

Results from Troped et al. (2003) showed that people who see people exercising had higher levels of transportation physical activity.

2.3.3 *Physical activity*

Booth, Owen, Bauman, Clavisi and Leslie (2000) used a cross-sectional survey to examine the relationships among physical activity participation, social-cognitive, and environmental influences in a random sample of Australian adults age 60 or older.

Self-reported physical activity and a range of social-cognitive and perceived environmental factors were assessed. Bivariate analyses showed that regularly receiving support and encouragement from friends and family to be active, family and friends saying that physical activity seemed to be good for appearance, and frequency with which partner, friends and family participate in physical activity were all associated with being active. Duncan and Mummery (2005) investigated the associations between

demographic, psychosocial, and environmental variables with self-reported physical activity and self-reported participation in recreational walking. They found that, when adjusting for age, gender income, educational level, and BMI, high levels of social support for activity were associated with sufficient physical activity.

Giles-Corti and Donovan (2002b) studied environmental determinants of health. Their Study on Environmental and Individual Determinants of Physical Activity (known as the SEID project) was a social ecological project that examined the relative influence of individual, social environmental and physical environmental determinants of recreational physical activity including walking for recreation or transport.

When adjusting for several variables, conditional logistic regression modelling showed that perceiving a high number of significant others who exercised weekly with the respondent and being a member of a sport, recreation or outdoor club were both associated with being active.

Stahl, Rutten, Nutbeam, Bauman, Kannas, Abel, et al. (2001) examined the relationships between reported physical activity, and the extent of perceived support for physical activity in the physical and policy environment (e.g. facilities, programs and other opportunities) and in the social environment. Respondents were categorized as active or inactive according to self-reported physical activity. They found that those who perceived low social support from their personal environment (i.e. family, friends, school and workplace) were more than twice as likely to be sedentary compared to those who reported high social support from their personal environment.

2.3.4 *Pattern of findings*

The findings of the studies relating to perceived social environmental factors and the directions of these associations are summarized in Tables 9 through 11 in Appendix B. In half of the cases, the perceived social environmental variables have been found to be associated with walking in general, for recreation, exercise and transport. All studies that measured companionship and social support found a positive relationship with walking in general, for recreation, exercise and transport. This means that people who report having someone to walk with and that they are encouraged by friends and family are more likely to walk. Remarkably, a relationship between perceptions of crime and walking seems almost non-existent. In almost all cases, the social environmental variables have been found to be associated with physical activity.

Companionship, social support as well as social modelling (having partner/friend/family participating in some type of physical activity) are all important for physical activity.

3 Concluding remarks

This report summarises scientific research concerning individual and perceived physical and social environmental factors related to walking. This overview of individual, perceived physical and social environmental determinants of walking can be used as part of an Intervention Map (Bartholomew, Parcel, Kok and Gottlieb, 2001) to develop more successful interventions to promote walking.

Intervention Mapping is a systematic approach to initiate interventions, from problem recognition until implementation, and provides a framework for making decisions about how to influence change in individual behaviour and in the environment of the individual. This reliable tool for initiating interventions at multiple levels has been developed by the universities of Texas and Maastricht, especially to enhance effective interventions based on social sciences theory and empirical research findings. Intervention Mapping has been successfully applied to several health-related problems. The steps in Intervention Mapping provide a framework for making decisions about how to influence change in individual behaviour and in the environment of the individual (see Figure 2). An Intervention Map aimed at promoting walking helps designing, implementing and evaluating an intervention program that is feasible and that has a high likelihood of being effective.

