A Walk in the Park: Exploring the Impact of Parks and Recreation Amenities as Activity-Promoting Features of the Built Environment

by

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Author’s Declaration

I hereby declare that I am the sole author of this thesis. This is a true copy of the thesis, including any required final revisions, as accepted by my examiners.

I understand that my thesis may be made electronically available to the public.

Abstract

Social ecological models of physical activity (PA) promotion embrace a wide range of factors and disciplines that may contribute to active living. Parks, trails, and recreation facilities have been acknowledged as important components of the built environment for promoting PA and overall health, but little research has investigated these community resources in detail. Therefore, the purpose of this study was to examine the association between the presence and characteristics of parks and recreation amenities and PA levels of community members. The study involved four integrated components: i) a written questionnaire with 585 adult residents from four Waterloo planning districts that addressed a variety of personal, psychosocial, and environmental correlates of PA, ii) a detailed seven-day log booklet of recreational, transportation, household and job-related PA episodes, iii) objective assessment of PA via accelerometers, and iv) observation and rating of parks for their features that may be related to PA.

Ratings of psychosocial characteristics (e.g., self-efficacy, social support) and perceptions of neighbourhood walkability attributes (e.g., land use diversity, street connectivity) were significantly different between those who engaged in some PA versus those who engaged in no PA, but neighbourhood perceptions did not moderate the relationship between psychosocial variables and PA, nor did psychosocial variables mediate the relationship between neighbourhood perceptions and PA. Parks and trails were used in approximately 8% and 3% of total PA episodes, respectively, with an average duration per episode of 49 minutes and 38 minutes, respectively. Parks with more facilities for PA and supporting amenities were more likely to be used for PA than parks with fewer facilities and amenities, and trails were the park feature most strongly related to park-based PA. The number of municipal parks within 1 km from participants' homes the and total parkland area within 1 km were associated with higher odds of neighbourhood PA and

neighbourhood park PA, while distance to the closest park from home was not related to either outcome. Although subject to several limitations, these results provide guidance for municipal and park planners in designing communities and the resources within them to promote increased levels of PA and active living. Suggestions for future research include studying environmental correlates of PA among youth and older adults, direct observation of PA in parks, and development of a comprehensive surveillance system to track both changes in the built environment and associated changes in residents' PA participation.

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CHAPTER ONE: INTRODUCTION

The connection between health and physical activity (PA) is well-documented (Sallis & Owen, 1999; Hardman & Stensel, 2003). This relationship is emphasized almost daily in laments about issues such as childhood obesity and the physical inactivity of North American populations in general. Low levels of PA have been linked not only to a greater prevalence of obesity, but also related diseases including diabetes, cardiovascular disease, osteoporosis, and cancer (Ball & McCargar, 2003; Bassuk & Manson, 2005; Stein & Colditz, 2004; U.S. Department of Health and Human Services, 1996; Westerlind, 2004). Lack of exercise is, along with poor nutrition and smoking, among the top three modifiable risk factors for chronic disease and premature death (World Health Organization, 2005). Therefore, improving PA levels has been consistently identified as a top public health priority (Ontario Ministry of Health Promotion, 2005; The Integrated Pan-Canadian Healthy Living Strategy, 2005; US Department of Health and Human Services, 2000).

Physical activity prevalence estimates vary, but disconcertingly low proportions of populations worldwide report sufficient amounts of PA to achieve health benefits. The World Health Organization (1999, as cited in Hardman & Stensel, 2003), for example, estimates that more than 60% of the world's population is inactive or insufficiently active to gain health benefits. The Centers for Disease Control and Prevention (CDC) (2001) in the United States report that only one-quarter of the U.S. population engages in the recommended amount of PA and another one-quarter are inactive. Data from the CDC's Behavioral Risk Factor Surveillance System show that the percentage of adults reporting no leisure-time PA has remained stable from 1990 to 1999 at just under 30% (Welk, 2002a). In Canada, the Physical Activity Monitor report produced by the Canadian Fitness and Lifestyle Research Institute (CFLRI) summarizes trends in

Canadians' activity levels. Estimates from the 2000/01 Canadian Community Health Survey indicate that 56% of Canadians and 57% of Ontarians are classified as insufficiently active (CFLRI, 2002). Fortunately, however, the proportion of Canadians classified as inactive appears to have declined from 75% in the first survey in 1981, although differences in survey methodology and analyses preclude definitive conclusions (Hardman & Stensel, 2003). Given these high levels of inactivity, much attention has focused on PA promotion and research especially over the past 40 years.

Sallis, Linton, and Kraft (2005) described how research on PA and health has entered a fourth major era. The first era (i.e., prior to 1970) dealt with physiological studies that examined the impact of patterns of PA on fitness. The second era (i.e., 1970s-1990s) included epidemiological studies leading to PA being viewed as a major health priority. The third era that occurred in a similar time period focused on appropriate interventions for promoting PA. Most of this research primarily addressed psychosocial factors such as self-efficacy, social support, and stages of change models (Dishman, 1994; King, Stokols, Talen, Brassington, & Killingsworth, 2002; Sallis, Kraft & Linton, 2002). The fourth era, which started in the late 1990s, focuses on a broader range of policy and environmental factors that promote health such as urban planning, transportation, housing, public health, and parks and recreation.

Dishman (1994) concluded that the variance in PA behaviour accounted for by models of PA was typically less than 35%. Most of this earlier research on PA dealt primarily with structured, vigorous exercise programs and viewed exercise participation (or lack thereof) as strictly an individual choice. However, the overemphasis on psychosocial and educational approaches to PA research and promotion that has dominated the literature until recently is subject to increasing criticism. Marcus and Forsyth (1999) divided PA promotion efforts into

downstream (e.g., programs to increase exercise self-efficacy), midstream (e.g., mass media campaigns), and upstream (e.g., altering building codes) interventions. Although they acknowledged at the time that evidence of the efficacy of upstream interventions was limited, they concluded that downstream interventions produced only 10-25% increases in PA and the improvements were short-lived. In contrast, upstream interventions, such as adding sidewalks or bike paths, are more permanent strategies and can affect greater numbers of people than just those individuals who are the targets of downstream or midstream interventions like mailings or physician counselling.

Researchers have also shown that psychological and social factors explain less variance in moderate-intensity PA than they do for vigorous activity (Sallis & Owen, 1999). Further, at least one study reported that moderate-intensity PA is significantly affected by environmental factors, moreso than vigorous PA (Saelens, Sallis, Black & Chen, 2003). This finding is significant given that recent PA recommendations have focused on promoting moderate-intensity PA (e.g., gardening, walking) because such activities are thought to be more appealing and more practical for a majority of the population than engaging in vigorous exercise programs, while still providing significant health benefits (Pate et al., 1995). In summary, ecological efforts can add explanatory value beyond the intra- and interpersonal factors that influence people's involvement and participation in physically active leisure. Although ecological models of health promotion acknowledge multiple levels of influence on behaviour, environmental factors are often emphasized (Sallis & Owen, 2002).

Physical Activity and the Built Environment

Several studies and reviews to be discussed later have examined a wide array of environmental variables that influence PA and have found substantial support for their

importance in ecological models. Early reviews by both Sallis, Bauman, and Pratt (1998) and King, Jeffery, Fridinger, and Dusenbury (1995) lamented a lack of empirical studies and conceptual models and were the impetus for research that followed in examining environmental and policy interventions. Since then, researchers have developed increasingly sophisticated systems for classifying PA as well as tools for measuring environmental correlates (e.g., Brownson, Ross, et al., 2004; Day, Boarnet, Alfonzo, & Forsyth, 2006; Pikora et al., 2002; Pikora, Giles-Corti, Bull, Jamrozik, & Donovan, 2003; Saelens, Sallis, Black & Chen, 2003). More recent reviews of the literature (e.g., Humpel, Owen, & Leslie, 2002; McCormack et al., 2004; Owen, Humpel, Leslie, Bauman, & Sallis, 2004; Saelens, Sallis, & Frank, 2003) found fairly consistent positive associations between PA and factors in the built environment such as access to facilities, safety, and aesthetics. These reviews also reported that transportation and zoning variables such as mixed land use, population density, connectivity of streets, and presence of sidewalks exhibit strong relationships with residents' PA levels.

The importance of parks, recreation and leisure to physical activity

The role that parks and recreation amenities may play in fostering increased PA has also received some attention. For example, Sallis et al.'s (1998) review concluded that children were more active outdoors and that being outdoors was the most powerful correlate of PA. Corti, Donovan, and Holman (1997) indicated that parks were more likely to stimulate activity if they are aesthetically pleasing with tree-lined paths rather than empty open space. Troped et al. (2001) determined that decreased distance between a person's home and a trail was associated with greater trail use. Most of the reviews mentioned above also include summaries of variables related to parks and recreation. Although research such as this demonstrates how parks and recreation amenities play an important role in ecological approaches to PA promotion, the ways

in which environments influence PA behaviour has not been a dominant topic in the leisure and recreation research literature (Henderson & Bialeschki, 2005). Instead, a social psychological approach (e.g., Mannell & Kleiber, 1997) has dominated in leisure research with the primary focus on individual behaviour within that person's environment. This approach has significantly advanced our understanding of leisure choice processes, but our understanding of environmental influences on behaviours such as PA has received much less attention. Similarly, the leisure field has been concerned more often with the social-psychological processes of activity involvement (e.g., enjoyment, perceived freedom, social interaction) than with the physiological products (e.g., lowered blood pressure). Finally, in a broader social and political context, the value of parks and recreation has also been related more often to other goals such as economic and community development, rather than as a contributor to PA promotion (Crompton, 1999, 2004; Glover & Hemingway, 2005).

Nevertheless, the role that leisure services and parks and recreation amenities play in helping people become physically active, and thus healthier, is beginning to be recognized. For example, *Healthy People 2010* (USDHHS, 2000) emphasized that the design of communities and the presence of parks, trails, and other public recreational facilities affect people's abilities to reach the recommended 30 minutes per day of moderate-intensity PA. Similar recommendations about access to places for PA, and specifically trails and facilities, were made by a collaboration of government agencies and private partners in the U.S. in the *Guide to Community Preventive Services* (Task Force on Community Preventive Services, 2002). In Ontario's *Active 2010* document, the section on creating enabling environments mentions the provincial trails strategy (Ontario Ministry of Health Promotion, 2005). Finally, a survey of city managers found that 89 percent named their local parks and recreation department as the main agency responsible for

obesity prevention (International City/County Management Association, 2005, as cited in Henderson, 2005). Despite these acknowledgements of the importance of our field, the examination and documentation of parks and recreation amenities as environmental correlates of PA remains in its infancy.

Conceptual arguments, however, have been put forward recently that parks and recreation amenities can make significant contributions to facilitating PA (Bedimo-Rung, Mowen, & Cohen, 2005; Godbey, Caldwell, Floyd, & Payne, 2005). Additional recognition of the growing role that parks and recreation has to play in addressing health and PA can be found in a recent special issue of *Leisure Sciences* (Henderson & Bialeschki, 2005), the advocacy promoted by Payne and her colleagues (Payne, 2002; Payne, Orsega-Smith, Roy, & Godbey, 2005), the National Recreation and Park Association's (2005) "Step up to Health" program, and the focus that the Robert Wood Johnson Foundation's Active Living Research Program has placed on research about parks and recreation (Sallis & Linton, 2005).

Study Purpose

In summary, although the importance of parks and recreation for promoting PA is becomingly increasingly recognized and studied both within and (more often) outside of our field, knowledge of the relationships between parks and recreation amenities as features of the built environment and PA remains limited. Therefore, the overall purpose of this study was to examine the association between the presence and characteristics of parks and recreation amenities and PA levels of community members. More specifically, the general research questions to be addressed include:

- How are psychosocial variables related to PA?
- How are perceptions of neighbourhood environmental attributes related to PA?
- How do psychosocial and environmental attributes interact to influence PA?
- How are parks and recreation amenities used for PA?

- How are park features related to PA?
- How is parkland proximity related to PA?

As these questions suggest, congruent with adopting a social ecological model (see Chapter Two), personal, interpersonal, and other environmental influences on PA will also be examined in addition to the focus on parks and recreation amenities. Chapter Two describes the numerous variables associated with PA that will be investigated in the present study, with a particular focus on explicating how parks and recreation amenities have been conceptualized in the built environment-PA literature. As is described in Chapter Three, the study involved four integrated components: i) a survey of residents addressing various factors related to PA, ii) a detailed log booklet of their PA participation over the course of a one-week period, iii) objective assessment of a sub-sample of participants' PA participation using accelerometers, and iv) objective ratings of several community parks for their features that may be related to PA via the use of a newly-developed assessment instrument (Saelens et al., 2006). It is hoped that this comprehensive approach helped to shed additional light on the activity-promoting features of parks and recreation amenities and the ways they interact with other personal, interpersonal, and environmental factors to impact PA participation.

CHAPTER TWO: LITERATURE REVIEW

This chapter describes numerous topics that are related, both directly and indirectly, to PA research and promotion. First, social ecological models are discussed as a relevant conceptual framework for PA research and promotion that address multiple influences on behaviour. The following sections describe health benefits and recommendations regarding desirable levels of PA, and provide an overview of personal, psychosocial, and environmental factors that have been studied in relation to PA.

Social Ecological Models

Beginning around the 1960s, much attention in the field of epidemiology shifted to the growing problem of chronic diseases. As epidemiologists expanded their focus to include behavioural correlates of health and disease, increased concern arose surrounding the need to examine an even wider array of social, economic, organizational, and political factors that impact health and that might be targeted in health interventions (Green, Richard & Potvin, 1996). Consequently, an interest in the principles of ecology gained momentum in health promotion research and practice. Ecology concerns the interactions between organisms and their environments (Hawley, 1950), and the ecological model of health promotion "presents health as a product of the interdependence between the individual and the subsystems of the ecosystem (e.g., family, community, culture, physical and social environment)" (Green et al., 1996, p. 272).

McLaren and Hawe (2005) suggest a number of reasons why ecological perspectives have increased in popularity in health research, including:

> increasing acknowledgement of the complexity of health problems …, frustration with individualism and linear and mechanistic ways of construing causality, … the rediscovery of the inextricable link between social inequality and health inequality, … [and] evidence of the independent effect of place of residence on

> health, with the consequent search for explanation that requires analysis of context" (p. 6).

However, despite the more recent influx of ecological approaches, the dissatisfaction with the domination of individual-focused approaches to health was evident more than a quarter-century ago. For example, one author stated:

> The complexities of social causation are only beginning to be explored. The ideology of individual responsibility, however, inhibits that understanding and substitutes instead an unrealistic behavioral model. It both ignores what is known about human behavior and minimizes the importance of evidence about the environmental assault on health. It instructs people to be individually responsible at a time when they are becoming less capable as individuals of controlling their total health environment. Although environmental factors are often recognized as "also relevant", the implication is that little can be done about an ineluctable, technological, and industrial society … What must be questioned is both the effectiveness and the political uses of a focus on lifestyles and on changing behavior without changing social structure and processes (Crawford, 1979, p. 256).

Similarly, Green (1984) argued, "the concentration of behavioral science applications is sometimes at the expense of action on needed change in organizational, institutional, environmental, and economic conditions shaping behavior" (p. 217). As a result of these concerns, the sub-discipline of eco-epidemiology was born as "a perspective that balances traditional biomedical concepts of risk with the broader social and environmental context" (McLaren & Hawe, 2005, p. 8). More common, however, is the term social ecology, which takes into account personal, interpersonal, and environmental factors that affect health, often with a deliberate emphasis on the latter categories of influences. In their glossary of terms related to ecological models, McLaren and Hawe (2005) define social ecology as:

> A framework or set of theoretical principles for understanding the dynamic interrelations among various personal and environmental factors in health. Social ecology pays explicit attention to the social, institutional, and cultural contexts of people-environment relations and draws on both large-scale preventative strategies of public health and individual level strategies of behavioural sciences and medicine" (p. 12).

Social ecological models form the basis, either explicitly or implicitly, for most research on PA and the built environment (e.g., Ewing, Schmid, Killingsworth, Zlot & Raudenbush, 2003; Fein, Plotnikoff, Wild, & Spence, 2004; Giles-Corti & Donovan, 2002b; Humpel, Owen, Iverson, Leslie, & Bauman, 2004; Sharpe, Granner, Hutto, & Ainsworth, 2004; Titze, Stronegger, & Owen, 2004). This section reviews some of the major ideas captured by social ecology.

Theories and Models Related to the Social Ecological Perspective

Modern ecological perspectives on health promotion can trace their roots to several earlier theories and models that acknowledged influences outside of the person (Sallis & Owen, 2002). For example, the host-agent-environment model applied predominantly to infectious diseases dictates that any of these three factors can influence the rates of disease in a given location (Frost, 1967). As well, principles of operant conditioning suggest that individuals' behaviours are shaped by feedback and interaction with elements of the surrounding environment (Skinner, 1953). Similarly, Barker's (1968) naturalistic observations of children led him to argue that people's behaviours can be predicted better by knowing the situations they are in than by knowing their individual characteristics (as cited in Wicker, 1979). Such research built upon that of Lewin (1936) who coined the term ecological psychology to describe the branch of psychology that recognized and studied outside influences on individual behaviour. Lewin first posited that behaviour is a function of the person and environment, B=f(PE), and he further argued that understanding people's perceptions of the constraints and opportunities in their environments is key to understanding their behaviours in those settings (McLaren & Hawe, 2005). However, some environmental psychologists have argued more recently that, beyond just perceptions, the environment can exert an influence so strong as to dictate individuals' actions and choices (Bargh & Chartrand, 1999).

Bandura's (1986; 1997) Social Cognitive Theory (SCT) has also been widely applied in health research. SCT is comparable to an ecological perspective in that addresses multiple influences on behaviour. "Within SCT, human behavior is explained in terms of a triadic, dynamic, and reciprocal model in which behavior, personal factors (including cognitions), and environmental influences all interact" (Baranowski, Perry, & Parcel, 2002, p. 165). As the environment, person, and behaviour all influence each other, the core construct of reciprocal determinism in SCT postulates that a change in one component has implications for changes in the other components (Bandura, 1986). However, although Bandura (1986) acknowledged that environmental constraints emerge as the overriding determinants of behaviour when they operate in significant ways, most applications of SCT, especially in PA research, have focused largely, if not exclusively, on intrapersonal (e.g., self-efficacy) and interpersonal (e.g., social support) processes that mediate behaviour, rather than on environmental factors (e.g., Dzewaltowski, 1989; Marcus, Eaton, Rossi, & Harlow, 1994; Petosa, Suminski, & Hortz, 2003; Rovniak, Anderson, Winett, & Stephens, 2002; Silver Wallace, Buckworth, Kirby, & Sherman, 2000).

Finally, the model which most clearly resembles and has helped shape current ecological models is Bronfenbrenner's (1979) theory of multiple interacting systems that affect a person's behaviour. Bronfenbrenner's model is often depicted as a series of nested, concentric circles with the individual whose behaviour is of interest at the centre of the diagram. The individual has inherent psychological and physiological properties, but acting around the individual are four systems that exert a collective influence on his or her behaviour. The microsystem includes environmental influences most proximal to the individual, including those from family, school, coworkers, and peer groups, among others. Numerous examples of microsystem-level influences can be found in the PA literature (e.g., Anderssen & Wold, 1992; Kerr, Yore, Ham, & Dietz,

2003; Davison & Lipps Birch, 2002; Proper et al., 2003; Sallis et al., 2003; Trost et al., 2003). The second level of influence is the mesosystem which is comprised of the interrelationships and overlap between any two or more microsystem settings of which an individual is a participant. For example, participation in a running club may conflict with family responsibilities to constrain opportunities for PA participation. The third level of influence is the exosystem. The exosystem links "settings that a person may or may not directly participate in, but that are nonetheless relevant because of their impact on his or her immediate environment" (McLaren & Hawe, 2005, p. 10). Influences in the exosystem might include media messages about the benefits of PA, local government provision of parks and recreation services, or industrial forces impacting the cost of equipment or facility construction. Finally, the macrosystem represents cultural ideologies that affect the exosystem and microsystems, such as dominant political, commercial, and environmental values. For example, gendered attitudes about male or female participation in particular sports is a macrolevel influence that could affect PA participation. Bronfenbrenner (1979) emphasized the interaction between the individual and all four systems in shaping behaviour in the first of his several propositions about ecological research: "The properties of the person and of the environment, the structure of environmental settings, and the processes taking place within and between them must be viewed as interdependent and analyzed in systems terms" (p. 41).

Social Ecological Models and Health Promotion

McLeroy, Bibeau, Steckler and Glanz (1988) also proposed an ecological model positing similar levels that influence behaviour. According to them, five classes of factors affect how or why a person might participate or fail to participate in a healthy behaviour such as PA: intrapersonal, interpersonal, institutional, community, and public policy. *Intrapersonal* factors

include the knowledge, skills, attitudes, behaviours (and so on) of potential participants. Physician counselling, mass media campaigns, and peer support groups are examples of intervention strategies that are sometimes delivered at a level greater than the individual, but that are nevertheless directed at influencing characteristics within the individual in order to evoke the desired behaviour change. *Interpersonal* processes include relationships with family members, friends, coworkers, neighbours, and other acquaintances. The opinions and support of these people in encouraging or discouraging PA participation has been widely documented. However, "health promotion interventions that use interpersonal strategies have typically focused on changing individuals through social influences, rather than on changing the norms of social groups to which individuals belong" (McLeroy et al., 1988, p. 357).

The third class of factors which may influence health behaviours are *organizational or institutional* influences. Organizational settings such as schools and workplaces provide the context for much of the activities people engage in during the course of a day. Again, numerous examples of worksite and school PA interventions exist in the literature, but aside from several recent studies, the majority of this research has been aimed at changing individuals' behaviours rather than characteristics of the institution (Stokols, 1992).

Community factors are also important influences on health behaviour. As described by McLeroy et al. (1988), communities within the community (e.g., churches) may play a mediating role in influencing the desirability or accessibility of particular behaviours. Community factors may also impact PA participation via the effective coordination of multiple agencies' efforts and through the exertion of power and influence in setting and addressing public health priorities. Thus, several community-level influences can exert formal or informal control over the behaviours of the individual members within those communities.