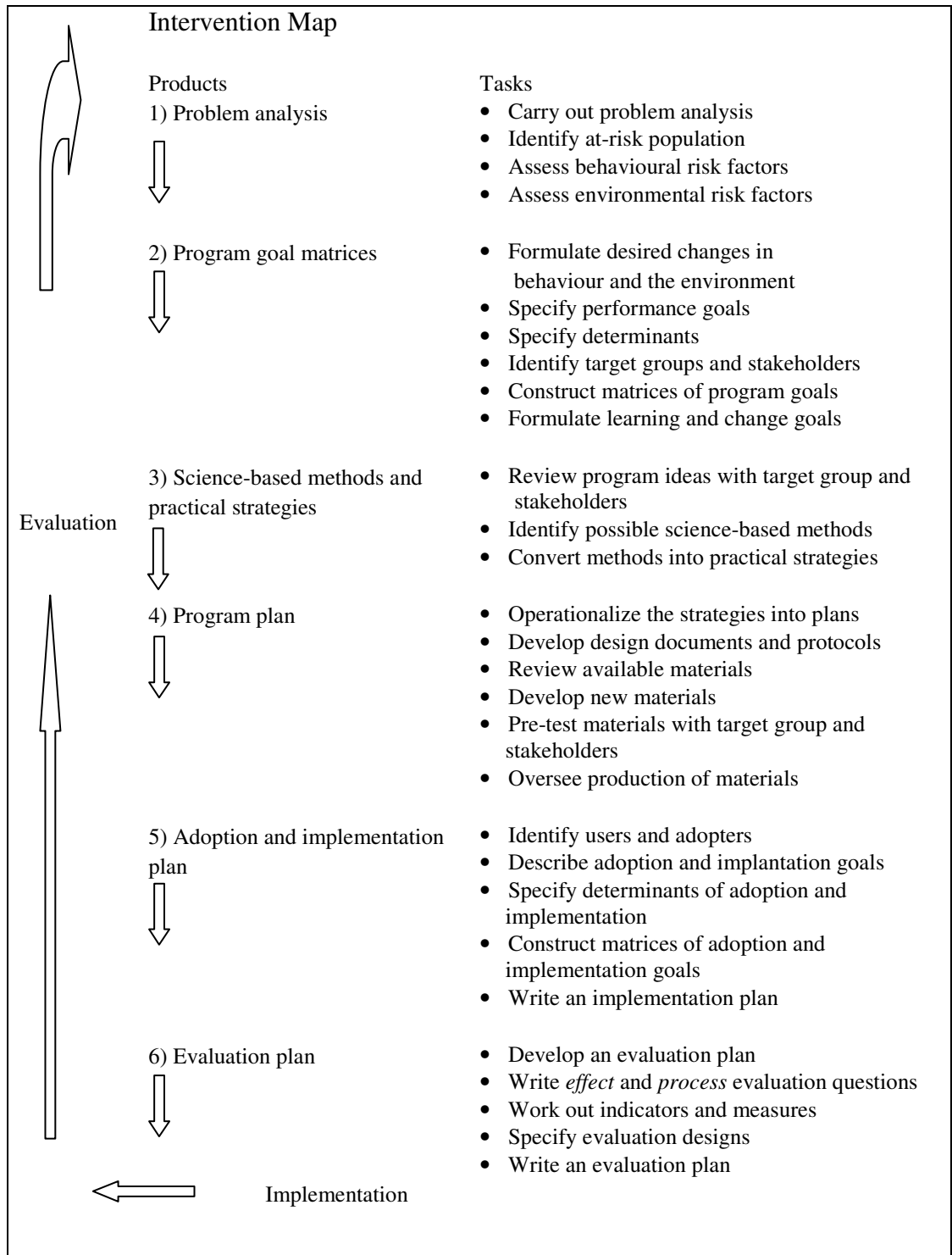


Figure 2 Intervention Mapping. Source: Bartholomew, et al. (2001).

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5 Signature

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A Main findings of studies

Table A.1 Characteristics and main findings of studies examining relationships between individual factors and walking.

Reference	Number/age/ gender	Relevant Individual variable	Scale	Relevant Outcome variable	Statistical adjustment	Significant associations with main outcome variable
Anable and Gatersleben (2005) ¹	N=235 M + F Adults	How they usually travel to work? How do you rate this journey on instrumental (environment, cost, health and fitness, convenience predictability, flexibility) and non-instrumental factors (relaxation, no stress, excitement, control freedom)?	Five-point Likert scale from 'Not at all important' (1) to 'Extremely important' (5)	Importance of instrumental and affective aspects when travelling either for work or for a leisure day trip		<p>Work journeys: Instrumental aspects, and especially to convenience are more important than affective factors.</p> <p>Leisure journeys: Instrumental and affective aspects, particularly flexibility, convenience, relaxation, a sense of freedom and 'no stress' are equally important.</p> <p>Journeys by bike or on foot scored high on affective aspects such as no stress, relaxation and freedom.</p> <p>Journeys on foot score highest on relaxation.</p> <p>Walking and cycling also scored highly on the more collective long term instrumental factors such as health and environmental quality as well as instrumental factors such as predictability and cost.</p>

Reference	Number/age/ gender	Relevant Individual variable	Scale	Relevant Outcome variable	Statistical adjustment	Significant associations with main outcome variable
Booth, Owen, Bauman, Clavisi & Leslie (2000) ²	N=449 > 60 years M + F	Attitudes: Compared to being inactive, how likely is that physical activity would ... and How important is it for you to ... relieve stress, makes you too tired, maintains or improves health, controls weight, helps with sleep, helps carry out chores, causes injury, makes you uncomfortable, makes present injury worse, helps in making friends, good way to have fun, takes up too much time Self efficacy: How confident are you that you could exercise in the following situations: when you are tired, when you are in a bad mood, when you do not have time, when you are on holidays, when it is raining, or when it takes a lot of effort	Five-point Likert scale from 'very likely' (1) to 'very unlikely' (5) Five-point Likert scale from 'very important' (+2) to 'very unimportant' (-2) Five-point Likert scale from 'very confident (1) to 'not at all confident' (5)	Vigorous activities Walking for exercise, leisure, or recreation Moderate-intensity activities (sufficiently active/ not sufficiently active)	Age, gender	A positive attitude towards the health benefits of psychical activity is associated with being active. No associations were found between attitudes towards risk of harm, enjoyment and time and being active. Higher self efficacy is associated with being active.

Reference	Number/age/ gender	Relevant Individual variable	Scale	Relevant Outcome variable	Statistical adjustment	Significant associations with main outcome variable
Darker, Larkin and French (2007) ³	N=10 aged 25-35 M + F	Experiences of walking	Qualitative method of interpretative phenomenological analysis.	Beliefs about walking Supporting factors and barriers to walking		Walking is seen as not being "proper" exercise. Walking is not a goal in itself. People engage in healthy behaviour for reasons other than to be healthy. Functionality of walking for transport, contextual factors of social support and psychological benefits make walking easier. Perceived lack of time was cited as an inhibitory barrier to walking.
Duncan & Mummery (2005) ⁴	N=1281 Adults M + F	Self-efficacy: How confident are you that you could perform physical activity "even when it is very hot outside," "when you don't have anyone to exercise with," "when you don't have any money," "when you are tired," "when you feel you don't have time," and " when activity takes a lot of effort."	Five-point Likert scale from 'not at all confident' to 'very confident	Physical activity: recreational and transport-related walking, vigorous sport and gardening, moderate intensity exercise activities (sufficiently active/ not sufficiently active). Recreational walking: recreational walking in the previous week (any recreational/ no recreational walking)	Income, level of educational achievement, age, and gender, BMI	Self efficacy was associated with attaining sufficient physical activity. Self-efficacy was not associated with recreational walking.

Reference	Number/age/ gender	Relevant Individual variable	Scale	Relevant Outcome variable	Statistical adjustment	Significant associations with main outcome variable
Giles-Corti & Donovan (2002) ⁵	N=1773 Adults M + F	<p>Attitude toward trying</p> <p>Attitude towards the process of trying</p> <p>Subjective norm</p> <p>Frequency of trying in the last three months:</p> <p>During the past three months, how many times, if any, did you try to do a regular physical activity routine?</p> <p>Perceived behavioural control:</p> <p>Assuming that you tried to do a regular exercise routine over the next to weeks, how likely or unlikely is it that you would actually stick to your routine?</p> <p>Behavioural skills used in the last month:</p> <p>How frequently in the last month did you: set a goal for how much physical activity you would like to do; plan particular days on which you would do physical activity; and arrange to meet someone to do physical activity with?</p>	<p>Five-point Likert scale from 'never' (1) to 'weekly' (5)</p> <p>Seven-point Likert scale from 'very unlikely' (1) to 'very likely' (7)</p> <p>Five-point Likert scale from 'never' (1) to 'weekly' (5)</p>	<p>Vigorous activity,</p> <p>Light to moderate activity,</p> <p>Walking for recreation</p> <p>Walking for transport (exercising as recommended/ not exercising as recommended)</p>	<p>Age, gender, number of children in the household under 18 years, work outside the home, household income and education</p>	<p>More frequently trying to exercise was associated with increased likelihood of exercising.</p> <p>Higher perceived behavioural control was associated with increased likelihood of exercising.</p> <p>Using behavioural skills in the last month was associated with increased likelihood of exercising.</p> <p>Higher intention to be physically active was associated with increased likelihood of exercising.</p>

Reference	Number/age/ gender	Relevant Individual variable	Scale	Relevant Outcome variable	Statistical adjustment	Significant associations with main outcome variable
		Intention to try in the next two weeks: Before this interview, how likely or unlike is it that in the next two weeks you would try to do a regular exercise routine?	Seven-point Likert scale from 'very unlikely' (1) to 'very likely' (7)			
Troped, Saunders, Pate, Reininger, & Addy (2003) ⁶	N=413 Adults M + F 13% had a long-term illness or injury that limited the person's ability to perform physical activity	Self-efficacy for exercise was assessed based on a three-item scale developed by Sallis et al. (1989) and one item from Marcus et al. (1992)	Four Likert-scaled items (5-point scale)	Transportation physical activity: walking and/or bicycling per week Recreational physical activity: physical activity or exercise per week		Self-efficacy for physical activity is associated with recreational physical activity and transportation physical activity

Table A.2 Characteristics and main findings of studies examining relationships between perceived physical environmental factors and walking.

Reference	Number/age/ gender	Relevant Physical environmental variable	Scale	Relevant Outcome variable	Statistical adjustment	Significant associations with main outcome variable
Addy, Wilson, Kirtland, Ainsworth, Sharpe, & Kimsey (2004) ¹	N=644	Perceived support in the neighbourhood: Sidewalks, public recreation facilities, streetlights, having a pleasant neighbourhood for walking. Perceived barriers in the neighbourhood: traffic volume, unattended dogs Perceived support in the community: walking/bike trails, swimming pools, recreation facilities, parks, playgrounds, sports fields, schools, malls, places of worship, and waterways.		Walking: Regular walking (30 or more minutes 5 or more days per week), Irregular walking (lower levels than regular walkers), Non-walking (no walking for 10 minutes or more at a time). Physical activity: Active Insufficiently active (lower levels of physical activity than active), or Inactive (no moderate or vigorous physical activity).		Having sidewalks available in the neighbourhood and using a mall for walking were associated with increased walking behaviours. Public recreation facilities, streetlights, having a pleasant neighbourhood for walking, traffic volume, unattended dogs were not associated with walking. Having good street lighting was associated with being regularly active. Sidewalks, public recreation facilities, pleasant neighbourhood for walking, traffic volume, unattended dogs were not associated with being regularly active.
Ball, Bauman, Leslie & Owen (2001) ²	N=3392 Adults M + F	Aesthetics: To what extent do you agree or disagree with each of the following about walking in your neighbourhood? Your neighbourhood is	Five-point Likert scale from 'strongly agree' (1) to 'strongly disagree' (5)	Walking for exercise in the past two weeks (any/no)	Gender, age, educational level	Perceiving a high level of environmental aesthetics, and a high level of environmental convenience is associated with walking for exercise.

Reference	Number/age/ gender	Relevant Physical environmental variable	Scale	Relevant Outcome variable	Statistical adjustment	Significant associations with main outcome variable
		friendly, Your local area is attractive, You find it pleasant walking near your home. Convenience: To what extent do you agree or disagree with each of the following about walking in your neighbourhood? Shops are in walking distance. A park or beach is within walking distance. A cycle path is accessible.				
Booth, Owen, Bauman, Clavisi & Leslie (2000) ³	N=449 > 60 years M + F	Do you have any exercise equipment at home? How safe do you feel walking in your neighbourhood during the day? How difficult is it to you to walk in your neighbourhood during the day? Do you have access to facilities that may be used for physical activity?	Yes/no	Vigorous activities Walking for exercise, leisure, or recreation Moderate- intensity activities (two categories: sufficiently active and inactive)	Age, gender	Having access to a recreation centre, a cycle track, a golf course, a park, or a swimming pool was associated with being active. Perceiving little difficulty using the footpaths (uneven paths, hills, dogs) was associated with being active.
Cerin, Leslie, Toit, Owen & Frank (2007) ⁴	N=291 M + F Adults	Please report the perceived walking distance from home to 1) commercial	Five-point Likert scale from '1– 5 min walking	Weekly minutes of walking for transport		Higher number of different types of destinations within a 5- min walk from home was associated with more weekly minutes of walking especially, proximity of workplace was