Finally, *public policy* plays a critical role in maintaining population health and preventing the further spread of infectious and chronic diseases. Laws and regulations may deter certain behaviours (e.g., smoking) deemed sufficiently detrimental through both positive and negative actions (e.g., increased taxes on cigarettes; smoking bans in public places). Similarly, public policy can promote a positive behaviour, such as PA, through funding and ordinances related to park and trail construction, while also discouraging it through other regulations related to minimum parking requirements and maintaining traffic flow (i.e., lane expansions). The impact of political backing was empasized by McKinlay (1975) who argued:

> One stroke of effective health legislation is equal to many separate health intervention endeavours and the cumulative efforts of innumerable health workers over long periods of time … Greater changes will result from the continued politicization of illness than from the modification of specific individual behaviors (p. 13).

Health promotion professionals adopting an ecological perspective can impact public policy through policy development, policy advocacy, and policy analysis (McLeroy et al., 1988).

Working from an environmental psychology background, Stokols (1992) also discussed the potential of integrating a social ecological perspective and the idea of health-promotive environments. In doing so, he offered four "core assumptions about the dynamics of human health and the development of effective strategies to promote personal and collective well-being" (p. 7) that are encompassed within a social ecological perspective. First, the healthfulness of a situation and the people within that context is influenced by multiple facets of the social and physical environments as well as numerous personal attributes. Second, analyses of health and health promotion should address the multidimensional and complex nature of human environments. Constructs such as behaviour settings, person-environment fit, and social climate have been forwarded to describe the composite milieus formed by multiple behavioural influences (Stokols, 1987). Third, behaviour can be studied at multiple levels of analysis and

using methods appropriate to each level. For example, individuals, small to large groups (e.g., families, workplaces), and entire populations can be researched using diverse methods and approaches to analysis, such as questionnaires, observation, and epidemiological statistics, to name but a few. Finally, a social ecological perspective on health promotion incorporates many ideas from systems theory and efforts to promote well-being should, therefore, take into account the interactions between different levels of behavioural influences.

Sallis and Owen (2002) proposed several similar ideas in their seven principles of ecological approaches to health behaviour change. First, multiple levels of factors influence health behaviours. The inclusion and interaction of interpersonal factors, sociocultural factors, policies, and physical environmental factors is what distinguishes ecological models from theories and models that focus primarily on intrapersonal or interpersonal factors that influence PA. Their second principle states that multiple types of environmental influences affect health behaviour. With respect to PA, these might include natural environment factors such as weather and geography or built environment factors such as facilities and street design. Other environmental influences might include those related to laws or policies, technology, and commerce.

Third, they argued that behaviour-specific ecological models can be useful. Ecological approaches recognize the importance of addressing multiple levels of influences, but useful models must delineate the specific factors that are associated with particular behaviours (Owen, Leslie, Salmon & Fotheringham, 2000). For example, greater access to swimming pools may promote increased PA participation, but is unlikely to significantly influence sexual risk-taking behaviour.

Fourth, multilevel interventions may be most effective. “A critical assumption of ecological models is that single-level interventions are unlikely to have powerful or sustained effects” (Sallis & Owen, 2002, p. 469). For example, on its own, construction of a new trail may not encourage increased PA without promoting its existence and the benefits of trail use. However, the majority of PA interventions over the past several decades have mirrored only the latter strategy by targeting only the individual level of influence (Sallis & Owen, 2002). Fifth, multilevel interventions are most easily implemented by multisectoral groups. Targeting multiple types and levels of influences represents a complex undertaking and will likely require the collaboration of both academics and professionals from numerous disciplines to plan, implement, and evaluate comprehensive efforts to increase PA participation. Similarly, Stokols (1992) states that the social ecological approach is inherently interdisciplinary.

Sixth, to evaluate ecological interventions, they suggest to monitor implementation and change in mediators at multiple levels. Understanding how and why ecological interventions promote PA requires assessing not only the outcome variables (e.g., PA), but also the implementation of the intermediary steps (e.g., park design) at several levels in order to understand the exact nature of the mediating influences (e.g., presence of facilities, washrooms) on PA. Finally, political dynamics can limit ecological interventions. Lobbying, laws and policies, and the level to which regulations are enforced can quickly and dramatically and affect the ability to invoke positive health behaviour changes. However, concerted and sustained multilevel efforts are likely to be successful over time, as evidenced, for example, by changes over the past decade in restrictions on tobacco sales and smoking.

Limitations of the Social Ecological Approach

Green et al. (1996) also advocate for the adoption of ecological models, but also review several limitations and criticisms that have been raised about their use in health practice and research. First, ecology's roots in the biological sciences that emphasize concrete, observable phenomena are sometimes in conflict with the need for the sensitivity to environment and context that would seem to be demanded by newer conceptions of social ecology.

Further, ecological models have been criticized for a lack of specificity and for being too complex. Because, as described above, it is usually suggested that multiple disciplines, sectors, and levels of analysis be addressed concurrently, ecological models present a daunting challenge for a health researcher or professional in sorting out the myriad relationships and influences that may affect a particular behaviour. As Green et al. (1996) put it, "The specificity with which ecological guidelines can identify the particular levels and sectors in need of attention is inherently limited by infinite variety of interactions that might apply in each idiosyncratic organization, community, or other social system" (p. 273). Moreover, this complexity may breed despair among individuals trying to implement an ecological approach and they may always be susceptible to criticism for not casting a wide enough net in addressing the roots of health problems. And indeed, there may be veracity to this claim given that even the best ecological intervention or research project must decide which elements of the many systems surrounding an individual to study or effect.

As well, advocates of ecological models have been rebuked for discounting the work of researchers and professionals that is aimed at directly modifying the behaviours of individuals and smaller groups. Members of the latter group that employ behaviour modification principles and other person-centred techniques have even been accused of "victim-blaming" and of impeding attention and progress on higher-level interventions (Ryan, 1976).

Finally, ecological research suffers, of course, from an inability to control the conditions in study locations such that positive changes in the targeted behaviour might be more confidently linked to the ecological interventions. Traditional experimental evaluation procedures employ random assignment and control over both exposure to treatments and other environmental factors. However, these design features may not be practical in community-based research with numerous intervention strategies and levels of analysis (Green et al., 1996).

Summary

Despite these concerns, social ecological models have gained greater acceptance in health-related research. Researchers and health professionals have recognized that multifaceted interventions in natural settings are often necessary, even if this means sacrificing some assurance of validity. As Bronfenbrenner (1979) put it, "We risk being caught between a rock and a soft place. The rock is rigor and the soft place relevance. The emphasis on rigor has led to experiments that are elegantly designed but often limited in scope" (p. 18). Others have offered the similar rebuttal that the scientific method often reduces behaviour to elements that are too minute (Green et al., 1996). Social ecological models have also been disparaged for their lack of precision and detail because of their wide-ranging mandate. However, it has been suggested that frameworks and theories particular to each point of intervention can be integrated to improve the specificity of the multiple levels in ecological models (Smedley & Smyne, 2000). In the end, Stokols (1992) adequately summarizes the perspective of ecological researchers in stating:

> The ecological perspective suggests that multifaceted interventions that incorporate complementary environmental and behavioral components and span multiple settings and levels of analysis are more likely to be effective in promoting personal and public health than are those narrower in scope (p. 18).

Indeed, the hallmark of a social ecological approach is that multiple levels of influence on individual behaviour are considered. Moreover, the interaction between different levels or

systems is important to a fuller understanding of the way individual and collective behaviour shapes and is shaped by the environment (Bronfenbrenner, 1979; Green et al., 1996; Stokols, 1992). In social ecological models, individuals' influence on the environment and the environment's influence on individuals' behaviour become inseparable. This principle of reciprocal determinism has a greater place for environmental impacts on behaviour than other more 'person-centred' behaviour modification theories and models (Green et al., 1996; Sallis & Owen, 2002).

In an analysis that is now a decade old, Richard, Potvin, Kischuk, Prlic, & Green (1996) reported that less than 25 percent of funded health promotion programs in Canada had strategies that addressed multiple levels of behavioural influences. More recent data of a comparable nature are not available, but multilevel, ecological approaches to health promotion are now being recommended in several prominent policy documents (Smedley & Syme, 2000; Ottawa Charter for Health Promotion, 1986; USDHHS, 2000). Although individual-level strategies for health promotion remain valuable, adopting a social ecological approach, with its attention to the importance of environments, is likely to hold greater promise for understanding complex health behaviours such as physical activity.

In summary, Figure 1 provides a comprehensive ecological model of active living domains recently constructed by representatives from public health, urban planning and transportation, leisure studies, and economics and political science (Sallis, Cervero, Ascher, Henderson, Kraft, & Kerr, 2006). Intrapersonal characteristics and people's perceptions of their environments are located on the inner circles of the model to indicate these factors being more proximal to the individual. The outer rings of the model portray the more objective characteristics of the environment, including behaviour settings where activities occur and

policies that affect active living. Active living behaviours (recreation, transport, household, and occupational), shown at the intersection of these person-level and environmental characteristics, are a function of the interaction between the different levels of the model, and are each likely affected by specific influences at each level (Sallis et al., 2006). The following section explores a number of factors that affect PA and active living at each level of the model.

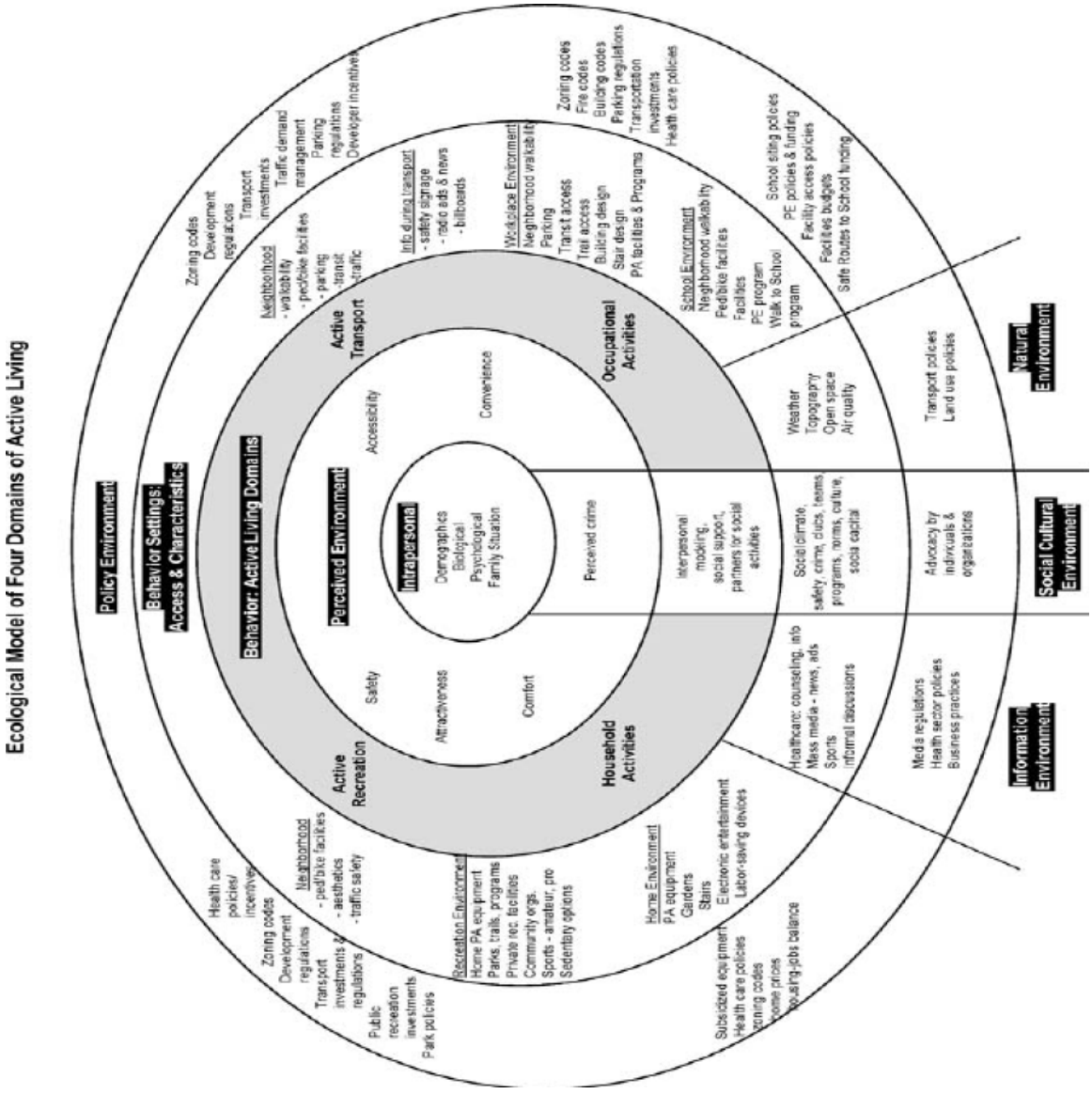


Figure 1: Ecological Model of Four Domains of Active Living (Source: Sallis et al., 2006)

Physical Activity

For all of recorded history, the importance of PA has been recognized. In cultures as widespread as China circa 2500 B.C., the ancient Greeks around 400 B.C., and the Native Indian tribes that occupied North America prior to the European invasion, PA has been a prominent part of everyday life, both for sport, rituals, and celebrations, as well as for hunting and other subsistence activities (Berryman, 1992; Hardman & Stensel, 2003; USDHHS, 1996). Only in the past 50 to 100 years has technology made it increasingly possible to engineer PA out of life's daily routines (Sallis & Owen, 1999). Consequently, conscious efforts have been made by governing bodies and professional associations to promote PA participation, especially since World War II. This section provides an overview of key conceptualizations and terms in PA research, health benefits of PA, and recommendations about quantity and types of PA.

PA can be defined as "any bodily movement produced by skeletal muscles that results in energy expenditure" (Caspersen, Powell & Christenson, 1985, p. 126). Exercise is a subcategory of PA defined as "physical activity that is planned, structured, repetitive, and purposive in the sense that improvement or maintenance of one or more components of physical fitness is an objective" (Caspersen et al., 1985, p. 128). Physical fitness is "a set of attributes that people have or achieve that relate to the ability to perform physical activity" (Caspersen et al., 1985, p. 128). Most research on PA up until the mid-1990s addressed exercise specifically, and often as it related to improving the fitness levels of participants in structured programs. However, more recently, a broadened conceptualization of PA has emerged to recognize the totality of means by which PA can be obtained. This new paradigm is commonly referred to as 'active living'. According to the website for Active Living Research (www.activelivingresearch.org),

> Active living is a way of life that integrates physical activity into daily routines. The goal is to accumulate at least 30 minutes of activity each day. Individuals may do this in a variety of ways, such as walking or bicycling for transportation,

> exercise or pleasure; playing in the park; working in the yard; taking the stairs; and using recreation facilities. Rather than addressing obesity as an individual health problem, this new, transdisciplinary field of active living is focusing on how the built environment — including neighborhoods, transportation systems, buildings, parks and open space — can promote more active lives.

As is discussed further below, a shift toward active living and its broader appeal was initiated, at least partly, out of a hope that a greater proportion of the population might realize the significant health benefits of PA.

Health Benefits of Physical Activity

As was described earlier, interest in PA research has grown exponentially over the past half-century in conjunction with our recognition of the many consequences of adopting active or inactive lifestyles. This section provides a brief overview of the many benefits to both mortality and morbidity that PA has been linked to. For more exhaustive reviews, readers are directed to Hardman and Stensel (2003), Dishman, Washburn, and Heath (2004), and the U.S. Surgeon General's report on *Physical Activity and Health* (USDHHS, 1996).

Early epidemiological research documented that rates of disease and death were lower in the presence of higher rates of physical activity when other factors were held constant. For example, an investigation of London bus company employees by Morris, Heady, Raffle, Roberts, and Parks (1953) found that conductors who engaged in the more active job of climbing stairs to collect fares suffered a lower incidence of heart disease than the more sedentary bus drivers. This landmark study stimulated the first major phase of PA research involving the documentation of health benefits arising from increased levels of exercise (Sallis & Owen, 1999). More recently, continued interest in PA promotion and its health benefits has been fuelled by research showing the significant effect that a lack of PA can have on rates of premature death. For example, a review by Lee and Skerrett (2001) found a linear relationship between PA and reductions in all-

cause mortality. Across the 44 studies which spanned 35 years, approximately 1,000 kcal/week was the average threshold amount of PA necessary to achieve a 20-30% decrease in mortality risk. One of the most famous individual studies of all-cause mortality is Paffenbarger et al.'s (1986) cohort research with over 20,000 Harvard alumni who graduated between 1916 and 1950. Among other conclusions, the investigators estimated that for each hour Harvard alumni spent exercising each week, they gained two hours of life. Similarly, a lack of PA can have negative impacts on mortality and morbidity. McGinnis and Foege (1993) concluded that physical inactivity was second only to smoking as the leading cause of preventable mortality, while Powell and Blair (1994) estimated that sedentary living habits account for a third of the deaths from coronary heart disease, colon cancer, and diabetes. In Canada, about $2.1 billion, or 2.5% of the total direct health care costs in Canada were attributable to physical inactivity in 1999, and approximately $150 million could be saved by just a 10% reduction in the prevalence of physical inactivity (Katzmarzyk, Gledhill, & Shephard, 2000). The following sections look at some of the diseases that have provided the link between PA and reduced mortality.

Cardiovascular diseases

Cardiovascular disease (CVD), also commonly called heart disease, is comprised mainly of coronary heart disease and cerebrovascular disease. Taken together, CVD, as of 2001, was the third, second, and leading cause of death in the U.S. amongst 25-44 year olds, 45-64 year olds, and adults 65 years and older, respectively (Centers for Disease Control and Prevention, 2003). In Canada, according to the Hearth and Stroke Foundation (2006), CVD accounts for the death of more Canadians than any other disease. In 2002 (the latest year for which Statistics Canada has data), CVD accounted for 74,626 Canadian deaths. Morris et al.'s (1953) study described above was one of the first to document a crude association between PA and CVD. However, a

more recent review of 36 studies showed that almost all found that PA had a protective effect on CVD (USDHHS, 1996). Similarly, Berlin and Colditz's (1990) meta-analysis reported that study participants classified into the least active or least fit groups in the individual studies had up to an 80% greater risk of dying from coronary heart disease than the most active or most fit groups. In another review of 23 mostly-cohort studies published between 1958 and 2000, 20 of 31 reports showed a significant decline in coronary heart disease with increased levels of PA. Three reports had mixed findings, while the other eight reports showed no association (Kohl, 2001). In summary, there are several risk factors for coronary heart disease (e.g., smoking, hypertension, obesity), but eliminating sedentary behaviour would have at least as great of a positive impact as improving any of these other factors (Dishman et al., 2004). Numerous studies have also documented the positive relationship between increased PA and reduced risks of cerebrovascular disease and stroke (Abbott, Rodriguez, Burchfiel, & Curb, 1994; Hu et al., 2000; Hu et al., 2005; Truelsen, Scharling, Schnohr, & Boysen, 2005).

Cancer

In the U.S., second only to cardiovascular disease in its contribution to mortality is cancer (American Cancer Society, 2003). In Canada, cancer is the leading cause of preventable mortality, and 44% of men and 38% of women will develop cancer in their lifetimes (Canadian Cancer Society, 2006). Each year in Canada, cancer is responsible for approximately 70,000 deaths and 153,000 new cases of cancer are diagnosed (Canadian Cancer Society, 2006). The term cancer describes a family of related diseases characterized by the uncontrolled growth of abnormal cells which usually become a tumour (Dishman et al., 2004). More than 200 types of cancer exist, but four – prostate, breast, colorectal, and lung – account for over half of all cancer deaths in developed countries (Hardman & Stensel, 2003). A wide variety of risk factors exist for

different types of cancers (e.g., smoking, excessive sun exposure), but nearly one-third of annual cancer deaths are attributable to lifestyle choices, including poor nutrition and physical inactivity (American Cancer Society, 2003).

Hundreds of studies have examined the association between PA and cancer (Dishman et al., 2004). Paffenbarger et al.'s (1987) cross-sectional study of Harvard alumni found that men who expended less than 500 kcal per week in PA had a 50% higher risk of being diagnosed with cancer than those who expended 500 kcal or more per week. In a review by Friedenreich and Orenstein (2002), 43 of 51 studies reported that PA was associated with an average reduction in colon cancer risk of 40-50%. A review of 41 studies concluded that PA was similarly associated with a reduction in the risk of breast cancer (Thune & Furberg, 2001). The same review reported that about half of 28 studies conducted around the world showed that leisure-time or occupational PA reduced rates of prostate cancer by 10-70% (Thune & Furberg, 2001). PA, then, is clearly a protective factor for many types of cancer, although work continues to improve understanding of the mechanisms by which this relationship occurs (Hardman & Stensel, 2003).

Osteoporosis

Osteoporosis is a disease of the bones involving low bone mass and deteriorating bone tissue which leads to brittle and more easily fractured bones (Dishman et al., 2004). It affects approximately 10 million people in the U.S., with women comprising approximately 80% of the diagnosed cases (Dishman et al., 2004). In Canada, 1.4 million people suffer from osteoporosis and $1.3 billion is spent treating the disease and the fractures it causes (Osteoporosis Canada, 2006). Moreover, these numbers are expected to rise as the proportion of the population in the older age groups which are disproportionately affected by osteoporosis increases (Hardman & Stensel, 2003).

PA helps to ward off osteoporosis by increasing peak bone mass during adolescence and young adulthood and by slowing bone loss during aging (Dishman et al., 2004). For example, Bailey et al. (1999), Kemper et al. (2000), Lloyd et al. (2000), and Sundberg et al. (2001) all found that, when other factors were controlled for, PA was related to gains in bone mass density in adolescent and young adult cohort samples in Canada, Holland, the U.S., and Sweden, respectively. A number of studies have also examined PA and osteoporosis in post menopausal women, the population most affected by this disease. For example, a meta-analysis by Berard et al. (1997) noted a significant effect of PA on bone mass density in only those articles published after 1991, although more credence should be given to these studies given advances in understanding of how PA affects osteoporosis (Hardman & Stensel, 2003).

Diabetes

The World Health Organization (1998) estimates that 120 to 140 million people suffer from diabetes worldwide and that this number will double by 2025 if current trends of obesity and physical inactivity continue. In Canada, over 2.25 million people are estimated to have diabetes and diabetes is the seventh leading cause of death (Public Health Agency of Canada, 2006). Characterized by a failure of the body to either produce or adequately transport insulin, diabetes can lead to blindness, kidney failure, and amputations, and also increases the risk of coronary heart disease, hypertension, and stroke by two to four times (Dishman et al., 2004). In the U.S., diabetes is the sixth-leading cause of death (Centers for Disease Control and Prevention, 2003) and is growing at rates of approximately 6-8% per year (Mokdad et al., 2001, 2003). Diabetes is particularly problematic among minority groups and older adults (mainly Type 2), but has also become increasingly prevalent in children (mainly Type 1).

Numerous studies have documented an inverse relationship between PA and onset of diabetes. For example, Hu et al.'s (1999) cohort study of over 70,000 female nurses ages 40 to 65 years in 11 U.S. states collected PA data on eight common activities, including walking, over a period of eight years. During that time period, over 1400 cases of diabetes were diagnosed, but a linear reduction in the risk of developing diabetes was observed across the quintiles of PA. From the least active group to the most active group, the risk ratios for developing diabetes were 1.0, 0.84, 0.87, 0.77, and 0.74, respectively, even after adjusting for such factors as age, smoking, alcohol use, hypertension, high cholesterol, and BMI. Another study (Knowler et al., 2002) reported on the U.S. Diabetes Prevention Program, a randomized clinical trial in which more than 3000 overweight adults (45% minority) at medical centres across the U.S. were assigned for three years to one of three groups: low fat diet and exercise (150 min/week) group; ii) treatment drug to reduce blood sugar, and iii) placebo drug plus information about diet and exercise. The rates of diabetes development after three years were 14%, 22%, and 29%, respectively. Other cross-sectional, cohort, and clinical studies have also documented a positive effect of PA on diabetes (Kriska et al., 1994; Manson et al., 1992; Pan et al., 1997; Pereira et al., 1995; Tuomilehto et al., 2001).

Other Health Risk Factors

Much of the benefit of greater PA to reducing the risk of the aforementioned diseases may come from its effect on conditions that are risk factors for those diseases. For example, being overweight or obese has been linked with cardiovascular disease, hypertension, and cancer. By helping to prevent an imbalance of energy intake and expenditure, PA can reduce the risk of becoming overweight. Exercise can also stimulate short-term increases in metabolic rates and can help to build and maintain lean muscle tissue that enhances metabolic rates (Grilo,

1995). Additionally, exercise helps to reduce waist-to-hip ratio and the central or abdominal fat that is most damaging to health (Kahn et al., 1997). Hypertension, or high blood pressure, is also a common risk factor for chronic diseases, but can be significantly reduced by increased PA (Folsom et al., 1990; Kelly & McLellan, 1994)

Mental Health

Finally, in addition to the aforementioned physiological health benefits, PA has also been associated with improved mental and psychological health. Although PA can be detrimental to mental and physical health when carried out to an extreme (e.g., anorexia), both acute and chronic exercise participation can have positive effects on psychological disorders like depression and anxiety (Dishman et al., 2004). Such psychological concerns are as prevalent and problematic as the diseases outlined in the previous sections. For example, the World Health Organization projects that depression will be second only to cardiovascular disease as the world's leading cause of death and disability by 2020 (Murray & Lopez, 1997). Several reviews and meta-analyses have reported that depression and exercise are inversely associated in epidemiological studies and that exercise interventions are frequently successful in reducing depression (Craft & Landers, 1998; Lawlor & Hopker, 2001; Morgan, 1994). Hypothesized mechanisms by which PA positively impacts mental health include both psychological explanations (e.g., distraction, enhanced self-efficacy) and physiological explanations (e.g., elevated endorphins, improved sleep) (Dishman et al., 2004; Paluska & Schwenk, 2000).

Physical Activity Recommendations

Given the several and significant health benefits that have been attributed to increased PA levels, much attention has been devoted to developing clear guidelines for the public about the recommended types and quantity of PA. Many statements have been forwarded by a variety of

professional associations and government agencies, but only a few of the most influential are reviewed here.

The American College of Sports Medicine's (ACSM) 1978 "Position statement on the recommended quantity and quality of exercise for developing and maintaining fitness in healthy adults" was the first formal document to prescribe a preferred type and level of PA (Hardman & Stensel, 2003). The recommendation was to engage in continuous aerobic activity on 3-5 days per week at an intensity level of 50-80% of maximal oxygen uptake (or 60-90% of maximal heart rate) for 15-60 minutes per session. Most of the position statements that followed from various agencies over the next decade-and-a-half were based on the same data and were therefore similar to that put forth by the ACSM (USDHHS, 1996).

These guidelines were based primarily on studies investigating the amount of activity (primarily vigorous exercise) necessary to maintain or improve cardiovascular *fitness*. However, epidemiological research in the last quarter of the 20th century strongly suggested that even moderate physical activities could confer significant health benefits, especially to previously sedentary people (USDHHS, 1996). Pate et al.'s (1995) landmark article, a joint statement from the Centers for Disease Control and Prevention and the American College of Sports Medicine, reflected this altered emphasis toward moderate-intensity activity. The result of a workshop involving twenty physical activity experts was the recommendation that "every … adult should accumulate 30 minutes or more of moderate-intensity physical activity on most, preferably all, days of the week" (Pate et al., 1995, p. 404). Further, based on evidence that intermittent PA confers similar health benefits, they also stipulated that the 30 minutes of daily activity could be accumulated in intervals as short as 8-10 minutes each. With these two changes, it was explicitly

hoped that this guideline would be both more appealing and more practical for a greater percentage of the population (Pate et al., 1995).

In turn, the CDC/ACSM guidelines have been integrated into the position statements related to PA of numerous other health agencies (Welk, 2002a). For example, Canada's Physical Activity Guide (Public Health Agency of Canada, 2005) suggests starting with 60 or more minutes of light activities (e.g., light walking, stretching) and progressing toward 30-60 minutes of moderate or vigorous activity per day. Ontario's *Active 2010* strategy lists one of its goals as "to increase to 55 percent by 2010 the number of adults … who will walk a minimum of 30 minutes daily (or participate in some other equivalent activity) (Ontario Ministry of Health Promotion, 2005, p. 27). The 1996 report on PA from the Surgeon General in the U.S. states that "people of all ages, both male and female, benefit from regular physical activity. Significant health benefits can be obtained by including a moderate amount of physical activity (e.g., 30 minutes of brisk walking or raking leaves) on most, if not all days of the week" (USDHHS, 1996, p. 4). Finally, *Healthy People 2010*, the U.S. federal strategy on disease prevention and health promotion, lists 15 specific objectives related to physical activity (USDHHS, 2000). One of these is to increase the proportion of adults who engage in at least 30 minutes of *moderate-intensity* PA on five or more days per week, while another aims to increase the proportion of adults who engage in *vigorous* PA that promotes fitness three or more days per week for at least 20 minutes. Whether participants meet recommended PA levels appears prominently as a dichotomous, dependent variable in epidemiological PA research, and a combination of these two latter guidelines is most often the criterion used to make that assessment. Most PA recommendations/policies also note that the health benefits of exercise increase with more

vigorous or more frequent activity or activity of a greater duration, and that individuals with low levels of PA will benefit most from increases in activity levels (USDHHS, 1996).

Most of the aforementioned PA recommendations refer to different intensities of PA, and physical activities are often classified into light, moderate, and vigorous categories. Light activities are often described as requiring less than 3 metabolic equivalents (METS) of energy expenditure, while moderate and vigorous activities require 3-6, and greater than 6 METS, respectively (Pate et al., 1995). "One MET is considered to represent resting energy expenditure, or approximately 3.5 ml/kg/min in terms of oxygen consumption. Because progressively more vigorous forms of activity require proportional increases in oxygen consumption, activities can be quantified in terms of multiples of this resting oxygen consumption" (Welk, 2002a, p. 4). Indeed, Ainsworth et al. (1993) presented a "Compendium of Physical Activities" that provided MET intensity levels for almost 500 individual activities. According to Ainsworth et al. (2000), the Compendium "was developed to facilitate the coding of physical activities obtained from PA records, logs, and surveys and to promote comparison of coded PA intensity levels across observational studies" (p. 498). MET levels for activities were derived from compiled lists and individual studies describing the energy cost of various physical activities (Ainsworth et al., 1993, 2000). In 2000, the Compendium was updated with the addition of two new categories and 129 new activities. The revised version now contains a total of 21 major headings and 605 specific activities. However, in response to some critiques that the absolute MET intensities may not be accurate for people of different body mass and body fat percentage, the authors note the following cautions:

> It should be emphasized that the Compendium was developed to facilitate the coding of PAs and to compare coding across studies. It does not take into account individual differences that may alter the energy cost of movement. Thus, a correction factor may be needed to adjust for individual differences when

> estimating the energy cost of PA in individuals; but no such correction is available at this time (Ainsworth et al., 2000, p. 502).

Despite these concerns, the Compendium is used widely to translate varied activity data into more comparable energy expenditure summaries.

In summary, PA has been shown to have a number of health benefits. Consequently, epidemiologists and other researchers from a wide variety of fields have become involved with understanding the determinants and outcomes of PA. Their involvement has been facilitated by progressive public health recommendations that recognize the importance of all types and intensities of PA, and by the development of tools and protocols which permit relatively simple collection and interpretation of PA data. Based on this research, the following sections discuss a plethora of factors that have been shown to be associated with adults' participation in PA.

Factors Affecting Physical Activity

Although diverse labels have been employed to categorize factors related to PA, this review is divided into major sections addressing personal, psychosocial, and environmental factors. Personal factors include biological and socio-demographic characteristics of the study participants. Psychosocial variables to be studied include several key constructs emanating from Social Cognitive Theory and the Transtheoretical Model that have been investigated widely in relation to PA. Finally, environmental variables included in this study relate to characteristics of the built environment, including parks and recreation amenities, that have received more recent attention with respect to their association with PA.

Personal Factors

For their book, *Physical Activity and Behavioral Medicine*, Sallis and Owen (1999) built upon previous reviews (Dishman, 1990; Dishman & Sallis, 1994; Dishman, Sallis & Orenstein,

1985; Sallis & Hovell, 1990) in summarizing approximately 300 studies up to 1998 that listed determinants or correlates of PA in adult samples. In what appears to be the most recent and comprehensive review of PA correlates among adults, Trost, Owen, Bauman, Sallis, and Brown (2002) updated Sallis and Owen's review by adding 38 new studies published between 1998 and 2000. In both of these publications, each of almost 100 factors are given one of six ratings ranging from a "repeatedly documented positive association with PA" to a "repeatedly documented negative association with PA". Finally, Sallis, Prochaska, and Taylor (2000) used a similar format in reviewing correlates of PA separately for children and adolescents. The associations for selected correlates within the "demographic and biological factors" sections of the more recent Trost et al. (2002) and Sallis et al. (2000) reviews are reproduced in Table 1 and discussed briefly below.

Age and sex are two of the most commonly-investigated variables and are the two most consistent correlates of PA in adults (Trost et al., 2002). As Hardman and Stensel (2003) state, two features of data on PA are common to most developed countries: i) a rapid decline with increasing age, and ii) higher levels of activity in men than women. Similarly, factors such as socioeconomic status and educational attainment are also consistently related to PA in that adults with greater incomes and/or education generally engage in higher levels of activity (Trost et al., 2002). In contrast, people from racial or ethnic minority groups frequently report lower levels of PA participation. Being married has a weak negative association with PA, while the single study reviewed by Trost et al. that examined being childless showed a positive association with PA for a sample of women (Sternfeld, Ainsworth, & Quesenberry, 1999). Finally, physical factors such as being overweight or obese negatively impact PA, while having a history of injury was found

to actually positively impact PA in the single study that examined this variable (Simonsick, Guralnik, & Fried, 1999).

Table 1
*Associations with Physical Activity for Selected Demographic and Biological Factors**

Demographic or Biological Factor	Adults[1]	Children[2]	Adolescents[2]
Age	--	??	--
Sex (Male)	++	++	++
Income/SES	++	00	00
Education	++		
Blue-collar occupation	-		
Marital status	-		
Childless	+		
Race/ethnicity (non-white)	--		
Ethnicity (EuroAm)		??	++
Overweight/obesity	--		
Body mass index		??	00
Parent overweight		+	
Injury history	+		

Table 1 Notes:
1. Associations taken from review by Trost et al. (2002).
2. Associations taken from review by Sallis et al. (2000). Children refers to studies of ages 4-12. Adolescents refers to studies of ages 13-18.
* Legend for association codes in table columns is as follows: ++, repeatedly documented positive association with PA; +, weak or mixed evidence of positive association with PA; 00, repeatedly documented lack of association with PA; ??, indeterminate association with PA; --, repeatedly documented negative association with PA; -, weak or mixed evidence of negative association with PA

In samples of both children (4-12) and adolescents (13-18), studies again consistently show that males exhibit higher levels of PA than females. In Sallis, Prochaska, and Taylor's (2000) review, 25 out of 31 studies of children and 27 out of 28 studies of adolescents reported that boys were more active than girls. Further, similar to adults, age was negatively related to PA in 70% of the adolescent studies reviewed by Sallis et al. However, amongst children, the negative relationships between age and PA were less consistent, with less than half (9 out of 19) of the studies reviewed showing a significant relationship. Similarly, many studies looked at

body mass index (BMI) in children, but approximately half reported negative associations with PA while the other half reported no association, resulting in an "indeterminate" classification by Sallis et al. The proportion of adolescent studies reporting that BMI was unrelated to PA was much greater (6 out of 21), resulting in a classification of "repeatedly documented lack of association" by the authors. Finally, for adolescents, being a non-minority status was associated with greater levels of PA, which was similar to the race/ethnicity conclusion for adults.

In summary, then, age, gender, socio-economic status, and race/ethnicity are some of the most consistent correlates of PA. These conclusions are supported by surveillance data (Centers for Disease Control and Prevention, 2005a) A few other personal factors and behaviours (e.g., smoking) that are related to PA will also be measured in this study and are discussed briefly in Chapter Three.

Psychosocial Factors

Self-Efficacy

Of all the constructs associated with physical activity, likely the most widely studied is self-efficacy (McAuley, Pena & Jerome, 2001). Originally described by Bandura (1977, 1986), self-efficacy can be defined as an "individual's beliefs in his or her abilities to execute necessary courses of action to satisfy situational demands" (McCauley et al., 2001, p. 236). It is often hypothesized to be a strong influence on behaviour because higher levels of self-efficacy are related to a propensity to undertake more challenging tasks, to expend more effort in pursuit of goals, and to demonstrate greater resilience in the face of aversive stimuli (Bandura, 1986). Self-efficacy can influence physical health in either of two ways: i) through the adoption of healthy behaviours, the cessation of unhealthy behaviours, or persistence with positive behaviours when challenges are encountered, and/or ii) by influencing biological and physiological processes that

are related to health behaviour, such as stress and perceived control (Maddux & Gosselin, 2003). PA participants who report higher levels of self-efficacy expend greater effort in attaining health-promoting levels of PA (Ewart et al., 1983) and are more likely to persist with PA in the face of obstacles and setbacks (McCauley, Lox & Duncan, 1993).

Self-efficacy is distinguished from the dispositional traits of self-esteem, self-worth, and self-confidence by its focus on a person's belief in an ability to accomplish a specific task, as opposed to being an aggregated self-perception that might span multiple situations (McAuley et al., 2001). Self-efficacy beliefs for performing a particular behaviour are further differentiated from intentions to perform the behaviour, predictions about whether one will perform the behaviour, expected outcomes from the behaviour, and perceived control over performing the behaviour (Maddux & Gosselin, 2003).

Conceptualizing self-efficacy is important not only from a definitional standpoint, but also for the purposes of measuring self-efficacy. Despite Bandura's contention that efficacy measures should be relevant to particular behaviours, self-efficacy has frequently been assessed as a global, trait-like construct in PA research (McCauley et al., 2001). However, increasing the specificity of the domain or situational referent in self-efficacy measurements improves the predictive power of these measurements (Maddux & Gosselin, 2003; McCauley & Mihalko, 1998). For example, rather than asking about a participant's ability to attend an aerobics class in the face of obstacles, a PA researcher would be better off to specify relevant obstacles (e.g. lack of child care, bad weather, etc.) and measure self-efficacy for overcoming those particular barriers. Similarly, self-efficacy usually refers to the actions necessary to achieve a goal, not one's belief in an ability to obtain the goal itself (Maddux & Gosselin, 2003). For example, we

may ask about a person's capacity to take a half-hour walk each day, but not his or her self-efficacy for achieving PA levels that are sufficient to provide health benefits.

Some confusion has arisen surrounding definitional issues as a result of more recent discussions of the scope of self-efficacy beliefs. Bandura originally defined self-efficacy as "the conviction that one can successfully execute the behaviour required to produce the outcomes" (Bandura, 1977, p. 193), but more recently introduced the term self-regulatory efficacy as the ability to "organize and execute the courses of action required to produce given attainments" (Bandura, 1997, p. 3). These two forms of self-efficacy are similar to what Kirsch (1995) termed *task* self-efficacy and *coping* self-efficacy, respectively. The former refers simply to performing the behaviour itself, while the latter broadens the construct to include one's ability to prevent, control, or cope with adverse circumstances encountered in performing the behaviour (Maddux, 1995). Although it has been argued that different types of self-efficacy do not exist in these constructs, but rather only the referent has changed (Maddux & Gosselin, 2003), many researchers in the field of PA and elsewhere have measured them separately.

Indeed, in reviewing 85 studies in the PA literature that employed 100 self-efficacy measures, McAuley and Mihalko (1998) summarized the different measures into six categories: i) exercise efficacy, ii) barriers efficacy, iii) disease-specific/health behaviour efficacy, iv) perceived behavioural control, v) general efficacy, and vi) other. Exercise efficacy (34%) and barriers efficacy (30%) were the mostly widely used and correspond closely to the categories of task and self-regulatory (coping) efficacy described above. Exercise efficacy measures "are directed at the assessment of beliefs in subjects' "capabilities to successfully engage in incremental bouts of PA" (p. 373). A series of scales might ask about a participant's confidence to engage in vigorous PA for increasing lengths of time, climaxing with the PA goal (e.g., 30

minutes on most days of the week). Measures of barriers efficacy "typically assess beliefs in capabilities to overcome social, personal, and environmental barriers to exercising" (p. 373). Particular barriers items vary somewhat from study to study, but many are consistent across the PA research they reviewed (McAuley & Mihalko, 1998). Finally, McAuley and Mihalko (1998) noted that studies predicting exercise behaviour should include some measure of both exercise performance (task) efficacy and barriers (coping) efficacy, while other aspects of self-efficacy require further investigation to assess their utility. Further discussion of self-efficacy measurement is included in Chapter Three.

As mentioned above, self-efficacy has been widely studied as an influence on PA and exercise. In their review of correlates of PA for children (3-12 years) and adolescents (13-18 years), Sallis et al. (2000) found mixed findings among the studies that examined self-efficacy. For children, the associations between self-efficacy and PA were positive and significant in four of the nine analyses that their searches uncovered. For adolescents, 7 of 13 reported associations between the self-efficacy and PA measures that were employed were positive and significant. Sallis and Owen's (1999) review of PA determinants in adults reported "a repeatedly documented positive association" between self-efficacy and PA (their strongest classification). In their update of that review, Trost et al. (2002) added that, of the psychological, cognitive, and emotional factors, "self-efficacy emerged as the most consistent correlate of physical activity behaviour" (p. 1998). Marquez, McAuley and Overman (2004) reviewed 20 studies that examined PA influences amongst Latino samples. Self-efficacy was the most commonly reported psychological correlate or outcome of PA, and although they did not provide any type of quantitative summary, the authors concluded that "self-efficacy appears to be an important

correlate and outcome of physical activity … [and] those Latinos with higher levels of self-efficacy are more likely to exercise" (p. 214).

The findings of the aforementioned reviews suggest that self-efficacy is an important moderator of PA behaviour. In leisure-related journals, self-efficacy has sometimes been studied, but most often as it relates to outdoor recreation, therapeutic recreation, or leisure education contexts (e.g., Bergin, 1992; Hoff & Ellis, 1992; Maughan & Ellis, 1991; Propst & Koesler, 1998; Sibthorp, 2003). One recent study, however, concluded that self-efficacy had the largest total effect (compared with peer support, family support, and gender) on the amount of physically active leisure engaged in by college students (Sylvia-Bobiak & Caldwell, 2006). In other PA research, self-efficacy demonstrated the strongest correlation (.48) with vigorous exercise out of 25 potential determinants in a community sample of adults in San Diego (Sallis et al., 1989). Further, a study of more than one thousand Toronto high school students found that self-efficacy for overcoming external barriers (e.g., lack of programs) was unrelated to engaging in vigorous physical exercise during physical education classes, but was a significant predictor of vigorous exercise both in non-physical education school activities and outside of school (Allison, Dwyer & Makin, 1999). However, self-efficacy for overcoming internal barriers (e.g., fear of injury) was not related to vigorous exercise performed in any of the three settings. In another adolescent sample, self-efficacy was a significant predictor of both moderate and vigorous PA (Winters, Petosa & Charlton, 2003). Finally, over the course of several studies, Brawley and colleagues have highlighted the influence of self-efficacy in understanding PA within a variety of other populations, including individuals with fibromyalgia (Culos-Reed & Brawley, 2003), post myocardial infarction patients (Woodgate, Brawley & Weston, 2005), and fitness club or class participants (Dawson & Brawley, 2000; DuCharme & Brawley, 1995; Gyurcsik &

Brawley, 2001). These are but a few examples of studies that have examined the relationship between PA and self-efficacy, most of which have reported strong associations between the two variables.