Reference	Number/age/ gender	Relevant Physical environmental variable	Scale	Relevant Outcome variable	Statistical adjustment	Significant associations with main outcome variable
		destinations (e.g., local shops, supermarket, greengrocer, laundry/dry cleaners); (2) home/car commercial destinations (hardware store, car service/repair, appliance store); (3) schools (primary and other schools); (4) workplace; (5) bus/train stop; (6) recreational destinations (park, nature reserve, sports field, fitness centre); (7) beach/river.	distance' (5) to >30-min walking distance (1).			associated with transport-related walking (for women). No significant relationships were found between walking and proximity of home/car commercial destinations, schools, bus/train stops, beach/river, and recreational destinations.
Duncan & Mummery (2005) ⁵	N=1281 Adults M + F	Safety, aesthetics, accessibility, and opportunities for physical activity: To what extent do you agree or disagree with the following statements: It is safe to walk in your neighbourhood, Dogs frighten people who walk in your neighbourhood, The neighbourhood is friendly, Crime is high in the neighbourhood, There are pleasant walks to do in your neighbourhood, Shops and services are in walking distance, You often see people out on	Five-point Likert scale from strongly disagree (1) to strongly agree (5)	Physical activity: Self-reported duration and frequency of recreational and transport-related walking, vigorous sport and gardening, and moderate intensity exercise activities in the previous week (sufficiently active/ not sufficiently active) Recreational walking: any self-reported	Income, level of educational achievement, age, and gender, BMI, self efficacy, social support	Perceiving their neighbourhood as not clean and tidy was associated with being sufficiently active. No associations between safety, accessibility, opportunities for physical activity and being sufficiently active were found. Perceiving the neighbourhood footpaths not in good condition was associated with recreational walking. No associations between safety, accessibility, opportunities for physical activity and recreational walking were found.

Reference	Number/age/ gender	Relevant Physical environmental variable	Scale	Relevant Outcome variable	Statistical adjustment	Significant associations with main outcome variable
		walks in your neighbourhood, Your neighbourhood is kept clean and tidy, There are busy streets to cross when out on walks, The footpaths are in good condition, There is heavy traffic, It is safe to cycle in your neighbourhood, The streets are well lit, There are steep hills, There are open spaces (such as parks and ovals) for people to walk in or around my neighbourhood (e.g., shops, parks, services).		recreational walking in the previous week		
Giles-Corti & Donovan (2002) ⁶	N = 1803 adults (18–59 years) stratified by SES using a geographic based index	Perceptions of the physical neighbourhood environment: The neighbourhood is attractive There are pleasant walks to do The neighbourhood is well maintained There are interesting walks to do There is a lot of traffic in the neighbourhood There are busy roads to cross when out on walks	11 items measured on a five-point scale (strongly agree to strongly disagree)	Walking: Walking for transport (any/no) Walking for recreation (any/no); Walking as recommended (6 or more 30 minute sessions of walking per week)/ not walking as recommended.	Demographic variables and motor vehicle ownership	Attractive public open space, available sidewalks, a shop within walking distance, a lot of traffic and busy roads to cross are associated with walking for transport Attractive and safe neighbourhoods and interesting walks were associated with walking for recreation Access to public open space and perceiving their neighbourhood as being attractive, safe, and containing interesting walks was associated with walking as recommended

Reference	Number/age/ gender	Relevant Physical environmental variable	Scale	Relevant Outcome variable	Statistical adjustment	Significant associations with main outcome variable
		Perceived access to neighbourhood facilities: Are there sidewalks available in your neighbourhood? Are the streets well lit? Is there public transport, a park, or a shop within walking distance?	Yes/no			
Hoehner, Brennan Ramirez, Elliot, Handy & Brownson (2005) ⁷	N= 1068 M + F Adults	Perceived land use: There are many destinations within walking distance from my home. Number of destinations (out of 13) within ≤5 minutes walking distance Recreational facilities: There are many places to be physically active in my community not including streets for walking or jogging. Do you have a park, walking trail, or private fitness facility within a 5-minute walk from home? Number of recreational facilities (out of seven) within ≤5 minutes walking distance. Transportation	Strongly disagree, disagree, agree, strongly agree Number Strongly disagree, disagree, agree, strongly agree Yes/no Number Strongly disagree,	Transportation activity: weekly minutes of walking and bicycling for transportation. Recreational activity: Weekly minutes of walking for leisure and moderate and vigorous leisure-time activity.	Age, gender, and education	Land use: perceiving more destinations within walking distance of one’s home was associated with transportation activity. Recreational facilities: Reporting many places to exercise in the community and reporting more facilities within a 5-minute walk was associated with recreational activity. Transportation environment: No associations found with recreational activity and transportation activity. Aesthetics: More attractive features were associated with recreational activity. Neighbourhoods’ free from garbage, litter, or broken glass, and well maintained were associated with transportation activity.

Reference	Number/age/ gender	Relevant Physical environmental variable	Scale	Relevant Outcome variable	Statistical adjustment	Significant associations with main outcome variable
		<p>distance, Public transport wi walking distance, Shops wi walking distance, number of Walking routes, hills, Unsafe footpaths Aesthetics: Enjoyable scenery, Attractive neighbourhood, Friendly neighbourhood Safety: Busy roads to cross, Dangerous, unpleasant traffic, Feeling safe, dogs. Weather: Rainy weather, Cold weather, Hot weather, Windy weather</p>		<p>week), walking for exercise (more or less than 120 minutes per week) walking for pleasure (any or no), and walking to get to and from places (any or no)</p>		<p>habits was associated with neighbourhood walking (women and men).</p> <p>Accessibility of facilities for walking was negatively associated with neighbourhood walking (men).</p> <p>Reporting weather as not inhibiting (women and men) and aesthetics (men) were associated with walking for exercise.</p> <p>Perceiving environment as highly safe was associated with less walking for pleasure (men).</p> <p>Positive perceptions of accessibility were associated with walking for pleasure (for women).</p> <p>Perceiving a beach or lake within walking distance was associated with increased neighbourhood, exercise, and pleasure walking.</p> <p>No association was found between perceived environmental attributes and walking to get to and from places.</p> <p>No evidence of a relationship between safety and neighbourhood walking was found for men or women.</p>
McGinn, Evenson, Herring & Huston (2007) ⁹	N=1482 M + F Adults	<p>Weather is a problem in my neighbourhood; Lack of trees along the street that provide shade is a problem in my neighbourhood; Exhaust fumes or other pollution are problems in</p>	Strongly agree/agree/disagree/strongly disagree	<p>Leisure time physical activity (meets recommendations/insufficiently active/ inactive) Walking (three activity</p>		<p>Perceiving hills as not being common in the neighbourhood was associated with walking and with engaging in transportation activity.</p> <p>Perceiving weather as not being a problem in the neighbourhood was associated with less walking and cycling for transportation.</p>