Though far less common, intervention (e.g., McAuley, Courneya, Rudolph & Lox, 1994; McAuley, Talbot & Martinez, 1999) and prospective/longitudinal studies (e.g., Sallis, Hovell, Hofstetter & Barrington, 1992) have also demonstrated that increases in self-efficacy are related to increases in PA, and that both acute and chronic PA participation can translate into higher levels of self-efficacy (e.g., McAuley, Katula et al., 1999; Scherer & Schmieder, 1997; Toshima et al., 1990). This mutually-reinforcing relationship is likely explained by higher initial levels of self-efficacy reducing task anxiety and increasing task persistence and effort, with the resultant successes in PA participation improving exercise-related self-efficacy (McAuley et al., 2001). As a potential manifestation of these phenomena, studies that have looked at self-efficacy levels over the different stages of exercise adoption (see Stages of Change section below) have found that participants who have progressed to later stages of established exercise patterns report higher levels of self-efficacy (e.g., Marcus & Owen, 1992; Cardinal, 1997). Overall then, self-efficacy has proven to be a useful psychological construct in understanding PA behaviour. The following sections examine other intra- and interpersonal variables that have commonly been studied in association with PA.

Social Support

Social support, which is commonly defined as "any behavior that assists another person in achieving desired goals" (Caplan et al., 1976 as cited in Taylor, Baranowski, & Sallis, 1994, p. 319), is another variable that has frequently been studied in exercise or PA research, especially that which focuses on intra- and interpersonal factors. Social support for PA can come from

several sources, including family (parents and siblings), friends, peers, and co-workers, and can take several forms. With respect to form, support may be instrumental, informational, emotional, or modelling (Duncan, Duncan, & Strycker, 2005). Instrumental support can involve an offer to participate in the activity with the person being supported or assistance with fees, transportation, or other auxiliary concerns. Informational support may include sharing knowledge about benefits of or opportunities for PA. Emotional support encompasses encouragement and interest in the person engaging in PA. Finally, social support for exercise and PA can also occur through seeing another person model exercise participation and an overall active lifestyle.

In reviews of PA correlates, social support from a variety of sources has been found to be positively related to PA. Sallis and Owen (1999) concluded that social support from friends/peers had a weak positive association with PA in supervised programs and a repeatedly documented positive association with overall PA. They also reported that social support from spouse/family had a repeatedly documented positive association with both categories of PA measures. In their update of that review, Trost et al. (2002) concurred with the repeatedly documented association between both sources of social support and overall PA. Finally, Sallis et al.'s (2000) review of PA correlates in child and adolescent studies provided summarized associations for several variables related to parents' influence on PA. The parent(s)' PA level was the variable examined most frequently and was found to be a significant correlate of child PA in 11 of 29 studies and 9 of 27 studies with adolescents. All of the other social factors they reviewed, including parental encouragement, transportation, and payment of fees were classified as having either a weak, indeterminate, or no association with children's and adolescents' PA.

As mentioned above, several different sources and forms of social support have been examined, although most studies have agglomerated the different forms (e.g., emotional) of

support within scales that address each source (e.g., family) of support. Brief examples of associations between various sources of social support and PA are described here. In a study of older adults in Colorado, Orsega-Smith, Payne, and Godbey (2003) measured social support from both family (household members) and friends (acquaintances and co-workers) using the Social Support for Exercise scale (Sallis, Grossman, Pinski, Patterson & Nader, 1987) that has frequently been employed in PA research. In examining the outcome variable of recreation centre usage, they reported that social support from family increased progressively from the low (less than once per week) to moderate (1-3 times per week) to high (4 or more times per week) participation groups. Social support from friends was lower for the moderate participation group, but similar for the low and high participation groups.

Rovniak et al. (2002) used only the 5-item Friend Support for Exercise Habits sub-scale from the same source as described above (Sallis et al., 1987). In their study of university students, they specified a structural equation model in which social support predicted self-efficacy, which in turn predicted PA (in addition to other predictors of PA). Their analysis concluded that social support exhibited a moderate total effect on PA which was mediated entirely by self-efficacy, and that higher levels of social support led to higher levels of self-efficacy. Leslie et al. (1999) employed two three-item scales that asked about the frequency (i.e., never to very often) of family and friends exercising with you, offering to exercise with you, and encouraging you to exercise. In both male and female college students, having high social support from both family and friends was significantly related to being classified as sufficiently active (>800 kcal/week). In a study of adults in San Diego, the same two three-items scales were used by Sallis et al. (1989), along with a two-item modelling scale that assessed the number of adults in the home and close friends who exercise regularly. In their regression analysis that

included numerous personal, interpersonal, and environmental variables, modelling and support from friends were significant predictors of the number of vigorous exercise sessions per week, but support from family was not. In examining the significant predictors by gender and age, significant associations were observed for modelling in younger (18-49 years) women and both younger and older (50+ years) men, while support from friends was a significant predictor for younger men and older women.

Finally, several intervention studies have featured social support as a key (or solitary) variable for increasing PA (e.g., Dunn et al., 1999; Peterson, Yates, Atwood, & Hertzog, 2005; Toobert, Glasgow, Nettekoven, & Brown, 1998). The impact of social support programs on PA was further supported in a review of PA interventions conducted by the Task Force on Community Preventive Services (Kahn et al., 2002). In summary, the influence of support from family, friends, and others has been studied frequently, especially in research that adopts a social cognitive perspective to analyze exercise and PA participation. The results of most of the studies and reviews described above uphold the premise that social support is an important influence on PA.

Stages of Change

Many PA researchers have found Proschaka and DiClemente's (1982, 1983) "stages of change" framework useful in understanding individuals' progression into regular PA or exercise. The stages of change (SOC) categories were originally developed as part of the Transtheoretical Model (TTM), which "uses stages of change to integrate processes and principles of change from across major theories of [behaviour change] intervention" (Proschaka, Redding, & Evers, 2002, p. 99). The TTM includes five stages of behaviour change (described below) and ten processes of change that people use to advance through the stages (e.g., consciousness-raising, self-

liberation, reinforcement management). As its name implies, the TTM draws upon major behavioural theories in formulating the processes of change. For example, social cognitive theory (e.g., self-efficacy) and the theory of reasoned action/behaviour (e.g., pros and cons) are both saliently reflected in the TTM (Sallis & Owen, 1999).

The SOC framework aims to classify people who are attempting to a change a behaviour into one of five categories. It was originally developed as a way to distinguish between people at different stages of smoking cessation. Based on data from self-changing smokers, Proschaka and DiClemente (1982, 1983) recognized that behaviour change occurs through a series of stages as opposed to being a finite event. For example, people who do not intend to begin exercising in the next six months would be classified as being in the *precontemplation* stage (Marcus et al., 1994; Proschaka et al., 2002). *Contemplators* intend to change their behaviour in the next six months, while those in the *preparation* stage plan to do so in the immediate future, usually measured as the next month (Proschaka et al., 2002). The *action* stage includes those who "have made specific overt modifications to their lifestyles within the past six months" (Proschaka et al., 2002, p. 102). Finally, the *maintenance* stage, in which people have established regular exercise patterns, is usually operationalized by respondents having adopted the behaviour change for greater than six months. A sixth phase call *termination* was included in the model and is characterized by total self-efficacy and a complete lack of temptation to abandon the healthy behaviour. However, this stage is rarely used or studied in research involving the TTM, perhaps because it is an unrealistic goal (Proschaka et al., 2002).

Although many SOC studies have been published in the smoking cessation literature, researchers from several other fields have also adopted the SOC model and algorithm to understand the fluidity of the behaviour change process and its relationships with other health

risk behaviours across the various stages (e.g., Glanz et al, 1998; Rakowski et al, 1996; Rosen, 2000; Schneider Jamner, Wolitski & Corby, 1997). For example, studies that collected SOC data for either smoking or PA while examining particular actions (but not stages) associated with the other behaviour have shown relatively strong associations between SOC and either smoking or PA actions (Boyle, O'Connor, Pronk & Tan, 2000; Costakis, Dunnagan & Haynes, 1999). However, research that has concurrently examined smoking and exercise change patterns suggests that SOC for adopting exercise and SOC for quitting smoking are mostly unrelated (Boudreaux, Francis, Taylor, Scarinci, & Brantley, 2003; Garrett et al., 2004; Kaczynski, Manske, Mannell & Grewal, in press).

In the PA literature, Marcus and colleagues have conducted several studies investigating the utility of the TTM's constructs in understanding and predicting exercise adoption and adherence. For example, Marcus and Simkin (1993) found that the stages of exercise adoption algorithm possessed concurrent validity with actual PA behaviours. In their sample of 235 employees, scores on a seven-day PA recall questionnaire significantly differentiated people among the different stages. Other research has suggested that stage of exercise adoption is also highly related to self-efficacy for exercise (Marcus & Owen, 1992; Marcus, Selby, Niaura & Rossi, 1992) and decisional balance (i.e., pros/cons) measures for exercise (Marcus & Owen, 1992; Marcus, Rakowski & Rossi, 1992). Further, similar to that which was found for addictive behaviours (Proschaka & DiClemente, 1983), people in later stages of PA adoption reported significantly greater use of the ten processes of change proposed by the TTM in both cross-sectional (Marcus, Rossi, Selby, Niaura & Abrams, 1992) and longitudinal (Marcus, Simkin, Rossi & Pinto, 1996) studies. Additionally, Berry, Naylor and Wharf-Higgins (2005) reported that self-efficacy was a strong predictor of stage classification for 15-17 year olds, but decisional

balance scores were not. Nevertheless, taken together, these studies suggest that the stages of change framework has shown good validity and utility in investigating PA behaviour.

Decisional Balance

In addition to self-efficacy and the stages and processes of change described above, decisional balance is another core construct within the Transtheoretical Model (Prochaska & Marcus, 1994). The idea of decisional balance is based on the notion that people's propensity to undertake a behaviour (change) is a function of how they perceive the pros and cons of the behaviour. For example, in the most widely used decisional balance measure (Marcus, Rakowski, & Rossi, 1992), respondents are asked to rate the importance of statements such as "I would feel less stressed if I exercised regularly" (a pro statement) and "I would have less time for my family and friends if I exercised regularly" (a con statement). Summary scores of both pros and cons measures are often related to other variables (e.g., level of PA participation), or a decisional balance score can be computed to represent the difference between (or weighting of) the pros and cons of the behaviour.

Janis and Mann (1977) originally developed the idea of a decisional balance sheet. They proposed that decision-making involves balancing eight factors: instrumental benefits to self; instrumental benefits to significant others; instrumental costs to self; instrumental costs to significant others; approval from self; approval from significant others; disapproval from self; and disapproval from significant others. As is described in Chapter Three, Marcus, Rakowski & Rossi (1992) built on the work of Velicer, DiClemente, Prochaska, and Brandenburg (1985) in translating decisional balance measures from smoking cessation research for use in exercise adoption research. Although Velicer et al. had found only two factors (pros and cons) in developing their decisional balance for smoking research, Marcus et al. initially developed over

70 statements to cover all eight decisional categories described above that had been proposed by Janis and Mann. However, their final instrument consisted of 16 items which, after expert reviews and factor analyses, again represented only the two factors of pros (10 items) and cons (6 items) (Marcus et al.).

The decisional balance construct has been used to investigate a wide variety of health concerns (e.g., Christie et al., 2005; de Vet, de Nooijer, de Vries, & Brug, 2005; Share, McCrady, & Epstein, 2004). In examining twelve problem behaviours (e.g., exercising, quitting drugs, using sunscreen), Prochaska, Velicer, et al. (1994) reported that for all twelve samples, people in the precontemplation stage perceived that the cons of improving the behaviour outweighed the pros. The opposite was true for people in the later action stage in 11 out of the 12 samples. In reviews of determinants and correlates for PA by Sallis and Owen (1999) and Trost et al. (2002), decisional balance was given their second highest rating of association with PA ("weak or mixed evidence of a positive association with PA"). Wilcox, Bopp, Oberrecht, Kammermann, and McElmurray (2003) observed that, of the many different types of variables investigated in their study, decisional balance (pros minus cons) scores had one of the highest correlations with a summary PA score for their sample of women over age 50. However, in another sample of older women, decisional balance variables were not significant predictors of days of moderate exercise in the past month at both the 3-month and 12-month points of an exercise program intervention (Litt, Kleppinger, & Judge, 2002).

Many other studies have examined the relationship between pros and cons and stage of change for PA. For example, Carmack Taylor, Boudreaux, Jeffries, Scarinci, and Brantley (2003) reported that analysis of variance post-hoc tests showed that for a sample of adult primary-care patients in Louisiana, respondents in the precontemplation stage for exercise adoption appraised

the pros of exercise as less important than did respondents in all four other stages of change. Similarly significant results were observed for the cons of exercise, with contemplators rating the cons as more important than those in the maintenance stage. Using decisional balance (pros minus cons), Cox, Stimpson, Poole, and Lambur (2003) found that in their sample of Virginia adults, scores were significantly lower for people in the precontemplation and contemplation stages and significantly higher amongst those in the maintenance stage. Several other studies have shown the ability of decisional balance constructs to differentiate people who engage in different levels of PA and/or who are at different stages of exercise adoption (e.g., Berry et al., 2005; Clarke & Eves, 1997; Cloutier Laffrey & Shin Lee, 2005; Marcus, Rakowski, & Rossi, 1992; Nigg & Courneya, 1998).

Environmental Factors

As was discussed in Chapter One, growing emphasis has been placed on identifying environmental factors that may be related to community PA levels. The initial section below describes several characteristics of the built environment, with a subsequent section dedicated solely to how parks and recreation amenities have been examined in relation to PA.

Built Environment

A wide variety of factors in the built environment have been investigated in relation to PA over the past decade. Many of these have been summarized in reviews mentioned above by Humpel et al. (2002), McCormack et al. (2004), Owen et al. (2004), Saelens, Sallis, and Frank (2003), and Sallis et al. (1998). The following paragraphs provide a brief summary of research on planning and transportation variables, access to facilities, safety, aesthetics, and weather.

Researchers, professionals, and activists in the fields of transportation and planning have long had an interest in issues related to PA, especially that which is engaged in for

transportational purposes (Frank, 2000). The 3D model – density, diversity, and design – has frequently been used as a framework to conceptualize the built environment in those disciplines (Cervero & Kockelman, 1997). Density refers to the ideas that higher residential densities promote greater ease and opportunities for social interaction, and that large lot sizes in more-dispersed residential communities mean greater distances must be travelled in the course of transportational PA. The idea of diversity suggests that people will be more active when their neighbourhoods contain mixed land uses, including residential, commercial, office, and public purposes. Design describes the characteristics of streets and sidewalks that are conducive to PA. In particular, the idea of connectivity is important, such that streets (and their related sidewalks) which are laid-out in a grid-like pattern permit more direct travel and more diverse routes to be taken each time than curvilinear streets and neighbourhoods with many cul-de-sacs (Saelens, Sallis, & Frank, 2003).

These factors have been found to be some of the strongest and most consistent environmental correlates of PA. For example, a joint review by the Transportation Research Board and the Institute of Medicine (2005) in the U.S. concluded that walking and cycling for utilitarian purposes was generally higher in the presence of mixed land uses, greater street connectivity, and higher population densities. Similarly, Saelens, Sallis, and Frank (2003) undertook a review of transportation studies that had examined the relationship between neighbourhood environment and non-motorized transport (walking or cycling). One of their findings was that residents in high-walkable neighbourhoods (i.e., those with high population density, a good mixture of land use, and high connectivity) reported approximately twice as many walking trips per week (3.1 vs. 1.4) than persons in low-walkable neighbourhoods. They also described several studies in which walking and cycling infrastructure (e.g., sidewalk

continuity; existence of bike paths) was positively related to active transportation outcomes (e.g., Cervero & Kockelman, 1997; Hess, Vernez Moudon, Snyder, & Stanilov, 1999; Kitamura, Mokhtarian, & Laidet, 1997).

A second broad category of environmental variables that is frequently examined in connection with PA relates to access to facilities. Notably, many of these variables are similar to those discussed in the following section on parks and recreation amenities (given that the "facilities" referred to in such survey questions are often implicitly or explicitly recreation facilities or parks). For example, Sallis et al.'s (2000) review of correlates of PA in children and adolescents found that access to recreational facilities and programs was consistently related to PA in these younger age groups. Humpel et al.'s (2002) review of the PA and built environment literature up to and including 2001 (19 studies) uncovered a wide array of variables which they classified under the headings of 'accessibility of facilities' (e.g., busy street to cross; shops within walking distance) and 'opportunities for activity' (e.g., awareness of facilities, coastal residence). For both categories, almost all of the variables examined in the studies they reviewed were positively and significantly related to various PA outcomes. Similarly, in McCormack et al.'s (2004) review of articles published since 2000, a variety of both perceived and objectively-measured variables related to 'destinations' (e.g., existence of and distance to facilities) were associated with both walking and overall physical activity in numerous studies. Finally, Owen et al. (2004) specifically reviewed studies examining environmental correlates of walking. They reported that a broad range of variables related to convenient and proximal facilities and destinations were positively related to increased walking for both transportation and exercise or recreation.

Variables related to safety comprise another category of environmental variables that have often been studied in relation to PA. Environmental safety issues include those related to crime, traffic, and sources of injury (e.g., unattended dogs, cracked sidewalks, etc.). In Humpel et al.'s (2002) review, few of the studies that included safety items demonstrated significant associations with PA. However, traffic concerns were a deterrent of walking for both transportation and recreation in Owen et al.'s (2004) review article.

Aesthetics is another category of variables which have been linked with PA. Elements of the environment which contribute to aesthetic appeal include pleasant and well-maintained scenery (e.g., trees, gardens), diverse and pleasing views, interesting architecture, and low levels of pollution and refuse (Pikora et al., 2003). Six out of seven studies reviewed by Humpel et al. (2002) reported some significant and positive associations between various measures of aesthetics and PA. As well, walking for recreation was consistently associated with perceptions of neighbourhood aesthetics in Owen et al.'s (2004) review of variables associated with walking. Similarly, McCormack et al.'s (2004) review reported that *perceptions* of environmental aesthetics were significantly associated with walking behaviour in most of the studies they examined, but only rarely did *objective* ratings of environmental appeal show positive correlations with walking behaviour. Perceptions of aesthetic appeal were also frequently related to other more general measures of PA (McCormack et al., 2004).

Finally, weather is an environmental variable which may significantly impact opportunities for PA participation. However, Humpel et al. (2002) retrieved only two studies that included weather as an environmental predictor of PA and reported that in neither study were the associations significant. Similarly, Owen et al. (2004) found only one other study and weather was not associated with walking for exercise or recreation or walking to get to and from places.

In general, despite its intuitively important influence on PA patterns, weather has not been prominently studied as an environmental predictor of PA.

In summary, this section has presented an overview of the wide variety of factors in the built environment that are linked to PA. The final section of the literature review provides a relatively exhaustive summary of one last category of environmental variables that have been studied in relation to PA participation.

Parks and Recreation Amenities

Even a cursory examination of the built environment literature reveals that parks and recreation amenities may be important features of the community for promoting PA. However, given that much of the emphasis in the present study is on the characteristics and types of parks and recreation amenities that are related to PA, a comprehensive review was conducted of the ways parks and recreation variables have been conceptualized and studied in this body of research. Systematic efforts were undertaken to identify peer-reviewed journal articles that reported an empirical relationship between parks or recreation amenities as features of the built environment and PA (Kaczynski & Henderson, in press). A brief summary of the methodology for these searches is provided below and a table listing the 50 studies that were found and a discussion of the reported relationships follow. This section then concludes with a description of the limited conceptual discussion of parks and recreation amenities that has been featured in the literature describing environmental influences on PA.

In December 2005, searches were conducted within four major databases – PsycInfo, PubMed, LeisureTourism Abstracts, and Web of Science – using search terms tailored to each

database[1]. Only articles printed in English were requested and the date range for articles was delimited to the period from 1998 to 2005. 1998 was considered a reasonable starting point for identifying research related to the built environment and physical activity for several reasons. For example, Sallis, Linton and Kraft (2005) stated, "In the early 2000s, a fourth phase of physical activity research could be discerned, characterized by … a primary concern for understanding and altering policy and environmental factors that are believed to contribute substantially to … inactive lifestyles (p. 93). In 1997, the Centers for Disease Control convened a multidisciplinary conference of health professionals and "that meeting was the dawn of what we are now calling the active living movement" (Killingsworth, Earp, & Moore, 2003, p. 1). In addition, the 1997 Cooper Institute's annual conference focused on physical activity interventions, including some environmental studies, and papers presented at that conference were published in a special issue of the *American Journal of Preventive Medicine* early the following year (Blair & Morrow, 1998).

The searches of the four databases returned a total of 1120 distinct articles after merging the results and removing all duplicate records. The abstract for each article was scanned and, similar to Humpel et al.'s (2002) work, "only those studies that measured environmental variables that could be related individually and directly to measured physical activity variables were retained" (p. 189). Articles were initially excluded if they failed to meet any of several

[1] **PsycInfo**: AB=("physical activity" OR exercise OR inactivity OR walking) AND AB=(environment OR neighborhood OR "urban design" OR park OR trail OR greenway)
PubMed: Search ("Motor Activity"[MeSH] OR "Exercise"[MeSH]) AND "Environment Design"[MeSH] Field: MeSH Terms
LeisureTourism Abstracts: ((environment) in ABSTRACT OR (neighborhood) in ABSTRACT OR (park) in ABSTRACT OR (trail) in ABSTRACT)) AND ((physical activity) in ABSTRACT OR (exercise) in ABSTRACT OR (walking) in ABSTRACT))
Web of Science: TS=(physical activity OR exercise OR walking) AND TS=(environment OR neighborhood OR urban design OR park OR trail OR greenway); Database = SSCI

criteria. First, very common were articles that examined other non-environmental correlates of PA, such as psychological constructs like self-efficacy or interpersonal variables like social support. If these articles did not also include environmental variables, they were omitted. Second, articles that examined the built environment or PA concurrently, but only as these two behaviours related to a third variable or condition (e.g., maximal oxygen uptake) were excluded. Third, studies that simply controlled for environmental influences and/or PA, while examining the relationship among two other variables were also excluded. Fourth, studies examining school or worksite environments in relation to PA were not included because they were determined to be minimally related, if at all, to parks and recreation amenities. Fifth, only studies that included PA as a dependent variable were retained, and not those that measured relationships between the built environment and other health measures (e.g. body mass index, mental health, cardiovascular disease). Finally, only original, empirical studies were reviewed, while conceptual papers and review articles were excluded. Similarly, studies that were purely methodological in purpose (e.g., validating self-report measures of the built environment or PA) are not included in the table below. In summary, application of these criteria temporarily reduced the original set of articles to a list of 105 studies that examined empirical relationships between some aspect of the built environment and PA levels.