Reference	Number/age/ gender	Relevant Physical environmental variable	Scale	Relevant Outcome variable	Statistical adjustment	Significant associations with main outcome variable
		my neighbourhood Hills or steep slopes are common in my neighbourhood		categories) Walking or cycling for transportation (any transportation activity/ no transportation activity)		
Suminski, Poston, Petosa, Stevens, Katzenmoyer (2005) ¹⁰	N=415 M+F Adults	<p>Functional: How would you describe: - the maintenance of sidewalks in your neighbourhood? - the width of the streets in your neighbourhood? - the condition of the intersections in your neighbourhoods</p> <p>Safety: How would you describe - the amount of traffic in your neighbourhood? - the speed of traffic in your neighbourhood? - the lighting in your</p>	<p>Ten-point Likert scales from 'poorly maintained' (1) via 'average' (5) to 'very well maintained' (10) from 'very narrow' (1) via 'average' (5) to 'very wide' (10) from 'very poor' (1) via 'average' (5) to 'very good' (10) from 'very light' (1) via 'average' (5) to 'very heavy' (10) from 'very slow' (1) via 'average' (5) to 'very fast' (10)</p>	<p>Walking for transportation (did perform the activity in the neighbourhood/ did not perform the activity or did not perform the activity in the neighbourhood) Walking a dog (did perform the activity in the neighbourhood/ did not perform the activity or did not perform the activity in the neighbourhood) Walking for exercise (did perform the activity in the</p>	Age and education	<p>Neighbourhood safety was associated with walking for exercise and walking a dog (for women)</p> <p>Neighbourhood features were not associated with walking for exercise or walking a dog in men</p> <p>Perceiving destinations in the neighbourhood was associated with walking for transportation in their neighbourhood (for women)</p> <p>Functional and aesthetic features were negatively associated with walking for transportation in men.</p>

Reference	Number/age/ gender	Relevant Physical environmental variable	Scale	Relevant Outcome variable	Statistical adjustment	Significant associations with main outcome variable
		<p>neighbourhood? - the level of crime in your neighbourhood?</p> <p>Aesthetic: How would you describe - the cleanliness of the sidewalks in your neighbourhood? - the views (such as houses and scenery) in your neighbourhood?</p> <p>Destinations: How would you describe - the availability of places to walk (shops and parks) in your neighbourhood?</p>	<p>from 'very poor' (1) via 'average' (5) to 'very good' (10) from 'low crime' (1) via 'average' (5) to 'high crime' (10)</p> <p>from 'very unclean' (1) via 'average' (5) to 'very clean' (10) from 'very unattractive' (1) via 'average' (5) to 'very attractive' (10)</p> <p>from 'very few places' (1) via 'average' (5) to 'a lot of places' (10)</p>	<p>neighbourhood/ did not perform the activity or did not perform the activity in the neighbourhood)</p>		
Timperio, Crawford, Telford & Salmon (2004) ¹¹	N=291 families of children aged 5–6 years and 919 families of children aged 10–12 years	<p>To what extent do you (parent) agree with the following statements: There is heavy traffic in our local streets. Road safety is a concern in our area. There are no lights/crossings for my</p>	Five-point Likert scale from 'strongly agree' (1) to 'strongly disagree' (5) and don't know (6)	Children's' total number of weekly walking or cycling trips to local destinations (<3 walking or cycling trips per week; ≥3 walking or cycling trips	SES	<p>Parents' perceptions of limited access to public transport options were associated with a lesser likelihood of walking or cycling among 5- to 6-year-old girls.</p> <p>Parents' perceptions of a lack of traffic lights and controlled crossings were associated with lower rates of walking and cycling among 10- to 12-year-old boys.</p>

Reference	Number/age/ gender	Relevant Physical environmental variable	Scale	Relevant Outcome variable	Statistical adjustment	Significant associations with main outcome variable
		<p>child to use.</p> <p>My child would have to cross several roads to get to play areas</p> <p>There are few sporting venues within our local area.</p> <p>Public transport is limited in my area.</p> <p>To what extent do you (child) agree with the following statements:</p> <p>I think there is heavy traffic in the streets where I live.</p> <p>My mum and dad think there is heavy traffic in our streets.</p> <p>I think the roads aren't safe.</p> <p>My mum and dad think the roads aren't safe.</p> <p>There are no parks or sports grounds near where I live.</p>		per week)		<p>Parents' perception that their 10- to 12-year-old girls had to cross many roads to get to a play area and of high levels of limited public transport in their area were associated with lower rates of walking and cycling among children.</p> <p>10- to 12-year-old girls who reported a lack of parks or sports grounds near their home made fewer walking and cycling trips.</p> <p>Perceptions of heavy traffic and road safety concerns were not associated with walking and cycling to school.</p>
Timperio, Ball, Salmon, Roberts, Giles-Corti, Simmons (2006) ¹²	N=291 families of children aged 5–6 years and 919 families of children aged	<p>To what extent do you (parent) agree with the following statements:</p> <p>There is heavy traffic in our local streets.</p> <p>Road safety is a concern in our area.</p>	Five-point Likert scale from 'strongly agree' (1) to 'strongly disagree' (5) and don't know (6)	Walking to school Cycling to school (three categories: never; infrequent/occasional (one to four times per week);		<p>Parents' perceptions of no lights or crossings for their child to use was associated with less active commuting to school.</p> <p>Traffic density, road safety, sporting facilities and public transport were not associated with walking and cycling to school.</p>

Reference	Number/age/ gender	Relevant Physical environmental variable	Scale	Relevant Outcome variable	Statistical adjustment	Significant associations with main outcome variable
	10–12 years	<p>There are no lights/crossings for my child to use.</p> <p>My child would have to cross several roads to get to play areas.</p> <p>There are few sporting venues within our local area.</p> <p>Public transport is limited in my area.</p>		frequent (five or more times per week)		
Troped, Saunders, Pate, Reininger, & Addy (2003) ¹³	N=413 Adults Female (60.4%), 13% had a long-term illness or injury that limited the person's ability to perform physical activity	Discrete neighbourhood characteristics: unattended dogs, hills in neighbourhood, streetlights, enjoyable scenery, sidewalks, heavy traffic	Yes/no	Min. of walking and/or bicycling per week (transportation physical activity) Frequency and duration of physical activity or exercise (recreational physical activity)	Age, and self-efficacy for physical activity.	<p>Presence of streetlights, enjoyable scenery, and neighbourhood sidewalks were associated with higher levels of transportation physical activity.</p> <p>Unattended dogs, hills and heavy traffic were not associated with walking and cycling for transport.</p> <p>Unattended dogs, hills in neighbourhood, streetlights, enjoyable scenery, sidewalks, heavy traffic were not associated with walking and cycling for recreation.</p>

Table A.3 Characteristics and main findings of studies examining relationships between perceived social environmental factors and walking.

Reference	Number/age/ gender	Relevant Social environmental variable	Scale	Relevant Outcome variable	Statistical adjustment	Significant associations with main outcome variable
Addy, Wilson, Kirtland, Ainsworth, Sharpe, & Kimsey (2004) ¹	N=644	Perceived support in the neighbourhood: physically active neighbours Perceived barriers in the neighbourhood: crime, and perception of neighbours being untrustworthy Perceived barriers in the community: crime and safety concerns associated with recreation facilities		Regular walking (30 or more minutes 5 or more days per week), Irregular walking (lower levels than regular walkers), Non-walking (no walking for 10 minutes or more at a time).		Perceiving neighbours as being active was associated with increased walking behaviours. Trusting the neighbours was associated with increased walking behaviours.
Ball, Bauman, Leslie & Owen (2001) ²	N=3392 Adults M + F	Companionship: You have someone (or a pet) to walk with you in the neighbourhood.	Five-point Likert scale from 'strongly agree' (1) to 'strongly disagree' (5)	Walking for exercise in the past two weeks (two categories: any or no walking in the past two weeks)	Gender, age, educational level	Having no company or a pet to walk with is associated with less walking for exercise (women).
Booth, Owen, Bauman, Clavisi & Leslie (2000) ³	N=449 > 60 years M + F	Social environment: How frequently, over the past three past months did friends or family 'offer to participate in an activity with you?', 'give helpful reminders to be active?', 'encourage you to be active?', 'take over chores to allow you to be active?'	Five-point Likert scale from 'very often' (1) to 'never' (5)	Vigorous activities Walking for exercise, leisure, or recreation Moderate-intensity activities	Age, gender	Regularly receiving support and encouragement from friends and family to be active was associated with being active. Family and friends saying that physical activity seemed to be good for appearance was associated with being active. Frequency with which friends and family participate in physical activity was associated with being active. Frequency of partner being physically active was

Reference	Number/age/ gender	Relevant Social environmental variable	Scale	Relevant Outcome variable	Statistical adjustment	Significant associations with main outcome variable
						associated with being active.
		Social reinforcement: How frequently, over the past three months, did friends or family ‘say that physical activity seemed to be good for your appearance?’, ‘get upset about the activities you wanted to do?’, ‘criticize the activities in which you participated?’.	Five-point Likert scale from ‘very often’ (1) to ‘never’ (5)			
		Social modelling: How frequently do you see other people in the neighbourhood involved in activities such as walking or jogging? How frequently do friends or family participate in some type of physical activity? How frequently does your partner participate in some form of physical activity?	Five-point Likert scale from ‘very often’ (1) to ‘never’ (5) > 3 times per week, 1-3 times per week, < once per week,			
Duncan &	N=1281	Social support:	Five-point Likert	Physical activity:	Age, gender	High levels of social support for activity were

Reference	Number/age/ gender	Relevant Social environmental variable	Scale	Relevant Outcome variable	Statistical adjustment	Significant associations with main outcome variable
Mummery (2005) ⁴	Adults M + F	How frequently over the previous 3 months family, friends, and colleagues “had encouraged them to perform physical activity,” “had done something to help you be physically active,” “made it difficult for you to be physically active,” and “offered to do physical activities with you.”	scale from “never” to “very often”	Self-reported duration and frequency of recreational and transport-related walking, vigorous sport and gardening, and moderate intensity exercise activities in the previous week (sufficiently active/ not sufficiently active) Recreational walking: Self-reported participation in recreational walking in the previous week (Two categories: no and any walking)	income, educational level, BMI	associated with sufficient physical activity and recreational walking.
Giles-Corti & Donovan (2002) ⁵	N = 1803 adults (18– 59 years) stratified by SES using a geographic based index	Perceptions of the social neighbourhood environment: The neighbourhood is safe for walking It is safe out walking day or night You often see others out on walks Your spouse/partner likes walking in the neighbourhood You have someone to walk with around the neighbourhood	11 items measured on a five-point scale (strongly agree to strongly disagree)	Frequency and duration of physical activities undertaken in the previous 2 weeks (vigorous activity, light–moderate activity, walking for recreation, and walking for transport). (two categories: sufficiently/insufficiently active)		Perceived social support and safety were associated with walking.