Within this group of articles, only those studies that reported an association between PA and some aspect of parks and recreation as features of the built environment were sought. Consequently, although rare, studies with parks and recreation programming (e.g., skills training) as the focus were excluded. Similarly, associations between PA levels and questionnaire items that related solely to the presence of recreational equipment (e.g., treadmills) in respondents' homes are also not discussed here. Some studies examining environmental influences on PA

frequently inquire about generalized variables such as “access to facilities” or “places to exercise”. Such broadly-defined measures were not considered to be clearly related to parks and recreation because they could easily be interpreted as referring to other PA settings (e.g., streets). Composite measures, such as aggregations of individual access ratings for multiple types of facilities or a single summary score covering all aspects of the built environment, were often described in the research as well. However, these measures were only included when a large majority of the items in the measure were related to parks or recreation amenities.

Table 2 provides brief summaries of the empirical associations that were reported in the 50 primary articles that described an empirical relationship between parks and recreation amenities as features of the built environment and PA levels of the study participants. The first three columns of the table describe the age, location, and size of the study sample, and whether it was it was drawn in a fashion so as to be representative of the larger population. Brief descriptions of the parks or recreation and PA variables are then provided, along with the associations among them that were reported by the original authors.

Table 2

Articles Reporting Empirical Associations between Parks and Recreation Amenities and Physical Activity

Authors and Date	**Population**[2]	**N**[3]	**Parks or Recreation Variable(s)**[4]	**Physical Activity Variable(s)**[3]	**Association(s)**[5]
Addy et al. (2004)	18+ year olds in southeastern U.S. county	1194*	Neighbourhood (within 0.5 miles or 10-minute walk of home) and community (10 miles or 20-minute drive) recreation facilities, walking/biking trails, swimming pools, parks, playgrounds, sports fields	Sufficiently active (5+ days with 30+ minutes of moderate PA or 3+ days with 20+ minutes of vigorous PA in past week) Insufficiently active (less PA) Inactive (no moderate or vigorous PA)	Users of neighbourhood recreation facilities significantly more likely to be sufficiently active (OR=4.36) or insufficiently active (OR=7.26) than inactive Users of community parks significantly more likely to be sufficiently active (OR=1.96) or insufficiently active (OR=2.20) than inactive
Atkinson et al. (2005)	Adults in two neighbourhoods in San Diego, CA	102*	Tally of convenience (5-minute drive, 10-minute walk, or on frequently traveled route) for 18 recreational or exercise facilities (yes/no for each)	Number of self-reported episodes in past 7 days of moderate, vigorous and total PA *Minutes of moderate, vigorous and total PA measured by accelerometer*	Convenient recreational facilities not significantly related to moderate (r=.17), vigorous (r=.12) or total (r=.17) self-reported PA Convenient recreational facilities not significantly related to moderate (r=-.08), vigorous (r=.05), or total (r=-.05) minutes of objectively-measured PA
Ball et al. (2001)	Adults in New South Wales, Australia	3392*	Convenience summary score of agreement on 5-pt scales that 3 items are within walking distance: shops, park or beach, cycle path	Walking for exercise in past 2 weeks (any vs. none)	Respondents reporting low (OR=.64) and moderate (OR=.84) convenience of facilities significantly less likely to walk for exercise than those reporting high convenience of facilities. Similar results found when sample divided into those in poor and good health.
Bauman et al. (1999)	18+ year olds in New South Wales, Australia	16,178*	*Live in postal code that touches coastline*	Vigorously active (>1600 kcal/wk) Adequately active (>800 kcal/wk) Sedentary (<50 kcal/wk)	Respondents from coastal locations significantly less likely to be sedentary (OR=.77) and more likely to be adequately active (OR=1.27) or vigorously active (OR=1.38) than respondents from inland locations
Blanchard et al. (2005)	Adults across U.S.	6739*	Summary score of availability of nine recreation facilities in neighbourhood	Number of days in past week that included 30+ minutes of total moderate or vigorous PA	Access to recreation facilities a significant predictor of PA in normal weight (BMI=20-25) and overweight (BMI=25-30) respondents (*B*=.05 and .08, respectively), but not in obese (BMI>30) respondents (*B*=.02)

[2] Only the sample age and location (where available) are reported here. For additional information about the sample and research design, readers are directed to the original studies.

[3] An asterisk adjacent to the sample size number indicates that the sample was drawn in a manner so as to be representative of the study population (e.g., randomly).

[4] Although other variables related to parks or recreation and/or physical activity may have been collected or analyzed (or other values of the variables that are presented), only the parks and recreation or physical activity variables/values that were related directly and empirically are reported in these columns. Variables in italics were assessed using some objective method of measurement (e.g., geographic information systems, accelerometer, etc.), rather than subjectively by participants' self-reports.

[5] Unless otherwise noted, the term "significantly" implies differences at the .05 level. Other variables that were adjusted or controlled for in the analyses, if any, are not reported here. When variables or variable values are listed in the variable columns but associations amongst them are not reported in this column, they were either absent, insignificant, or both.

Authors and Date	Population[2]	N[3]	Parks or Recreation Variable(s)[4]	Physical Activity Variable(s)[3]	Association(s)[5]
Booth et al. (2000)	60+ year olds across Australia	449*	Access to local exercise hall, recreation center, cycle path, golf course, gym, park, swimming pool, tennis court, bowling green (yes/no; asked individually)	Sufficiently active (>800 kcals.kg^{-1} energy expenditure per week) Inactive (<800 kcals.kg^{-1} per week)	In bivariate analyses, significantly greater proportion of active than inactive respondents reported access to an exercise hall (38.5% vs. 26.9%), recreation center (38.5% vs. 26.9%), cycle track (46.9% vs. 34.1%), golf course (46.9% vs. 37.2%), park (81.0% vs. 63.7%), and swimming pool (58.7% vs. 44.4%) In multivariate analysis, only having access to a local park significantly increased odds (OR=1.14) of sufficient PA
Brownson et al. (2001)	Adults across U.S.	1818*	Access to walking/jogging trail, park, indoor gym (yes/no; asked individually)	Meets PA recommendation (5+ days with 30+ minutes of moderate PA or 3+ days with 20+ minutes of vigorous PA in past week)	Meeting PA recommendation significantly associated with access to walking/jogging trails (OR=1.55), parks (OR=1.95), and indoor gyms (OR=1.94)
Brownson et al. (2000)	18+ year olds from 12 counties in southeast Missouri	1269*	Access to walking trails (trails or paths in area – yes/no) Used walking trail (yes/no) Length of trail Distance to trail	Increase in walking since beginning to use trail (yes/no)	Of those who reported having access to and having used a walking trail, 55% reported an increase in walking since they began to use the trail Persons using longer trails (>0.25 miles) significantly more likely to report an increase in walking since using trail Distance to trail not significantly related to an increase in walking since using the trail
Carver et al. (2005)	12-14 year olds in western Sydney, Australia	347	Parents' agreement that "our neighbourhood has good sports facilities" (1 or 2 on a scale ranging from -2 to 2)	Adolescents' reports of their frequency and duration of walking and cycling for exercise, recreation, transport, and to/from school	Of all walking or cycling and purpose combinations, sports facilities a significant predictor of only frequency (not duration) of cycling for transport and only in boys (*B*=.155)
Chad et al. (2005)	50+ year olds in a midsized Canadian city	764	Presence of facilities within neighbourhood (within 5-minute walk or drive): biking trails, walking/hiking trails, golf course, public park, skating rink, swimming pool, tennis courts, dance studio, public recreation center	Summary score for participation in 12 activities of varying intensities more specific to older adult populations (e.g. yard care, volunteering, etc.)	Significantly higher PA scores for respondents reporting the presence of biking trails, walking/hiking trails, golf course, public park, skating rink, swimming pool, and tennis courts. Some minor differences in significance of facilities when sample split into 50-64, 65-79, and 80+ age groups.
De Bourd-eaudhuij et al. (2003)	18-65 year olds in Ghent, Belgium	521*	Tally of convenience (5-minute drive from work or home or on frequently traveled route) for 18 recreational or exercise facilities (yes/no for each)	Minutes of sitting, walking, moderate-intensity, and vigorous-intensity activities during past week (measured separately)	For both males (r=.11) and females (r=.14), convenience of facilities score significantly related to amount of vigorous activity only

Authors and Date	Population[2]	N[3]	Parks or Recreation Variable(s)[4]	Physical Activity Variable(s)[3]	Association(s)[5]
Deshpande et al. (2005)	20+ year olds in Missouri, Tennessee and Arkansas	278*	Use of community facilities in past 30 days (used/did not use): park, recreation center, biking/walking trail, public swimming pool, health club Number of minutes to walk from home to each of above facilities	Engage in regular PA (30+ minutes at least 5 days per week)	Significantly increased odds of engaging in regular PA for respondents who had used a park (OR=4.21), recreation center (OR=12.20), trail (OR=3.81), or health club (OR=7.48). Odds increased dramatically with use of 3+ facilities. Shorter walking times to park, recreation center, trail, and health club associated with more regular PA
Duncan & Mummery (2005)	18+ year olds in Rockhampton, Australia	1281*	*Street network distance to nearest parkland*	Achieves recommended PA level (150 minutes in past week) Any recreational walking in past week	Participants with parkland beyond 600m significantly more likely to achieve recommended PA level (OR=1.41) than those less than 600m from parkland Parkland proximity not related to recreational walking
Duncan et al. (2004)	10-14 year old siblings in 58 neighbourhoods in Pacific Northwest U.S.	930*	There are playgrounds, parks, or gyms close to my home or that I can get to easily (1-5, disagree-agree) *Number of parks and exercise and recreational facilities in neighbourhood*	Number of days in past week that each sibling took part in: vigorous exercise for 20+ minutes; stretching exercises; strengthening exercises Number of days of vigorous PA in a typical week for each sibling	Perceptions of neighbourhood recreational facilities and count of number of neighbourhood PA facilities were both negatively and significantly related to family levels of PA
Eyler et al. (2003)	18+ year olds across U.S.	1818*	No walking/jogging trails	Regular walker (5x/week for 30 min) Occasional walker (walk 10+ min at least once during past week) Never walker (did not walk 10+ min at least once in past week)	Never walkers significantly more likely to report a lack of walking/jogging trails than regular walkers (OR=1.59) Occasional walkers not significantly more likely to report a lack of walking/jogging trails than regular walkers (OR=1.18)
Fisher et al. (2004)	64-94 year olds from 56 neighbourhoods in Portland	582*	*Total parks, paths, trails per neighbourhood acre*	Neighbourhood walking activity (score derived from individuals' responses to 3 behavior questions rated on 5-pt scale)	Walking facilities per neighbourhood acre significantly (B=16.93) related to neighbourhood walking activity
Foster et al. (2004)	16-74 year olds across England	4157*	A park/open space is within walking distance (agree/disagree) A leisure center is within walking distance from my home (yes/no)	Walking >150 minutes per week in past four weeks Walking at least 15 minutes per week in past four weeks	In bivariate analyses, neither the park nor leisure center variable were significantly related to either walking measure in either men or women In multivariate analyses, for men, having a park within walking distance was only environmental variable associated with higher odds of walking >150 minutes per week (OR=2.22)

Giles-Corti et al. (2005)	18-59 year olds in Perth, Australia	1803*	*Three models of access to public open space (each divided into quartiles: very poor, poor, good, very good):* *1) Distance only model* *2) Distance and attractiveness model* 3) *Distance, attractiveness, and size model*	Achieves sufficient PA (30+ minutes of moderate PA on most days of week) High levels of walking 6+ walking sessions per week totaling 180+ minutes	For distance-only (OR=0.69) and distance plus attractiveness (OR=0.71) models, poor access to public open space significantly decreased odds of achieving sufficient PA compared to those with very poor access For distance, attractiveness, and size model, having very good access to public open space significantly increased odds of engaging in high levels of walking compared to those with very poor access (OR=1.50)
Giles-Corti & Donovan (2003)	18-59 year olds in Perth, Australia	1803*	*Access to attractive public open space, river, beach, golf course (divided into quartiles)*	Walking at recommended levels (12+ sessions in previous 2 weeks totaling 360 minutes or more)	Participants in top quartile of access exhibited significantly higher odds of sufficient walking than those in bottom quartile of access (OR=1.47)
Giles-Corti & Donovan (2002a)	18-59 year olds in Perth, Australia	1803*	*Access to open space (top quartile vs. other three quartiles combined)* *Access to beach (top quartile vs. other three quartiles combined)*	In past two weeks: any walking for transport; any walking for recreation; any vigorous exercise Walking as recommended (6+ times per week for 30+ minutes) Exercising vigorously at recommended level (3+ times per week for 20+ minutes)	Being in top quartile of access to open space significantly increased odds of walking for transport (OR=1.35) and walking as recommended (OR=1.43) Being in top quartile of access to beach significantly decreased odds of walking for transport (OR=0.62), but significantly increased odds of walking for recreation (OR=1.49), exercising vigorously at all in past two weeks (OR=1.38), and exercising vigorously at recommended level (OR=1.58)
Giles-Corti & Donovan (2002b)	18-59 year olds in Perth, Australia	1803*	*Access to built facilities: e.g. golf course, health club (divided into quartiles)* *Access to natural facilities: e.g. beach, river (divided into quartiles)*	Exercising as recommended (30+ minutes of moderate PA on most days of week)	Neither access to built facilities nor access to natural facilities significantly related to exercising as recommended
Gomez et al. (2004)	Grade 7 students at 5 schools in San Antonio, TX	177	*Straight line distance from participant's home to nearest open play area (playground, pool, athletic field)*	Bouts per week of outdoor, non-school related PA (based on recall of number of days per month and number of months per year)	Distance to nearest open play area inversely and significantly related to bouts per week of outdoor PA in boys (*B*=-.317, p=.006), but not in girls or total sample
Gordon-Larsen et al. (2000)	Grade 7-12 students across U.S.	17,766*	Use of neighbourhood recreation center (use/do not use)	Number of episodes of moderate to vigorous PA per week (based on 7-day activity recall questions) Hours per week of physical inactivity (TV/video watching and video game playing)	Using recreation center significantly increased odds of falling into highest (5+ episodes/wk) PA category (OR=1.75), but was not associated with being in the highest (25+ hrs/wk) inactivity category (OR=1.01)

Hoehner et al. (2005)	18-96 year olds in areas of St. Louis, MO and Savannah, GA	1073*	There are many places to be active in my community, not including streets Park, walking trail, private fitness facility within 5-minute walk of home (yes/no - individually) Number of recreation facilities within 5-minute walk of home (7 total) *Within 400m of respondent's home: Count of parks with facilities; Any park, trail or fitness facility; Count of recreational facilities*	Recreational PA (not including transport) during leisure-time: Meets PA recommendation (5+ days with 30+ minutes of moderate PA or 3+ days with 20+ minutes of vigorous PA in past week) Does not meet recommendation	Respondents who agreed that there are many places to be active (OR=2.0) and that reported 2-3 recreation facilities within 5-minute walk (OR=1.6) significantly more likely to meet PA recommendation (but trends not clear) Having any of park, walking trail, or private fitness facility within 5-minute walk not associated with meeting PA recommendation None of the objective measures of parks or recreation facilities significantly related to meeting PA recommendation
Humpel, Marshall et al. (2004)	Faculty and staff at an Australian university	800* and 512 at 10-wk follow up	Summary 'convenience' score of (each item rated 1-10 for unfavorable to favorable): Walking distance to park/beach Accessibility of path/cycle way Overall convenience of neighbourhood for walking	Number of minutes per week of neighbourhood walking	In both men and women, increased perceptions of convenience related to significantly increased odds of any increase in walking (OR=1.95 and 2.58, respectively), increase of 30 or more minutes of walking (OR=2.02 and 2.31, respectively), and increase of 60 or more minutes of walking (OR=1.98 and 2.01, respectively)
Humpel, Owen, Iverson et al. (2004)	40+ year olds from a coastal Australian city	399*	*Live in postal code that touches coastline* Lake or beach within easy walking distance	Number of minutes per week of neighbourhood walking, walking for exercise, for pleasure, and to get to and from places (separately)	In bivariate analyses, participants living in coastal postal code reported significantly more minutes walking in neighbourhood (189 vs. 149) and for exercise (139 vs. 109) than those in non-coastal postal code In bivariate analyses, participants with a lake or beach within walking distance reported significantly more minutes walking in neighbourhood (224 vs. 139), for exercise (163 vs. 100), and for pleasure (33 vs. 21) In multivariate analyses, living in coastal postal code not significantly associated with increased odds of any type of walking for men, but greater odds of neighbourhood walking for women (OR=3.32)
Humpel, Owen, Leslie et al. (2004)	Faculty and staff at an Australian university	800*	Summary 'convenience' score split into low, moderate, high tertiles based on (each item rated 1-10 for unfavorable to favorable): Walking distance to park/beach Accessibility of path/cycle way Overall convenience of neighbourhood for walking	Number of minutes per week of neighbourhood walking (split into high and low groups at median) Number of minutes per week of total walking (split at median) Number of minutes per week of total PA (split at median)	In men, participants in high convenience tertile exhibited significantly higher odds of neighbourhood walking (OR=2.20) and total PA (OR=1.82) than those in low convenience tertile In women, those in high (OR=3.78) and moderate (OR=3.19) convenience tertiles exhibited significantly higher odds of neighbourhood walking than those in low convenience tertile

Huston et al. (2003)	18+ year olds in 6 counties in North Carolina	1796*	Trails in neighbourhood (yes/no)	Any leisure-time PA in past month Meets PA recommendation (5+ days with 30+ minutes of moderate PA or 3+ days with 20+ minutes of vigorous PA in past week)	In bivariate analyses, respondents reporting presence of trails significantly more likely to engage in any PA (77.8% vs. 70.3%) and recommended PA (31.3% vs. 23.8%) than those reporting no trails In multivariate analyses, reported presence of trails not associated with higher odds of any PA, but marginally associated with recommended PA (OR=1.46, p<.10)
King et al. (2005)	52-62 year old women in Pittsburgh area	158	*Is facility within walking distance? (1500m from home along road network): park, walking/biking trail, museum or art gallery, golf course*	*Average number of steps per day (as measured by pedometer over 7 days)*	Significantly greater steps per day for participants with a golf course within walking distance (p=.01), but no difference for having park (p=.92), trail (p=.10), or museum (p=.86) within walking distance
King et al. (2003)	Older women in Pittsburgh area	149	Is facility within walking distance? (20-minute walk from home): park, walking/biking trail, community center	*Average number of steps per day (7 days of pedometer readings)* Walking activity (kcal/week) Total PA (kcal/week)	Significantly greater steps per day for participants with a park (p=.004) or trail (p=.002) within walking distance, but no difference for community center (p=.72) Having none of the three facilities within walking distance was associated with significantly greater self-reported walking or total PA
Li, Fisher & Brownson (2005)	65-94 year olds in 28 neighbourhoods in Portland	303	There are playgrounds, parks, or gyms close by that I can get to easily (1-5, disagree-agree)	Neighbourhood walking activity (score derived from individuals' responses to 3 behavior questions rated on 5-pt scale)	Neighbourhoods with greater access to recreational PA facilities showed less decline in walking activity over four measurement time points (baseline, 3 months, 6 months, 12 months)
Li, Fisher, Brownson & Bosworth (2005)	65-94 year olds in 56 neighbourhoods in Portland, OR	577	*Total acres of green and open space for recreation per neighbourhood* *Total acres of green & open space for recreation within 0.5 mile radius of participant's home* There are playgrounds, parks, or gyms close by that I can get to easily (1-5, disagree-agree) Number of recreational facilities in the neighbourhood (out of 11)	Neighbourhood walking activity (neighbourhood score derived from individuals' responses to 3 behavior questions rated on 5-pt scale)	At neighbourhood level, area of green and open space in neighbourhood significantly related to neighbourhood walking (p=.05) At individual resident level, area of green and open space and number of recreation facilities significantly related to walking. Having playgrounds, parks, or gyms close by not significantly related to walking.
Lund (2003)	8 neighbor-hoods in Portland	n/a	*Neighbourhood has park access only (vs. has retail access only, retail and park access, or access to neither park or retail)*	Number of strolling trips in previous week Number of destination trips in previous week	Number of strolling or destination trips not significantly different between neighbourhoods with park access only and control group of neighbourhoods with no access to parks or retail amenities

Mota et al. (2005)	7th-12th grade students	1123	My neighbourhood has several public recreation facilities, such as … (single item; agree/disagree)	PA score out of 20 (5 PA questions scored on 4-pt scales) divided into non-active (0-10) and active (11-20)	Significantly greater percentage of active (49.3%) than non-active (41.6%) respondents agreed with the presence of recreational facilities
Norman et al. (2005)	11-15 year olds in San Diego	878	Recreation in neighbourhood score assessed by proximity of five facilities (each rated on a 5-pt proximity scale anchored by 1-5 minutes and 31+ minutes): school, park, recreation center, gym, fitness facility	Total minutes spent doing four sedentary activities (TV, video games, sitting listening to music, and talking on phone) on most recent non-school day: <240 minutes vs. >240 minutes	In bivariate analyses for both girls (OR=1.01) and boys (OR=1.08), recreation in neighbourhood score not significantly related to time spent in sedentary activities
Plaut (2005)	Adults across U.S.	38,243*	Live close to green area (within half block)	Mode of travel to work (car, bicycle, walk)	37.1% of car commuters, 28.9% of bicycle commuters, and 36.3% of people who walk to work live close to a green area
Reed et al. (2004)	18-96 year olds in a rural south-eastern U.S. community	1112*	Use of a community trail (within 10 miles or 20- minute drive): used, did not use, did not have	Sufficiently active (5+ days with 30+ minutes of moderate PA or 3+ days with 20+ minutes of vigorous PA in past week) Regular walker (5+ days per week for 30+ minutes)	42% of trail users reported being sufficiently active and 51% engaged in a lesser amount of PA 49% of regular walkers and 35% of people who walked a lesser amount reported using trails
Reed & Phillips (2005)	Undergraduate students at a U.S. university	411*	*Proximity of exercise facility (average distance from home to facilities used over a one week period)*	Frequency (number of exercise bouts over 7-day period) Intensity (sum of METs x minutes for each type of activity) Duration (number of minutes per exercise bout over 7-day period) Total PA (METs x frequency)	In both total sample and females, proximity significantly correlated to intensity (.106 and .180, respectively) and duration (.119 and .113., respectively) In males, only significant correlation was between proximity and frequency (-.195)
Romero (2005)	10-16 year olds in a mid-sized southwestern U.S. city	74	Availability of six facilities (yes/no; 0-6 index score): community center, outdoor park/facility, YMCA/YWCA, school playground, backyard/front yard, home gym	Number of days in past week that included 20+ minutes of vigorous activity	Availability of facilities not significantly correlated to PA (r=.18)
Rutt & Coleman (2005)	25-69 year olds in El Paso County, TX	943*	*Total number of parks, gyms, schools, and biking/walking paths within 2.5 miles of participant's home* *Street distance to each type of facility*	Minutes per week during past month engaged in light (e.g. walking), moderate (e.g. yoga), and vigorous (e.g. swimming) activities	Number of facilities not related to any PA measure Distance to facilities a significant predictor of vigorous PA (*B*=.18)