Reference	Number/age/ gender	Relevant Social environmental variable	Scale	Relevant Outcome variable	Statistical adjustment	Significant associations with main outcome variable
				“Walking as recommended” was defined as 6 or more 30 minute sessions of walking per week.		
Giles-Corti & Donovan (2002) ⁶	N=1773 Adults M + F	Social environment: Are you a member of a sport, exercise, or outdoor recreational group or club? How often over the last month did your spouse/partner, close family members, people at work, close friends, and people in your neighbourhood do physical activity including walking? Over the past three months, which of these people, if any, did physical activity with you including walking?	Yes/no Five-point Likert scale from ‘never’ (1) to ‘more than once a week’ (5) Four-point Likert scale from ‘never’ (0) to ‘weekly’ (4)	Vigorous activity, Light to moderate activity, Walking for recreation Walking for transport	Age, gender, number of children in the household under 18 years, work outside the Home, household income and education	Higher number of significant others who exercised weekly with the respondent and being a member of a sport, recreation or outdoor club was associated with being active.
Hoehner, Brennan Ramirez, Elliot, Handy & Brownson (2005) ⁷	N= 1068 M + F Adults	Social environment: How safe from crime do you feel while you are walking or riding your bike in your neighbourhood? A lot of people in your neighbourhood are physically active	Extremely, quite, slightly, or not at all safe Strongly disagree, disagree, agree, strongly agree	Transportation activity: weekly minutes of walking and bicycling for transportation. (two dichotomous outcomes: (1) engaged in any versus no transportation activity (walking or bicycling) and (2) met/did not meet public health	Age, gender, and education	No associations found.

Reference	Number/age/ gender	Relevant Social environmental variable	Scale	Relevant Outcome variable	Statistical adjustment	Significant associations with main outcome variable
				recommendations) Recreational activity: weekly minutes of walking for leisure and moderate and vigorous leisure-time activity. (single dichotomous variable: met/did not meet public health recommendations)		
Stahl, Rutten, Nutbeam, Bauman, Kannas, Abel, et al. (2001) ⁸	N= 3343 adults, M + F from six countries (Belgium, Finland, Germany, The Netherlands, Spain, Switzerland)	Perceived social support for participation in physical activity: How much have you been motivated to sports and physical activity by: - friends/ acquaintances - spouse/ family/ relative - workplace - school - journals/ newspapers - tv/ radio - health insurance - doctor - politicians - community	5-point Likert scale (5=very much, 1=not at all)	Physical activity, gymnastics, sports, active transport, gardening (inactive/active)	Age, gender and education	Perceiving low social support from personal environment was associated with not being active.
Troped, Saunders, Pate, Reininger, & Addy (2003) ⁹	N=413 Adults	Perceived neighbourhood safety	Five-point Likert- scaled item	Minutes of walking and/or bicycling per week (transportation physical activity) Frequency and duration		Seeing people exercising was associated with higher levels of transportation physical activity. Social support for physical activity from family and friends (positive) showed statistically significant

Reference	Number/age/ gender	Relevant Social environmental variable	Scale	Relevant Outcome variable	Statistical adjustment	Significant associations with main outcome variable
				of physical activity or exercise (recreational physical activity)		associations with recreational physical activity.
Timperio, Crawford, Telford & Salmon (2004) ¹⁰	N=291 families of children aged 5–6 years and 919 families of children aged 10–12 years	To what extent do you (parent) agree with the following statements: Stranger danger is a concern to me. To what extent do you (child) agree with the following statements: I am worried about strangers. My mum and dad worry about strangers.	Five-point Likert scale from 'strongly agree' (1) to 'strongly disagree' (5) and don't know (6)	Children's' total number of weekly walking or cycling trips to local destinations (<3 walking or cycling trips per week; ≥3 walking or cycling trips per week)		No association found between parents' concerns about strangers and children's walking or cycling in the neighbourhood.
Timperio, Ball, Salmon, Roberts, Giles-Corti, Simmons (2006) ¹¹	N=291 families of children aged 5–6 years and 919 families of children aged 10–12 years	To what extent do you (parent) agree with the following statement: There are not many other children around for my child to play with	Five-point Likert scale from 'strongly agree' (1) to 'strongly disagree' (5) and don't know (6)	Walking to school Cycling to school (three categories: never; infrequent/occasional (one to four times per week); frequent (five or more times per week)		Parents' perceptions of few other children in the neighbourhood for their child to play with was associated with less active commuting to school.

B Patterns of findings

Table B.1 Pattern of findings on associations of individual factors and walking in general.

Individual factor	Direction of Association	Reference
Experiences		
lack of time	-	3
functionality of walking for transport	+	3
social support	+	3
psychological benefits	+	3

Note: The references refer to the numbers in Table 1 in Appendix A.

Table B.2 Pattern of findings on associations of individual factors and walking for recreation.

Individual factor	Direction of Association	Reference
Self- efficacy	-	4

Note: The references refer to the numbers in Table 1 in Appendix A.

Table B.3 Pattern of findings on associations of individual factors and walking and cycling for transport.

Individual factor	Direction of Association	Reference
Beliefs		
affective beliefs	+	1
instrumental beliefs	+	1
Self- efficacy	+	6

Note: The references refer to the numbers in Table 1 in Appendix A.

Table B.4 Pattern of findings on associations of individual factors and physical activity.

Individual factor	Direction of Association	Reference
Attitude		
towards health benefits	+	2
towards risk of harm	0	2
towards enjoyment	0	2
towards time constraints	0	2
toward trying	0	5
towards process of trying	0	5
Subjective norm	0	5
Frequency of trying	+	5
Perceived behavioural control	+	5
Behavioural skills	+	5
Intention	+	5
Self efficacy	+/+/+	2/4/6

Note: The references refer to the numbers in Table 1 in Appendix A.

Table B.5 Pattern of findings on associations of perceived physical environmental factors and walking in general.

Physical environmental factor	Direction of Association	Reference
Facilities for walking		
sidewalks, foot paths available	+ / 0	1/6
pleasant neighbourhood for walking	0	1
walk/ bike trails	0 / -	1/8
pleasant walks	+	6
interesting walks	+	6
number of walking routes	-	8
hills	-	8
Destinations within walking distance		
public recreation facilities	0	1
swimming pools	0	1
parks	0/+ / 0	1/6/8
playgrounds	0	1
sports fields	0	1
schools	0	1
malls	+	1
places of worship	0	1
waterways	0	1
public transport	0/0	6/8
shops	0/0	6/8
lake/ beach	+	8
Safety		
streetlights	0/0	1/6
traffic volume	0/0	1/6
unattended dogs	0/0	1/8
busy roads to cross	0/0	6/8
dangerous traffic	0/0	8
footpath condition	-	8
Weather		
rainy weather	+	8
cold weather	+	8
hot weather	+	8
windy weather	+	8
Aesthetics		
attractive neighbourhood	+/+	6/8
well maintained neighbourhood	+	6
enjoyable scenery	+	8
friendly neighbourhood	+	8

Note: The references refer to the numbers in Table 2 in Appendix A.