Sharpe et al. (2004)	18+ year olds in 2 South Carolina counties	1936*	Number of days in typical month used public trail, track, path or mapped route for PA Number of days in a typical month used a public park or other outdoor recreation area for PA Knowledge (number) of walking or jogging routes in county Knowledge (number) of known bicycling routes in county Perceptions of the number of parks, trails or other outdoor recreation areas in county	Meets PA recommendation (5+ days with 30+ minutes of moderate PA or 3+ days with 20+ minutes of vigorous PA in past week) Does not meet PA recommendation	Significantly greater predictors of meeting PA recommendation than not meeting recommendation included number of days used a track, trail, pathway, or mapped route for PA, number of days used public parks and other outdoor recreation areas for PA, and having higher number of known routes for walking and bicycling in county Perceptions of number of parks, trails, and other outdoor recreation areas not associated with meeting PA recommendation
Timperio et al. (2004)	5-6 and 10-12 year olds and their parents in Melbourne, Australia	1210*	No parks or sports grounds near where I live (10-12 year olds' agreement on 5-pt scale) Few sporting venues within our local area (parents' agreement on 5-pt scale)	Child's walking or cycling to destinations (e.g. playgrounds, shops, school, etc.) at least three times per week	Significantly lower odds of walking or cycling for 10-12 year olds agreeing with no nearby parks (OR=0.5), but no association for few sporting venues among younger age group
Troped et al. (2003)	18+ year olds in Arlington, MA	413*	*Road network distance to access point for a paved community rail-trail*	Minutes per week of recreational PA Minutes per week walking or cycling for transportation	Distance to rail-trail significantly and negatively related to minutes of PA for transportation (B=-54.65, p=.05), but not related to recreational PA
Troped et al. (2001)	18+ year olds in Arlington, MA	419*	Distance to bike trail (to closest quarter mile)	Any use of bike trail over past four weeks	For every 0.25 mile increase in distance to trail, participants were 0.65 times more likely to use trail
Van Lenthe & Mackenbach (2005)	20-69 year olds in Eindhoven, Netherlands	8767*	Availability of sport and recreation facilities (5-pt scale)	Time spent per week on sports participation (almost none vs. 1+ hours)	Respondents with poor proximity to sports facilities significantly more likely to report almost no sports participation (OR=1.23)
Vernez-Moudon et al. (2005)	18+ year olds in King County, WA	608*	Presence of bicycle lanes and trails in neighbourhood *Distance to closest rail trail*	Cyclist (bike at least once per week in neighbourhood for recreation, exercise, or transportation)	Significantly higher odds of cycling with presence of bicycle lanes and trails Distance to closest rail trail associated with higher odds of cycling
Wendel-Vos et al. (2004)	20-59 year olds in Maastrict, The Netherlands	11,541*	*Square hectares of each green or recreation space within 300-m and 500-m radius: woods, parks, sport grounds (e.g. tennis courts but not fitness centers), day-trip grounds (e.g. zoo)*	Hours per week of each of walking and bicycling for each of leisure-time and commuting purposes	For leisure-time activity, only significant relationship was between bicycling and sport grounds within 300m radius (*B*=.04) For commuting activity, only significant relationships were between bicycling and sport grounds (*B*=.02) and parks (*B*=.02) within a 300m radius

Wilcox et al. (2000)	40+ year old women across U.S.	2338	Easy access to walking trails, swimming pools, recreation centers, or bicycle paths (single item - present/absent)	Sedentary (no sports or exercise or activities that increased heart rate in past two weeks)	Easy access to exercise facilities not significantly related to being sedentary in either urban (OR=.96) or rural (OR=1.09) women
Wilson et al. (2004)	18-96 year olds in a rural U.S. southeastern county	1194*	Walking or bicycling trails: respondent uses trails, does not use trails, no trails reported within 10 miles or 20- minute drive) Parks: respondent uses parks, does not use parks, no parks reported within 10 miles ore 20-minute drive)	Meets PA recommendation (5+ days with 30+ minutes of moderate PA or 3+ days with 20+ minutes of vigorous PA in past week) Walk 30+ minutes for 5+ days per week	Significantly greater odds of meeting PA recommendation for low socio-economic status (SES) respondents who use trails (OR=2.81), but no association for high SES Significantly greater odds of walking 150+ minutes per week for low socio-economic status (SES) respondents who use trails (OR=3.04) and significantly lower odds of walking for high SES respondents who do not use parks (OR=.44)
Zlot & Schmid (2005)	18+ year olds in 34 U.S. cities	n/a*	Parkland acreage as a percentage of total city acreage	Utilitarian walking/bicycling prevalence rate (walking or biking for transport in past week) Recreational walking/bicycling prevalence rate (walking or biking one of top two most frequent physical activities in past month)	Parkland acreage significantly correlated with utilitarian walking and bicycling rate (r=.62) Parkland acreage not significantly correlated with recreational walking and bicycling rate (r=.15)

In 21 of the 50 studies (42%), all or most of the associations examined between parks or recreation and PA variables were positive (Addy et al., 2004; Ball, Bauman, Leslie, & Owen, 2001; Bauman, Smith, Stoker, Bellew, & Booth, 1999; Blanchard et al., 2005; Booth, Owen, Bauman, Clavisi, & Leslie, 2000; Brownson, Baker, Housemann, Brennan, & Bacak, 2001; Chad et al., 2005; Deshpande, Baker, Lovegreen, & Brownson, 2005; Fisher, Li, Michael, & Cleveland, 2004; Giles-Corti et al., 2005; Giles-Corti & Donovan, 2003, 2002a; Gordon-Larsen, McMurray, & Popkin, 2000; Humpel, Marshall, Leslie, Bauman, & Owen, 2004; Humpel, Owen, Leslie, et al., 2004; Li, Fisher & Brownson, 2005; Mota, Almeida, Santos, & Ribeiro, 2005; Reed, Ainsworth, Wilson, Mixon, & Cook, 2004; Troped et al., 2001; van Lenthe, Brug, & Mackenbach, 2005; Vernez-Moudon et al., 2005). Nine of the articles (18%) reported that the associations examined were insignificant (Atkinson, Sallis, Saelens, Cain, & Black, 2005; Carver et al., 2005; Duncan & Mummery, 2005; Giles-Corti & Donovan, 2002b; Lund, 2003; Norman, Schmid, Sallis, Calfas, & Patrick, 2005; Plaut, 2005; Romero, 2005; Wilcox, Castro, King, Housemann, & Brownson, 2000), while one study reported a negative relationship (Duncan, Duncan, Strycker, & Chaumeton, 2004). The remaining 19 articles (38%) reported mixed findings, including at least some positive relationships between parks or recreation variables and PA (Brownson et al., 2000; De Bourdeaudhuij, Teixeira, Cardon, & Deforche, 2003; Eyler, Brownson, Bacak, & Housemann, 2003; Foster, Hillsdon, & Thorogood, 2004; Gomez, Johnson, Selva, & Sallis, 2004; Hoehner, Ramirez, Elliot, Handy, & Brownson, 2005; Humpel, Owen, Iverson, Leslie, & Bauman, 2004; Huston, Evenson, Bors, & Gizlice, 2003; King et al., 2005; King et al., 2003; Li, Fisher, Brownson, & Bosworth; 2005; Reed & Phillips, 2005; Rutt & Coleman, 2005; Sharpe et al., 2004; Timperio, Crawford, Telford, & Salmon, 2004; Troped, Saunders, Pate, Reininger, & Addy, 2003; Wendel-Vos et al., 2004; Wilson, Kirtland,

Ainsworth, & Addy, 2004; Zlot & Schmid, 2005). In these studies, disparate associations were observed when different classifications of the parks or recreation variables (e.g., type of facility; distance to facility) or PA variables (e.g., transportational vs. recreational purpose; moderate vs. vigorous) were analyzed, or when substituting objective versus subjective measurements of either type of variable altered the relationships. In a few cases, mixed findings were also observed when different age, gender, or socio-economic status categories were analyzed. The following sections describe patterns in the relationships between different types and proximity of parks and recreation variables and different purposes and intensity levels of PA.

Relationships between Different Types of Parks or Recreation Amenities and Physical Activity

To begin, the relationships between PA and particular types of park or recreation amenities were examined. Unfortunately, approximately one-third of the studies reviewed used parks or recreation variables that represented an aggregate or overall score of participants' ratings of their access to several recreation facilities (e.g., De Bourdeaudhuij et al., 2003; Mota et al., 2005). In a few other cases, a single parks or recreation variable was used to analyze the relationship with PA, but the particular amenity was unspecified (e.g., Gomez et al., 2004). Consequently, the associations between PA and these indeterminate variables were excluded from the descriptions of individual types of amenities described below. The following paragraphs briefly address the observed relationships between PA and trails/paths, parks, recreation centers, exercise/fitness facilities, sports fields, golf courses, swimming pools, and living near a coast/lake/beach. Several other facilities were mentioned in only one or two studies (e.g., skating rink, bowling green, dance studio, museum/art gallery, playground, gym, tennis court), and are not described here.

Trails (or paths) were the park or recreation amenity examined most frequently in the studies reviewed. More than half (n=17) of the articles that did not use aggregated or non-specific measures of parks or recreation variables included trails as a potential influence on PA, while thirteen looked individually at parks, and eight employed some total combination of the amount of green or open space within a specified area (e.g., Fisher et al., 2004). With respect to trails exclusively, in most of the studies at least some, if not all, of the reported relationships between the trail and PA variables were positive. For example, Troped et al. (2001) concluded that for every quarter-mile increase in distance to a trail from home, participants were almost half as likely to have used a bike trail in the past month. In a follow-up analysis, Troped et al. (2003) reported that distance to the trail was negatively related to the number of minutes per week spent walking or cycling for transportation, but not to the number of minutes of PA for recreational purposes. Findings from a study of adults in South Carolina (Sharpe et al., 2004) indicated the importance of knowledge and use of outdoor amenities (as opposed to just their mere presence) for enhancing PA. In this case, meeting the recommended PA level was not associated with participants' perceptions of the number of available parks, trails, and other outdoor recreation areas in their county, but was significantly related to the number of days they used trails in a typical month and their knowledge of walking/jogging and bicycling routes in the county. Deshpande et al. (2005) and Reed et al. (2004) provided similar results about how use of trails was related to engaging in recommended amounts of PA (e.g., 30 minutes on 5 or more days per week). Finally, Brownson et al. (2000) found that of the 36% of their study respondents in Missouri who reported having access to a trail, 39% of them had used a trail, and 55% had increased their level of walking since doing so. Increased walking was significantly more common among women and among people using longer trails (i.e., greater than ¼ mile), but was

unrelated to distance to the trail. Several other correlational studies provided supportive results about the importance of trails (Booth et al., 2000; Brownson et al., 2001; Chad et al., 2005; Eyler et al., 2003; Huston et al., 2003; King et al., 2003; Vernez-Moudon et al., 2005; Wilson et al., 2004), while only a few others documented mixed or non-significant findings (Addy et al., 2004; Hoehner et al., 2005; King et al., 2005).

The relationship between parks and PA was examined in about one-third (n=13) of the articles that reported distinct associations between parks or recreation variables and PA. For example, Lund (2003) featured parks as a key variable in testing the New Urbanism hypothesis "that placing amenities within walking distance of homes will increase pedestrian travel and social interaction among neighborhood residents" (p. 414). Eight neighbourhoods were purposefully selected based on their differing levels of access to parks and shopping areas. Compared to individuals in the control group of neighbourhoods that lacked access (i.e., within ¼ mile) to either parks or shopping areas, participants with access to only parks had taken a similar number of both "strolling" and "destination" trips in the past week. However, shopping areas appeared to have some influence on transportation PA in that individuals in neighbourhoods with both retail and park access or just retail access had a higher number of destination trips than people in neighbourhoods with access to just parks or to neither feature. In another study with similar results, distance to the nearest parkland was not related to participants having engaged in any recreational walking in the past week, and those individuals with parkland beyond 600 metres from their homes were actually significantly more likely to achieve recommended PA levels than people who lived closer to parkland (Duncan & Mummery, 2005). Mixed or non-significant findings about the influence of parks on PA were found in several other articles as well (Foster et al., 2004; Hoehner et al., 2005; King et al., 2005; Wendel-Vos et al.,

2004). Nevertheless, in other studies, parks were found to be one of the only variables that remained associated with achieving sufficient activity levels when multivariate models were examined (Addy et al., 2004; Booth et al., 2000). Further, Deshpande et al. (2005) reported that respondents who had used parks in the past month were more than four times more likely to have engaged in PA at least five times per week for more than thirty minutes per episode. Several other studies reviewed also showed primarily positive associations between parks and assorted PA variables (Chad et al., 2005; King et al., 2003; Sharpe et al., 2004; Wilson et al., 2004).

In addition to the articles that examined trails and parks, eight studies looked more generally at open space within a particular area and its relationship to PA. Giles-Corti and colleagues published several papers that used complicated models involving the distance to, size, and attractiveness of public open space (Giles-Corti et al., 2005; Giles-Corti & Donovan, 2003, 2002a, 2002b). All of these articles reported that residents in Australia with greater access to open space reported higher levels of PA. Among older adults in Portland, Oregon, an overall measure of walking activity within the neighbourhood was significantly associated with the absolute number of parks, paths, and trails per neighbourhood acre (Fisher et al., 2004), and with the total acreage of green and open space in the neighbourhood (Li, Fisher, Brownson & Bosworth, 2005). Similarly, Zlot and Schmid (2005) examined parkland acreage as a percentage of total acreage in the 55 most populated cities in the U.S. (as taken from Harnik, 2003), and found a strong correlation with the rate of walking and biking for transportation, but a non-significant relationship with recreational walking and bicycling. Finally, in a somewhat contradictory finding, Plaut (2005) analyzed data from the 2001 American Housing Survey and stated that a relatively equal proportion of people who traveled to work on foot (28.9%), by car (37.1%), and by bicycle reported living within a half block of a green area.

Recreation centres (or facilities) were examined in seven articles. Three of these studies reported positive relationships with participants achieving recommended PA levels (Addy et al., 2004; Booth et al., 2000; Deshpande et al., 2005), while another three showed non-significant associations with various activity outcomes (Chad et al., 2005; Foster et al., 2004; King et al., 2003). In the other study, Gordon-Larsen et al. (2000) analyzed data from almost 18,000 middle and high-school students who participated in the U.S. National Longitudinal Study of Adolescent Health. They found that use of a neighbourhood recreation centre was associated with a 75% increase in adolescents falling into the highest category of PA (i.e., 5 or more episodes per week). However, not using a recreation centre was unrelated to greater levels of time spent engaged in television/video watching and video game playing.

Four papers discretely examined the relationship of exercise facilities to PA. In two studies of differing age groups, access to a local exercise hall and level of health club use were significantly associated with being classified as sufficiently active (Booth et al., 2000; Deshpande et al., 2005). Different proximity measures for exercise facilities were also positively related to particular PA variables in the articles by Reed and Philips (2005) and Deshpande et al. However, in the only other study to individually examine this type of amenity, having a fitness facility within a 5-minute walk of home showed no association with achieving the recommended level of PA during leisure time (Hoehner et al., 2005).

Three research teams examined the relationship between PA and sports facilities (or grounds or venues). Both Carver et al. (2005) and Timperio et al. (2004) asked parents of 12-14 year olds and 5-6 year olds, respectively, to rate the presence of sports facilities in their neighbourhood or local area on a 5-point scale. In the latter study, parents' ratings were unrelated to the 5-6 year olds walking or bicycling to get places at least three times per week. However, in

the former study, sports facilities were a significant predictor of the frequency of cycling for transport among 12-14 year old boys, but were unrelated to walking or bicycling for exercise, recreation, or to get to and from school for either boys or girls. In Wendel-Vos et al.'s (2004) study of adults in the Netherlands, the area dedicated to sports grounds within 300 metres of participants' homes was significantly associated with bicycling for both leisure and commuting purposes.

Three studies examined golf courses with all three showing positive and significant associations with PA. Interestingly, all three studies were conducted with participants 50 years of age and older. In two of the studies, golf courses were just one of several facilities exhibiting positive associations with PA (Booth et al., 2000; Chad et al., 2005), but in the other study golf courses were the only amenity significantly associated with a greater number of pedometer-measured steps per day (King et al., 2005).

Swimming pools were included in three of the articles reviewed. Engaging in PA for 30 or more minutes on at least five days per week was not significantly associated with the number of days respondents had used a community swimming pool in the past month (Deshpande et al., 2005) or with having a swimming pool within 10 miles or a 20-minute drive (Addy et al., 2004). However, in the third study, swimming pools were one of several facilities significantly related to higher PA scores among a sample of Canadian adults 50 years of age and older (Chad et al., 2005).

Finally, proximity to a coast or lake or beach appeared to positively impact PA. Across the three studies that examined these features, significant associations were observed with being less likely to be sedentary and more likely to be adequately active and vigorously active (Bauman et al., 1999), with spending more minutes walking in the neighbourhood for exercise

and for pleasure (Humpel, Owen, Iverson et al., 2004), and with engaging in any vigorous exercise, any walking for recreation, and exercising vigorously at recommended levels (Giles-Corti & Donovan, 2002a). Only one study, however, reported that having greater access to a beach resulted in significantly decreased odds of participants having walked for transport in the past two weeks (Giles-Corti & Donovan, 2002a).

Relationships between Proximity of Parks or Recreation Amenities and Physical Activity

Almost all of the 50 studies necessarily included some form of spatial referent when investigating how features of the surrounding environment were associated with PA. For example, participants were asked to indicate amenities that were found in their "neighbourhood" or within "walking distance." Unfortunately, as the list in Table 2 illustrates, a wide range of spatial definitions have been employed in relation to the availability of parks or recreation amenities. A small minority of studies employed continuous measures for the parks or recreation variables studied (e.g., street network distance to a facility) and these improved the specificity of the relationships with PA that could be observed. However, most of the studies reviewed defined the space participants should refer to in responding to the questions about parks or recreation amenities using a defined categorical descriptor that was either quantitative (e.g., 5-minute walk) or qualitative (e.g., "close by"). Consequently, described below are the various spatial groupings that were used to investigate parks and recreation amenities, and how the differing proximity categories relate to PA.

Only a small number of studies included specific distance or time referents. Wendel-Vos et al. (2004) used GIS data to ascertain the presence of several park and recreation amenities within 300 metres and 500 metres of each participant's home. In their study, none of the facilities beyond 300 metres were significant predictors of either walking or bicycling for leisure or

commuting purposes. However, the presence of sports grounds within 300 metres was associated with increased bicycling for both leisure and commuting, while parks within 300 metres were associated with only increased bicycle commuting. Hoehner et al. (2005) found that objective assessments of the facilities within 400 metres of the respondents' homes were unrelated to meeting PA recommendations during recreational pursuits. As described above, Duncan and Mummery (2005) dichotomized participants' distance to the nearest parkland into greater and less than 600 metres. In their Australian sample, parkland proximity was not related to engagement in recreational walking, and those individuals with parkland beyond 600 metres were more likely to achieve recommended PA levels. Finally, the total acres of recreational open space within a half-mile (i.e., 800 metres) of participants' homes was significantly related to neighbourhood walking activity for a sample of older adults in Portland, Oregon (Li, Fisher, Brownson & Bosworth, 2005).

With respect to time, De Bourdeaudhuij et al. (2003), Atkinson et al. (2005), and Chad et al. (2005) all asked participants to think about whether numerous park or recreation facilities were within a 5-minute drive. The latter two studies also included the concurrent referents of a 10-minute walk and a 5-minute walk, respectively, while the former two also included those facilities on a frequently traveled route. In two of these studies (De Bourdeaudhuij et al., Atkinson et al.), the majority of the relationships with the PA variables studied were not significant, while the other study (Chad et al.) reported almost all positive associations. In addition to the objective measures described above, Hoehner et al. (2005) inquired about participants' perceptions of amenities within a 5-minute walk of home. Addy (2004) used a 10-minute walk criterion while adding the extra referent of 0.5 miles. Both studies reported some positive and some nonsignificant findings about the importance of different parks or recreation

amenities for PA participation. Finally, Deshpande et al. (2005) found that shorter walking times (as reported by participants as a continuous variable) to most park or recreation facilities translated into more regular PA.

Some studies asked more generally about facilities within "walking distance." For example, Ball et al. (2001) found that Australians' overall perception of having shops, a park or beach, and/or cycle path within walking distance was significantly related to increased walking for exercise. Humpel, Owen, Iverson, et al. (2004) reported that having a lake or beach within walking distance was associated with increased time spent walking for a variety of purposes, although most of the latter associations disappeared in more complex multivariate models. In two separate studies that provided additional descriptors to guide respondents, King et al. (2005) defined walking distance as 1500 metres from home, while King et al. (2003) defined it as a 20-minute walk from home. In the former investigation, achieving a significantly greater number of steps per day on a pedometer was influenced by a golf course, but not a park, trail, or museum. In the 2003 study, the same PA variable was positively associated with having a park or trail within walking distance but not a community centre. Finally, Foster's (2004) study of adults in England showed mixed results for walking with respect to having a park or leisure centre within walking distance.

The largest group of studies used similar terms such as "close by," "near where I live," or "neighbourhood" to guide respondents' thinking about parks and recreation amenities. A small number also included additional referents such as "within a half block" or "that I can get to easily." In about half of these investigations, the associations between the parks or recreation amenities and the PA variables studied were mainly positive and significant (Blanchard et al., 2005; Gordon-Larsen et al., 2000; Li, Fisher & Brownson, 2005; Mota et al., 2005). For

example, Mota et al. asked 1123 middle and high school students to rate on a 4-point scale their level of agreement with the statement, “My neighbourhood has several public recreation facilities, such as parks, walking trails, bike paths, recreation centers, playgrounds, public swimming pools, etc.” The PA variable in their study consisted of five questions, each with four response choices, about sports and PA participation outside school. Participants were divided into active and non-active groups using the midpoint of the scale and a significantly greater percentage of active than non-active students agreed with the presence of the parks and recreation facilities in their neighbourhood. However, several other studies investigating “nearby” or “neighbourhood” facilities reported mixed (Huston et al., 2003; Li, Fisher, Brownson & Bosworth, 2005; Timperio et al., 2004), mostly non-significant (Carver et al., 2005; Lund, 2003; Plaut, 2005), or negative (Duncan et al., 2004) findings about the relationship between parks or recreation and PA.

Some researchers employed distance or time referents that were more reflective of *community* park and recreation amenities. Reed et al. (2004) and Wilson et al. (2004) both found generally positive associations with PA participation for people who used trails that were within 10 miles or a 20-minute drive of home. Some similar results were found for parks within the same reference area (Addy et al., 2004; Wilson et al.). However, Rutt and Coleman (2005) counted the total number of parks, gyms, schools, and walking/biking paths within 2.5 miles of participants’ homes and found this figure was unrelated to the number of minutes per week their study participants spent engaged in light, moderate, or vigorous activities.

A few studies simply asked about participants’ “access to” various parks or recreation amenities (e.g., Booth et al., 2000; Brownson et al., 2001; Wilcox et al., 2000). For example, in a survey of women 40 years of age or older across the U.S., Wilcox et al. found that the presence

or absence of easy access to a set of amenities (walking trails, swimming pools, recreation centres, or bicycle paths) was unrelated to having engaged in no sports or exercise activities in the past week for either urban or rural respondents. In contrast, Booth et al. reported that having access to almost all of the park or recreation facilities they studied was associated with being classified as active for older Australian adults when each facility was examined individually. However, in their multivariate model that included a wide variety of environmental and personal variables, only having access to a local park remained a significant predictor of PA. Lastly, Browson et al.'s telephone survey of adults across the U.S. showed that having access to trails, parks, and indoor gyms were each associated with meeting PA recommendations.

Finally, some studies used distance measures that were either continuous or included several ordered response categories (e.g., ¼ mile, ½ mile, ¾ miles, etc.) that improved their specificity. As mentioned above, two studies by Troped and colleagues (2001, 2003) using these types of measures found positive associations between distance to a paved rail-trail and both use of the trail and number of minutes spent walking or cycling for transportation. Vernez-Moudon et al. (2005) also reported positive associations with distance to a rail-trail in an examination of cycling. Other researchers that used continuous distance measures discovered mainly positive associations as well. Gomez et al. (2004) found that for the grade 7 boys (but not girls) in their San Antonio sample, straight line distance from home to the nearest open play area was significantly associated with their number of outdoor bouts of PA per week. Street distance to various indoor and outdoor facilities was related to minutes per week of vigorous PA, but not to light or moderate PA for a sample of adults in El Paso (Rutt & Coleman, 2005). Further, Reed and Phillips (2005) calculated the average distance from university students' places of residence to the exercise facilities they used over the course of a week. This measure was related to

intensity and duration of use among females, and to frequency of use for males. Finally, in Norman et al.'s (2005) study of 11-15 year old boys in San Diego, participants indicated the time it would take to walk to each of five recreation facilities on a five-point scale ranging from 1-5 minutes to 31 or more minutes. The aggregated "recreation in the neighbourhood" score was not significantly related to the total amount of time the boys spent engaged in several sedentary activities over the course of a non-school day.

In summary, it is difficult to draw any firm conclusions about the importance of proximity to park or recreation facilities based on the often-conflicting associations observed in Table 2 and described above. This problem is exacerbated by the fact that more than half of the studies examined used imprecise, categorical descriptors (e.g., close by, access to, neighbourhood) to direct participants' responses.

Relationships Between Parks or Recreation Amenities and Type/Purpose of Physical Activity

Articles addressing the built environment often examine its influence on different functions of PA. Examining relationships between environmental characteristics and different PA purposes is important because each PA function may be associated with a different set of correlates and motivations (Giles-Corti, Timperio, et al., 2005; Handy, 1996). Typically, PA can be categorized into exercise, recreation, and utilitarian functions with the latter including transportation. In this review, seven articles focused on multiple PA purposes among the dependent variables that were studied (Carver et al., 2005; Giles-Corti & Donovan, 2002a; Humpel, Owen, Iverson et al., 2004, Lund, 2003; Troped et al., 2003; Wendel-Vos et al., 2004; Zlot et al., 2005). Four research teams examined PA undertaken for a single specific purpose (Ball et al., 2001; Duncan & Mummery, 2005; Hoehner et al., 2005; Timperio et al., 2004).

Only three studies, all from Australia, included specific measurements of walking for exercise (Ball et al., 2001; Carver et al., 2005; Humpel, Owen, Iverson et al., 2004). In one study, living in a postal code adjacent to the coast and living within walking distance of a lake or beach were both significantly associated with a greater number of minutes per week spent walking for exercise (Humpel, Owen, Iverson et al.). Similarly, Ball et al. indicated that the overall convenience of four different amenities was significantly related to engaging in any walking for exercise in the past two weeks. In contrast, however, Carver et al. found that parents' perceptions of the quality of sports facilities in their neighbourhoods were unrelated to their reports of the frequency and duration with which their children walked or cycled for exercise.

All seven articles that addressed multiple PA purposes included both recreational and utilitarian PA. Of these, three showed a similar degree of association between the parks or recreation variables and each PA function (Humpel, Owen, Iverson, et al., 2004; Lund, 2003; Wendel-Vos et al., 2004). However, in each of the other four, significant relationships were found for utilitarian PA but not for recreational PA (Carver et al., 2005; Giles-Corti & Donovan, 2002a; Troped et al., 2003; Zlot et al., 2005). The two studies that looked exclusively at recreational PA also showed either mixed (Hoehner et al., 2005) or negative (Duncan & Mummery, 2005) relationships with the parks or recreation independent variables that were studied.

Relationships between Parks or Recreation Amenities and Intensity of Physical Activity

In addition to the different PA purposes, examining the association between parks or recreation and intensity of PA participation is useful. For example, Reed and Phillips (2005) employed an overall measure of PA intensity involving total MET values (as described earlier in the section on physical activity). In their sample of undergraduate students, proximity of the

exercise facilities used during a week was significantly related to intensity of PA participation in females, but not among males. Three other studies disaggregated participants' PA participation into both moderate and vigorous activity to examine the association of parks or recreation with each variable separately[6]. In two of these three studies, different measures of the convenience of recreation or exercise facilities were significantly related to vigorous activity, but not to moderate-intensity activity or other forms of PA (De Bourdeaudhuij et al., 2003; Rutt & Coleman, 2005). For Atkinson et al.'s (2005) small sample, convenience of facilities was not related to moderate or vigorous PA when either of the latter variables was measured subjectively or objectively.

Another three studies examined only vigorous PA without considering moderate activity. Bauman et al. (1999) and Giles-Corti and Donovan (2002a) studied samples of Australian adults and found positive associations between access to a beach/coast and different measures of vigorous PA. In Giles-Corti and Donovan's study, however, the other independent variable, access to open space, was not significantly related to participation in vigorous exercise. Similarly, among a sample of 10-16 year olds, Romero (2005) reported that the overall availability of six recreation facilities was not significantly correlated to the number of days in the past week that the children had engaged in at least twenty minutes of vigorous PA.

Numerous other articles included some measure of walking (a moderate-intensity activity) as an autonomous outcome variable. More than half of these studies reported a primarily positive association between the parks or recreation variables and the walking measures that were examined (Ball et al., 2001; Eyler et al., 2003; Fisher et al., 2004; Giles-Corti et al., 2005; Giles-Corti & Donovan, 2003, 2002a; Humpel, Marshall, 2004; Humpel, Owen,

[6] Vigorous activities are sometimes defined as >6.0 METs (Pate et al., 1995) or those that make you sweat or breathe hard. Moderate activities are those that do not make you sweat or breathe hard or 3.0-6.0 METs.

Leslie, et al., 2004; Li, Fisher, & Brownson, 2005; Wilson et al., 2004). For example, via a telephone survey, Wilson et al. asked over 1000 adults in a southeastern U.S. county to indicate whether they used, did not use, or did not have both parks and trails within 10 miles or a 20-minute drive of their home. Among participants from low socioeconomic status neighbourhoods (i.e., median HHI=$15,600), the likelihood of walking more than 150 minutes per week was three times greater for those individuals who reported they used trails. For participants from higher socioeconomic status neighbourhoods (i.e., median HHI=$27,600), not using parks reduced the likelihood of reporting high levels of walking by more than half.

Four studies, however, reported both positive and non-significant findings depending on the parks or recreation and walking variables analyzed (Brownson et al., 2000; Foster et al., 2004; Humpel, Owen, Iverson, et al., 2004; Li, Fisher, Brownson, & Bosworth, 2005). In four other articles, the associations were mainly not statistically significant (DeBourdeaudhuij et al., 2003; Duncan & Mummery, 2005; King et al., 2003; Wendel-Vos et al., 2004). Li, Fisher, Brownson and Bosworth obtained somewhat mixed results about the importance of recreation facilities and open space to promoting walking. At both the neighbourhood and individual levels of their multi-level analysis, total acreage of green and open space was significantly related to residents' neighbourhood walking activity. Although the *number* of recreation facilities (out of 11) respondents reported being in the neighbourhood was also significantly associated with walking, having parks, playgrounds, or gyms *close by* was not a significant factor. However, in Wendel-Vos et al.'s study of leisure-time and commuting walking and bicycling, the findings about the significance of parks and recreation to walking were clearer. For their large Dutch sample, none of the recreation (e.g., tennis courts, zoo) or park (e.g., woods, parks) facilities they investigated were significant predictors of walking for either purpose. In conclusion, although

some amount of walking is likely included in most PA measurements, the studies that have specifically examined walking as an autonomous activity have generally supported the importance of parks and recreation amenities. Only four of sixteen studies reported only non-significant relationships, while the other twelve suggested that some aspect of parks or recreation amenities was valuable in enhancing this common activity. However, the majority of the independent variables involved some form of open space, usually parks or trails, while the relationship of recreation facilities to walking has been studied less frequently.

In summary, the 50 studies provided some evidence as to the associations between different types and proximities of parks and recreation facilities and various purposes and intensities of PA. With approximately 80% of the articles showing at least some significant relationships, parks and recreation and PA appeared to share a positive association. However, such generalized conclusions must be drawn with caution for several reasons. For instance, only eight of the 50 studies reviewed involved participants younger than 18 years of age (e.g., Carver et al., 2005; Duncan et al., 2004; Gomez et al., 2004; Gordon-Larsen et al., 2000; Mota et al., 2005; Norman et al., 2005; Romero, 2005; Timperio et al., 2004), and seven out of these eight studies showed either non-significant or mixed findings. Therefore, the strength of the association between parks or recreation and PA for non-adult samples appears somewhat more attenuated. Additionally, less than one-fifth of the studies reported findings disaggregated by gender (Carver et al., 2005; De Bourdeaudhuij et al., 2003; Foster et al., 2004; Gomez et al., 2004; Humpel, Marshall, et al., 2004; Humpel, Owen, Iverson, et al., 2004; Humpel, Owen, Leslie, et al., 2004; Reed & Phillips, 2005), despite the fact that female rates of PA participation, especially in youth, are lower than those of males (Caspersen, Pereira, & Curran, 2000). In about half of these studies, the association between parks or recreation and PA was different between

the two genders. Complex relationships may exist for other population sub-groups as well (e.g., races, income levels). As Sallis, Cervero, Ascher, Henderson, Kraft, and Kerr (2006) concluded, most of the active living research to date has involved middle class, mostly white adults living in urban and suburban settings.

Further, the studies reviewed employed diverse operationalizations of both parks or recreation and PA. For example, proximity definitions (e.g., within neighbourhood, walking distance) ranged from 400m to 1500m or 5 minutes to 20 minutes, while many studies left it up to the respondent to define terms like "access/availability" or "neighbourhood/near my home." Similar diversity was evident in the PA variables employed. In addition, as with any regression-type analyses such as the frequent use of odds ratios, controlling for or including different variables changes the impact of the predictor variables on the outcome measures. Some studies listed the variables that were included in the model at different steps of the analysis, but other authors either elected not to control for covariates or failed to report this stage in their narratives.

Another aspect notably missing from this research review was a corpus of qualitative studies. Only a handful of qualitative studies were uncovered in the searches (e.g., Hesketh, Waters, Green, Salmon, & Williams, 2005; Thompson et al., 2002; Thomson, Kearns, & Petticrew, 2003) and almost all of the descriptions of park and recreation amenities therein were lacking. For example, in a study about perceptions of parents and children regarding healthy eating, activity, and obesity, Hesketh et al. found that parents thought the local environment including playgrounds, bike tracks, and sporting facilities helped encourage children to be physically active. The parents noted that their children "frequently used the available facilities but expressed a need for a greater number and variety of facilities, particularly in light of the decreasing size of backyards" (p. 23). Although this qualitative information is useful, it provides

little detail. Similarly, the American Indian women in Thompson et al.'s study described the lack of access to affordable and convenient facilities but provided limited descriptions about the operation of those facilities or the proximity needed. The value of qualitative studies in the future may be in the potential to elicit greater detail that can be used in designing and providing public park and recreation programs and amenities.

Finally, almost all of the studies reviewed were cross-sectional. Therefore, inferring causality or the direction of the relationship is nearly impossible. Cross-sectional studies are important for expediently identifying factors that might be targeted to improve PA in controlled or community intervention studies (Sallis & Owen, 1999). Nevertheless, even when one variable (e.g., proximity of park) is treated as the independent or predictor variable by the researcher(s), concluding from a cross-sectional survey that this variable is causing the change in the other measure (e.g., meeting recommended PA levels) is difficult, or that the causal effects, if any, are not reversed or even reciprocal.

With these limitations in mind, some conclusions can be offered with respect to the literature reviewed. Results concerning the types of parks and recreation amenities and PA were mixed, but generally trails, parks, open spaces, golf courses, swimming pools, and other water forms were more likely to be associated with PA than recreation centres, exercise facilities, and sports facilities. Drawing conclusions about the importance of proximity to park or recreation areas or facilities was difficult because of the mixed results and the wide variety of descriptors used to measure access and proximity. However, the studies that used continuous distance measures generally reported that improved proximity was associated with increased PA. With respect to the purpose of the PA, somewhat surprisingly, park or recreation amenities were more likely to be associated with exercise or utilitarian, rather than recreational, activity. Relative to

intensity of PA, walking, a moderate-intensity activity, was associated with park and recreation amenities in most of the studies that examined this common form of exercise. More mixed results were reported for the association between parks and recreation amenities and other moderate and vigorous PA variables. Overall, then, this systematic review provides some evidence about the contribution that parks or recreation make to PA but most of the findings are generally inconclusive.

Perhaps even more problematic, though, was the lack of detail about parks and recreation amenities that appeared in the literature reviewed. Sallis et al. (2000) proposed a five-phase framework to classify stages of research in any area of behavioural epidemiology: 1) establish links between the behaviour (e.g., park-based PA) and health; 2) develop measures of the behaviour; 3) identify influences on the behaviour (e.g., proximity to park); 4) evaluate interventions to change the behaviour; and 5) translate research into practice. Very few studies amongst those reviewed fell into the latter stages, indicating a lack of methodological maturity in research investigating the relationship of parks and recreation with PA (Sallis et al., 2000). Most of the studies would rudimentarily be classified into phase 3, while few articles addressed parks or recreation measurement, interventions, or implementation.

To address the lack of detail in studies investigating associations between parks and recreation amenities and PA, some recent efforts have been made to advance thinking in this area. Two of these examples appeared recently in the *American Journal of Preventive Medicine*. Godbey et al. (2005) provided a review of several topics in the leisure studies and park and recreation management literature that have relevance to promoting active living. Among other things, they discuss the concepts of constraints, flow, specialization, leisure socialization, and crowding and conflict. A similar section is found within Sallis et al. (2006) describing the

importance and contributions of the field of leisure studies to the active living research agenda. Bedimo-Rung et al. (2005) described a conceptual model to associate park environments with PA. The model describes four geographic areas and six conceptual areas in parks which should be studied and then examined in relation to PA levels of users and nearby residents. The four geographic areas include activity areas (e.g., playgrounds), supporting areas (e.g., washrooms), overall park (e.g., size, aesthetic appeal), and surrounding neighbourhood (e.g. appeal, crime). Park conceptual areas include features (e.g., physical facilities), condition (e.g., maintenance), access (e.g., availability), aesthetics (e.g., design), safety (e.g., perceived and objective), and policies (e.g., budgets). According to the authors, data should be collected on each of the conceptual areas within each of the four geographic areas in order to increase understanding of the park characteristics that are related to PA. A similar methodology for relating park characteristics to PA was described by Saelens et al. (2006) and was used in this study (see Chapter 3).

Others within the field of leisure studies have called on parks and recreation departments to reposition themselves as health promotion agencies (Payne, 2002), and PA is one specific component of health promotion that leisure studies and recreation management may be especially suited to contribute to (Henderson & Ainsworth, 2002). Although leisure studies researchers have not completely ignored issues related to PA (cf. Green, Smith, & Roberts, 2005; Henderson et al., 2001; Hubbard & Mannell, 2001; Miller & Brown, 2005; Rosenberger, Sneh, Phipps, & Gurvitch, 2005; Spreitzer & Snyder, 1983; Thompson, Rehman, & Humbert, 2005), significant opportunities remain to advance understanding and implementation of the ways parks and recreation amenities are associated with PA amongst community members. To facilitate this potential direction, three types of repositioning strategies have been proposed to assist parks and

recreation agencies in addressing significant community-wide concerns such as PA and health (Kaczynski & Crompton, 2004a; 2004b). The first, and most important, type is real repositioning, wherein an agency actually changes its program and facility offerings to be more conducive to PA promotion. Such strategies could include altering the design of parks and facilities, changing programming to focus on more active offerings, and placing increased emphasis on promoting active pursuits in communications with the public. Once an agency's operations are in line with its objective(s) (e.g., PA promotion), it can employ i) psychological repositioning so that stakeholders views its services in terms of end outcomes (e.g., increased community PA levels) rather than means (e.g., swimming pools), and ii) competitive repositioning to demonstrate the superior effectiveness and efficiency of investments in parks and recreation in contrast to other methods (e.g., the health care system) for addressing (or redressing) problems related to inactivity and obesity. Supported by an improved understanding of the ways in which parks and recreation are related to PA, municipal agencies can reposition themselves as significant contributors to this prominent public concern.

Other Marketing Mix Elements Related to Physical Activity Promotion

To this point, significant emphasis has been placed on the impact the built environment has on limiting or enhancing opportunities for PA. This viewpoint is similar to the distributional component of marketing or service delivery. However, other elements of the traditional marketing mix may also influence physical activity involvement, including factors related to programming, pricing, and promotion. For example, a significant body of literature exists describing programmatic efforts to foster PA participation. Community walking and running groups have often been used as interventions in experimental research (Brownson, Baker, et al., 2004; Fahrenwald, Atwood, & Johnson, 2005; Fisher & Li, 2004). Many studies have also

examined the impact of implementing workplace programs, facilities, counselling, and other interventions to promote PA (e.g., Dishman, Oldenburg, O'Neal, & Shephard, 1998; Engbers, van Poppel, Paw, & van Mechelen, 2005; Oldenburg, Sallis, Harris, & Owen, 2002; Pohjonen, & Ranta, 2001; Purath, Miller, McCabe, & Wilbur, 2004; Shephard, 1996).

Considerably less attention, however, has been placed on the impact of pricing policies on PA participation. The male teenagers in Allison et al.'s (2005) qualitative study cited the cost of facilities as a barrier to their participation in PA. Other interview research by Corti, Donovan, and Holman (1997) reported that people felt they were most likely to be physically active when they had access to both free and pay facilities. However, at least one experimental study showed that providing access to free facilities, alone, does not lead to increases in physical activity levels (French, Jeffery, & Oliphant, 1994). Therefore, the potential impact of manipulating pricing decisions to increase PA appears uncertain. However, the association of pricing/cost issues and PA has been explored to a much lesser extent than other marketing-related factors, especially in intervention research.

Finally, a great deal of research and health practice has dealt with promotion or communication efforts to encourage PA participation. For example, common are public health messages that promote the benefits of a more active lifestyle, and parks and recreation department's seasonal brochures and other materials sometimes contain similar messages. Owen, Bauman, Booth, Oldenburg, and Marcus (1995) evaluated the success of national media campaigns in back to back years (1990 and 1991) in Australia that used television advertisements and serials, public service announcements, magazine articles, and several other smaller strategies to encourage people to engage in greater levels of walking. Prevalence of walking for exercise in the past two weeks was significantly higher post-campaign vs. pre-campaign for the three oldest

age groups in the study (40-49, 50-59, and 60+). However, these increases were modest (e.g., 5-10% per age group) and only observed for the first year's campaign (1990). Marcus, Owen, Forsyth, Cavill, and Fridinger (1998) conducted a review of seven such studies that used state or national media-based PA interventions and 21 studies in which media campaigns were delivered through the workplace or in the community. They concluded that recall of messages in those studies was generally high, but mass media campaigns had very little impact on PA behaviour, especially beyond the short term.

In summary, each of the "4 Ps" of the marketing mix may be used to encourage PA participation among various populations. However, the present study primarily addresses the "place" or distribution component in examining how elements of the built environment, including parks and recreation amenities, are associated with PA levels of community members.