Table B.6 Pattern of findings on associations of perceived physical environmental factors and walking for exercise, recreation and pleasure.

Physical environmental factor	Direction of Association	Reference
Facilities for walking		
pleasant walks in neighbourhood	0/0	5/6
footpath condition	-/+	5/8
hills	0/+	5/8
interesting walks	+	6
sidewalks (bike lanes)	0/0/+	6/7/8
number of places to exercise	+	7
number of walking routes	+	8
side walk maintenance	-	10
Destinations within walking distance		
shops	+/0/0/+	2/5/6/8
park/beach/lake	+/0/+	2/6/8
walking trail	0	7
cycle path	+	2
open space	0	5
public transport	0/0/+	6/7/8
number of destinations	0	7
number of recreational facilities	+	7
Safety		
safe to walk in neighbourhood	0	5
dogs	0/-	5/8
crime	0	5
busy streets to cross	0/+/-	5/6/8
traffic volume	0/+	5/6
street lights	0/0	5/6
feeling safe from traffic	0/-	7/8
dangerous traffic	-	8
Weather		
rainy weather	+	8
cold weather	+	8
hot weather	+	8
windy weather	+	8
Aesthetics		
friendly neighbourhood	+/0/+	2/5/8
attractive local area	+	2
pleasant walking near home	+	2
clean and tidy neighbourhood	0	5
attractive neighbourhood	+/+	6/8
well maintained neighbourhood	0/0	6/7
pleasant neighbourhood to exercise	+	7
trees	+	7
neighbourhood free from litter	0	7
enjoyable scenery	+	8

Note: The references refer to the numbers in Table 2 in Appendix A.

Table B.7 Pattern of findings on associations of perceived physical environmental factors and walking and cycling for transport.

Physical environmental factor	Direction of Association	Reference
Facilities for walking		
sidewalks	+/0/0/+	6/7/8/13
number of walking routes	0	8
footpath condition	0	8
hills	+/0	9/13
Destinations within walking distance		
commercial destinations	0	4
schools	0	4
workplace	+	4
bus/train stop	0/0/0/0	46/7/8
recreational destinations	0	4
beach/river	0/0	4/8
park	+/0/+	6/8/10
shop	+/0/+	6/8/10
number of destinations	+	7
number of places to exercise	0	7
park, walking trail, or private fitness	0	7
Safety		
unattended dogs	0/0	8/13
streetlight	+	13
heavy traffic	0/0	12/13
no crossings or no lights	0/+	8/12
Weather		
rainy weather	0	8
cold weather	0	8
hot weather	0	8
windy weather	0	8
Aesthetics		
well maintained neighbourhood	+	7
enjoyable scenery	0/+	8/13
clean sidewalks	-	10
views in neighbourhood	0	10
attractive neighbourhood	+/0	6/8
neighbourhood free from litter	+	7

Note: The references refer to the numbers in Table 2 in Appendix A.

Table B.8 Pattern of findings on associations of perceived physical environmental factors and physical activity.

Physical environmental factor	Direction of Association	Reference
Facilities for walking		
pleasant walks in neighbourhood	0	5
footpath condition	0/+	5/3
hills	0/+	5/3
sidewalks (bike lanes)	0	1
Destinations within walking distance		
shops	0	5
park/beach/lake	0	5
number of recreational facilities	0	1
Safety		
safe to walk in neighbourhood	0	5
dogs	0/+0	1/3/5
busy streets to cross	0	5
traffic volume	0/0	1/5
street lights	+0	1/5
Aesthetics		
friendly neighbourhood	0	5
clean and tidy neighbourhood	0	5
pleasant neighbourhood to exercise/walk	0/0	1/5

Note: The references refer to the numbers in Table 2 in Appendix A.

Table B.9 Pattern of findings on associations of perceived social environmental factors and walking in general, for recreation and exercise.

Social environmental factor	Direction of Association	Reference
Companionship		
having someone to walk/exercise with	+/+	2/5
Social support		
encouragement from friends and family	+	4
Social modeling		
seeing other people in the neighbourhood being involved in physical activity	0	9
active neighbours	+0	1/7
Neighbourhood crime		
trustworthy neighbours	+	1
crime and safety concerns associated with recreational facilities	0	1
crime in the neighbourhood	0	1
feeling safe from crime in the neighbourhood	0	7
perceived neighbourhood safety	+	5
parents' concerns about strangers	0	10

Note: The references refer to the numbers in Table 3 in Appendix A.

Table B.10 Pattern of findings on associations of perceived social environmental factors and walking and cycling for transport.

Social environmental factor	Direction of Association	Reference
Companionship		
other children to play with	+	11
Social modeling		
seeing other people in the neighbourhood being involved in physical activity	+	9
active neighbours	0	7
Neighbourhood crime		
feeling safe from crime in the neighbourhood	0	7

Note: The references refer to the numbers in Table 3 in Appendix A.

Table B.11 Pattern of findings on associations of perceived social environmental factors and physical activity.

Social environmental factor	Direction of Association	Reference
Companionship		
having someone to walk/exercise with	+	6
being member of sport club	+	6
Social support		
social support from friends and family	+	3
encouragement from friends and family	+/+	3/4
motivated by others to engage in physical activity	+	8
family and friends saying that physical activity seemed to be good for appearance	+	3
Social modeling		
seeing other people in the neighbourhood being involved in physical activity	0	3
friends and family participating in some type of physical activity	+	3
partner participating in some type of physical activity	+	3

Note: The references refer to the numbers in Table 3 in Appendix A.

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