CHAPTER THREE: METHODOLOGY

This study involved four integrated components. The first component was a questionnaire investigating various personal, psychosocial, and environmental variables related to PA, as well as certain outcome measures of PA and health. The second component was a seven-day PA log booklet in which participants provided detailed information about their individual PA episodes over the course of a week. The third component involved objective measurement of PA using accelerometers with a subset of participants who completed the first two parts of the study. Finally, the fourth aspect of the study involved direct observation of particular parks and open space areas using an instrument designed to capture the features of these areas that may be related to PA. This chapter describes the four components in roughly the order listed above and concludes with the study's research questions and data analysis strategies.

Data Collection Procedures

Study Area

Study participants included adults (18 years and older) living in four selected planning districts in the City of Waterloo. At the time of the study, the City of Waterloo was divided into 6 wards (changed to 7 for the November 2006 municipal election) and was further subdivided into 23 planning districts, not including the Rural East and Rural West districts that had yet to be planned (personal communication, April 27, 2006, Dan Currie, City of Waterloo). The four districts selected for sampling in the study included Central, Willowdale, Beechwood, and Eastbridge. Selected features of each district based on 2001 Statistics Canada Census data are listed in Table 3 and each is described briefly below using data from the City of Waterloo website (City of Waterloo, 2006a, 2006b) and additional information provided by City staff.

These four districts were selected because they represent a diverse mix of population characteristics, population densities, designs, and land uses.

Table 3
Selected Features of Selected City of Waterloo Planning Districts

District	Area (ha)	House-Holds[1]	Single-Detached[2]	Median Income[3]	Immigrant Population[4]	Youth (0-19)[5]	Adults (20-64)[5]	Adults (65+)
Central	439	4,425	55.3%	$40,060	22.8%	13.7%	64.8%	21.6%
Willowdale	316	3,500	32.3%	$50,371	18.0%	20.4%	59.3%	20.2%
Beechwood	320	2,905	58.0%	$74,815	23.5%	25.1%	64.1%	10.6%
Eastbridge	274	865	77.5%	$82,738	16.5%	30.7%	65.3%	3.2%
All Waterloo	6535	32,625	55.4%	$62,747	21.8%	26.5%	62.4%	11.0%

Table 3 Notes:
1. All district data, including number of households, are based on the 2001 Statistics Canada Census as compiled by City of Waterloo Development Services staff.
2. Percentage of total dwellings (households) that are single-detached houses.
3. Median *household* income. Households include both families and all other non-family households including people who live alone and unrelated or unmarried people who live together (as contrasted with median *family* income which represents income from families of married or common law couples with or without children or a lone parent with children).
4. Percentage of district residents born outside of Canada.
5. Census age categories overlapping the customary lower cut-off for "adult" classification (18 years old) include 15-19 years and 20-24 years old. Thus, 0-19 years has been used here to delineate the "youth" category.

The Central planning district covers 439 hectares and is bounded roughly by University Avenue to the north, Weber Street to the east, the Waterloo-Kitchener border to the south, and several streets running parallel to and just east of Westmount Road on its west side (Figure 2). Notably, it includes the core, downtown area of the city, and the majority of its streets run in a traditional, grid-like pattern that has been associated with increased levels of PA in transportation research (Saelens, Sallis, & Frank, 2003). Most of the development in this area happened between 1850 and 1945, although some redevelopment of properties has since occurred. According to the 2001 census, approximately 4,425 households existed within the district, making it the district with the greatest number of households (although it is not the greatest in area). This district has a similar percentage of immigrants as the entire City of Waterloo, but a

substantially lower proportion of single-detached dwellings and a lower median household income. With respect to age composition, a substantially smaller percentage of youth (0-19 years) but a substantially greater proportion of older adults live in the heart of the city. The Central district contains Waterloo Park as well as several other small green spaces. Waterloo Park covers 47 hectares and contains four playgrounds, four ball diamonds, two multi-use sports fields, one cricket-pitch, and a seasonal petting zoo. Other major City of Waterloo facilities such as the Waterloo Memorial Recreation Complex (Olympic-sized ice surface, multi-use swimming pool), Rink in the Park (curling), and the Adult Recreation Centre are also located within the boundaries of the Central district.

The Willowdale planning district covers 316 hectares is bounded roughly by Weber Street on the west, University Avenue on the north, the Conestoga Parkway on the east, and the Kitchener-Waterloo border to the south (Figure 3). It was largely developed in the 1950s and 1960s. Willowdale contains 3,500 households with a similar percentage of single-detached dwellings to that found in the City of Waterloo as a whole, but a lower household income than the city-wide median. Moreso than the other selected districts or the city as a whole, Willowdale's population is composed of a higher proportion of both youth and older adults. The City of Waterloo's Moses Springer Community Centre, including the Moses Springer Park Preserve (4.92 ha) and the recreational aquatics facility and arena (3.34 ha), are located within the Willowdale district. Four other parks (Vermont, Roselea, Harvard, and Willowdale), ranging in size from 0.43 hectares to 4.22 hectares also fall within the district's boundaries.

Figure 2: Map of Central Planning District

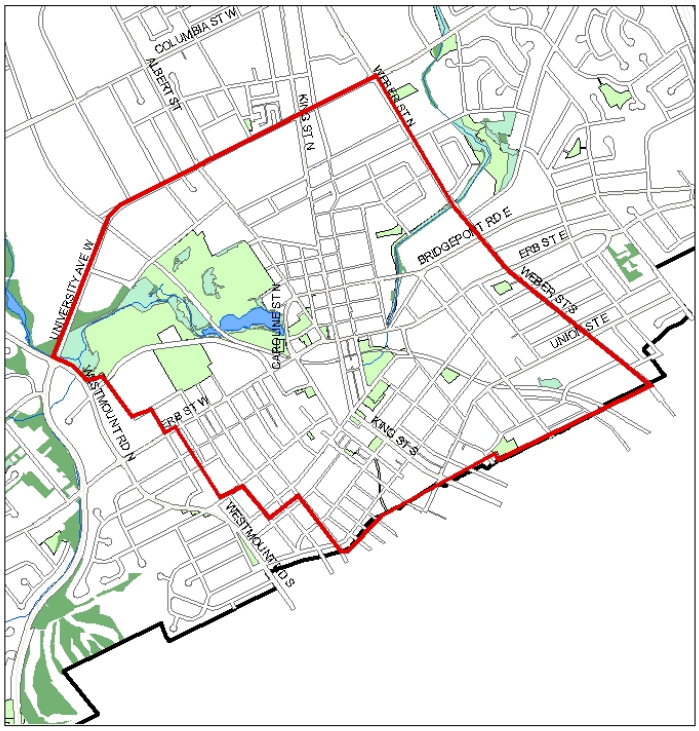


Figure 3: Map of Willowdale Planning District

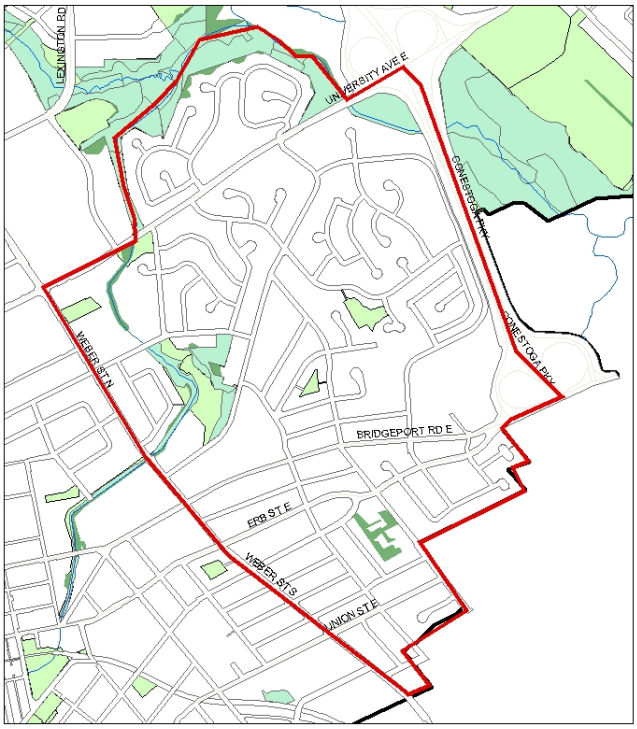


Figure 4: Map of Beechwood Planning District

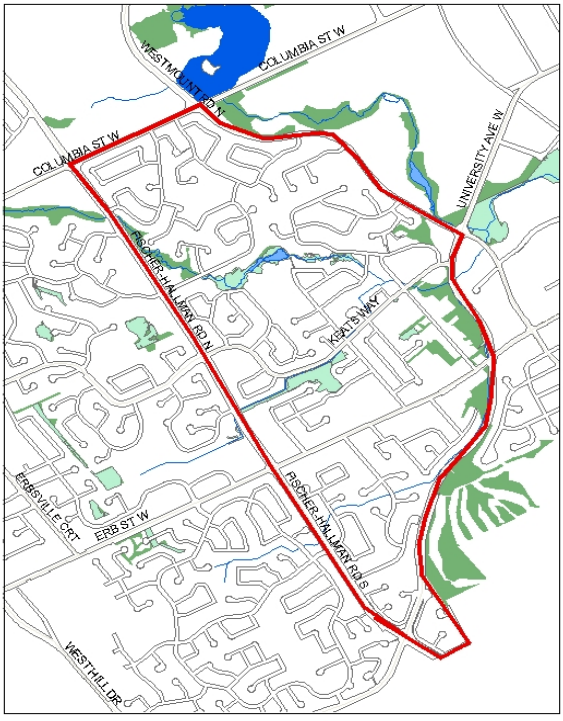
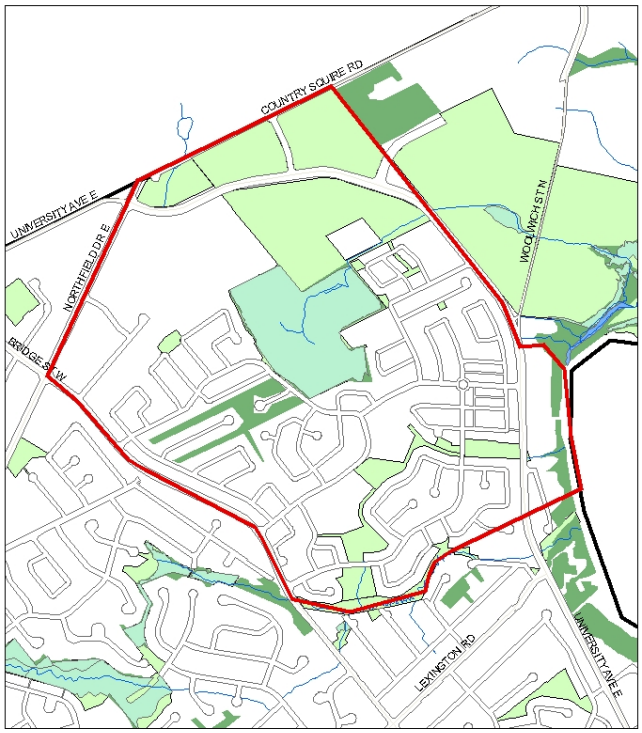


Figure 5: Map of Eastbridge Planning District


COUNTRY SQUIRE RD
UNIVERSITY AVE E
NORTHFIELD DR E
WOODWICH ST N
BRIDGE ST W
LEXINGTON RD
UNIVERSITY AVE E

The Beechwood planning district covers 320 hectares and is bounded roughly by Columbia Street to the north, Westmount Road to the east, University Avenue to the south, and Fischer-Hallman Road to the west (Figure 4). This area was developed in the 1960s and 1970s. Street patterns in Beechwood are characterized by numerous crescents and cul-de-sacs. Its percentage of single-detached dwellings and population composition by age are almost identical to that found in the city as a whole, but the median household income is substantially higher in this district. Beechwood does not contain any 'signature' City of Waterloo parks or recreation facilities, but the district has numerous parks and open spaces (many of which are linear in shape and/or highly connected), including Clair Lake Park (9.26 ha), Craigleith Park (4.16 ha), Old Post Park (2.54 ha), and Keatsway Woods (1.88 ha), among others.

Finally, the Eastbridge planning district covers 274 hectares and is bounded roughly by Bridge Street to the west, Northfield Drive to the north, University Avenue to the east, and a combination of streets and creeks to the south (Figure 5). Development in this area began in the 1990s and continues in the current decade. Like Beechwood, the majority of the streets in Eastbridge are curved and lack connectivity, making them non-conducive to direct travel to a destination. According to 2001 census data, Eastbridge had only 865 households but these included a very high proportion of single-detached dwellings (77.5%). Its median household income was also the highest of the four districts and it contained fewer immigrants, almost no older adults, and a high proportion of youth. Although other green spaces can found be within the district, adjacent to Eastbridge on its northeast corner is the 212.5 hectares comprising the City of Waterloo's RIM Park. RIM Park includes a major indoor recreation facility housing multiple gymnasiums, playing fields, and ice pads, among other amenities, while its outdoor

facilities include a championship golf course, three playgrounds, six ball diamonds, and twelve sports fields.

Pretest Procedures

A convenience sample of 19 Waterloo residents who lived in the four study districts each completed the three components described below that were engaged in by study participants (questionnaire, PA log booklet, and accelerometer). These pretest participants were recruited solely based on their residence in one of the four study areas and they represented a range of age groups, socio-demographic backgrounds, and PA participation levels. Participants were asked for feedback regarding clarity and wording of questions and any concerns related to recording their PA episodes in the log booklet. Some difficulty was reported by one pretest participant with respect to the response format for the two social support scales included in the questionnaire (see section C of Appendix D). Otherwise, only minor editorial changes to the study materials and protocols were suggested by the pretest participants (e.g., a missing number on one of the scales) and the data collected from them have consequently been included in the results described in the following chapter.

Sampling and Data Collection Process

Potential participants for the main phase of the study were selected from property lists for each of the four districts that were provided by City of Waterloo staff. These lists included, among other information, the address and zoning category for each property. Prior to sample selection, all non-residential properties were removed from the list. Then, residentially-zoned properties which represented more than one household (e.g., triplex) but which were represented as only a single row in the property database were reproduced to be represented by a more accurate number of rows (e.g., three for a triplex). This ensured, to the extent possible, that each

existing household in the district had the potential to be selected as part of the study sample and that the ratio of property types (e.g., single-detached, semi-detached, multi-unit, etc.) in the district was accurately represented in the database. After these initial steps, 250 households per district were systematically selected for the initial sample.

Prior to delivery of the study materials, an introduction letter was mailed to the 250 selected households per district that described the study and the forthcoming visit by a member of the study team (Appendix A). Approximately one week later, in mid-August 2006, a team comprised of the author and 15 students (2 graduate and 13 undergraduate) distributed the study materials. Each team member attended four two-hour training sessions which covered topics including background about the study, data collection procedures, and the participant recruitment script (Appendix B). The 1000 households across the four districts were divided into 33 data collection routes of approximately 30 addresses each. Working in pairs (usually on opposite sides of the street) and dressed in University of Waterloo shirts and wearing study nametags, team members visited one route per evening between the hours of 6:00-9:00 p.m. For each household where an adult was home, the team member described the study and asked for the participation of any or all of the adults in the home using the recruitment script. Each visit to a home lasted approximately 5-7 minutes.

At the conclusion of each visit, the team member recorded the result of the visit on the data collection route sheet (Appendix C). If one or more adults in the home agreed to participate, the number of packages handed out was recorded. The person spoken with was also given a card which listed the date on which a study team member would return to pick up their completed materials (approximately 8-10 days later). If the household refused to participate, this was also noted on the route sheet along with a reason for the refusal where available. If the address was

initially inaccessible (e.g., gated) or non-existent, this was also noted. Finally, if no one was home at this initial visit, this was noted and a second visit was attempted approximately 1-4 days later.

As well, when a “not home” was encountered on the first visit to a household that was part of the initial sample of 250 addresses, a study introduction letter was also dropped off to the mailbox of a neighbouring home and this address recorded in a blank row on the route sheet. When the household that was initially not home was visited for a second contact, the secondary home was also visited for the first time. The result of both of these visits was recorded, as described above, as “package(s) accepted”, “refused”, or “not home”. In some cases, further contacts were attempted on subsequent nights for both initial and secondary households when time permitted. Table 4 in the Results section (Chapter Four) describes the number of households that were visited, reached (i.e., someone was home), accepted, and refused.

Approximately 8-10 days after the initial distribution of study packages, team members returned to each route to re-visit houses that had initially agreed to participate. The result of these visits was recorded, similar to the initial visit, as “packages completed - #”, “packages incomplete”, or “not home”, and numerous attempts were made to reach the household (including one phone call with message) until a conclusive result was achieved (e.g.., complete or incomplete). During these visits, team members quickly reviewed certain aspects of the study booklets and asked about and clarified any problems or concerns encountered by the participant. Participant compensation, described in the next section, was also disbursed at this time.

After the first round of data collection, approximately 450 study packages had been retrieved from participants. However, the Beechwood and Eastbridge study areas comprised a disproportionately large percentage of this total, while fewer packages had been retrieved from

the Willowdale and Central districts. Consequently, a second round of data collection was undertaken in which 45 new addresses in both Willowdale and Central were delivered study introduction letters and subsequently visited in the manner described above. This process occurred over approximately ten days in mid-September 2006. The result of this extra effort was a more even number of completed packages across the four study areas (see Table 4).

Participant Compensation and Feedback

As part of the door-to-door recruitment script, potential participants were told that they would receive $5 per respondent for participating in the study. These funds were distributed when picking up the study materials upon receipt of partially- or fully-completed packages. Additionally, each participant who requested a copy of the results of the study via a question on the back of the study questionnaire, was given the opportunity to receive personalized feedback from his or her seven-day PA log. Four randomly-selected study participants (one from each district) also won a $50 gift certificate to a restaurant of their choosing.

Measures of Questionnaire Variables

Numerous correlates of PA have been identified in the literature, many of which were discussed in Chapter Two. The following sub-sections describe personal, psychosocial, and environmental variables that were assessed using the resident questionnaire. Self-report and objective methods used to measure PA and the process for rating park features (the second, third, and fourth components of the study) are discussed in subsequent sections.

Personal Variables

Chapter Two described several socio-demographic and other personal variables that have been shown to be associated with PA in adult populations. The final section of the resident questionnaire (section J of Appendix D) includes questions related to the gender, age, height, and

weight of all household members, as well as education level, employment status, and marital status of the participant. Several other variables related to the overall health of the questionnaire respondent are also included, such as smoking behaviours, injuries or disabilities, and current health problems. Additionally, a few questions are included about factors that may impact PA participation, such as auto ownership, having a membership to a gym, and owning home exercise equipment. Finally, section A7 of the questionnaire asks the respondent to indicate how important several factors were in the decision to move to his/her current neighbourhood of residence. The scale includes 11 items, as well as an "other" option, and is taken from the Twin Cities Walking Study Survey (available at http://www.activelivingresearch.org/ index.php/Twin_Cities_Walking_Survey/328) which originally adapted the scale from a research report reproduced by Frank, Leerssen, Chapman, and Contrino (2001) for the Georgia Institute of Technology. In cross-sectional studies examining the association of neighbourhood features and PA, issues related to causation are difficult to resolve. A primary concern relates to whether activity-friendly neighbourhoods promote increased PA or whether people who are already active choose activity-friendly neighbourhoods (Berrigan & Troiano, 2002; Sallis & Glanz, 2006). Inquiring about motivations for choosing the neighbourhood (e.g., proximity to parks and recreation facilities) will help to address some of these confounding issues, as necessary.

Psychosocial Variables

Self-Efficacy

Numerous prominent scales exist for measuring self-efficacy related to exercise and PA involvement (Marcus, Selby, et al, 1992; McAuley, 1992; Sallis, Pinski, Grossman, Patterson, & Nader, 1988; Dishman et al., 2002; see also Davis, Fox, Brewer, & Ratusny, 1995; DuCharme & Brawley, 1995; Garcia & King, 1991; Ryckman, Robbins, Thornton, & Cantrell, 1982; Saunders

et al., 1997). However, for some of these measures, the items were not printed in the original (or subsequent) articles, while others were developed with and/or have only been used with populations dissimilar (e.g., adolescents) to the adult sample in this study. The measure used in this study was Sallis et al.'s (1988) Self-Efficacy for Exercise Behaviors Scale. This instrument consists of two subscales comprised of five and seven items, respectively, that measure respondents' confidence in "making time for exercise" and "resisting relapse". Originally, items were developed based on interview data with 40 adults aged 45 years or younger who had children aged 8-16 and who were in the process of making a health behaviour change. Sallis et al. (1988) reported test-retest reliabilities of .68 for both subscales and internal consistency alphas of .83 and .85 in a sample of primarily university students. The scale also demonstrated satisfactory validity when correlated with reports of vigorous exercise participation and a health locus of control measure (Sallis et al., 1988). Among others, the full scale has been used recently by Rovniak et al. (2002), Sallis, Calfas, Alcaraz, Gehrman, and Johnson (1999), Texeira et al. (2002), Nies, Chruscial, and Hepworth (2003), Wilcox, Bopp, Oberrecht, Kammermann, and McElmurray (2003), and Wilson et al. (2002), with the latter four studies reporting internal consistency results of .84, .87, .95 and .96, respectively.

Several minor changes were made to the scale, however, for the present population and for the current study's purpose. The original scale is provided below (Figure 6) while the amended scale is presented in section D of Appendix D. First, all references to "exercise" within the items were changed to "physical activity". Many of the original scales (e.g., see also the social support scale below) that were developed to measure constructs related to social cognitive theory addressed participation in regular exercise programs, given that the literature in those areas focused more narrowly on exercise than PA at the time. Nevertheless, various versions of

the scale developed by Sallis et al. (1988) have been used since in studies that focused more broadly on PA (e.g., Nies et al., 2003; Rovniak et al., 2002; Sallis et al., 1999; Texeira et al., 2002; Wilcox et al., 2003; Wilson et al., 2002). Second, and similarly, several items, especially those in the 'resisting relapse' dimension of the scale, begin with the phrase "Stick to your exercise program when …". Instead, these items were changed to read "Be physically active when …". Finally, one item that reads "Read or study less when …" was removed because it is likely inappropriate to the majority of the present sample, and cannot be altered only minimally to make it more suitable. Each of the remaining 11 items were rated on a scale ranging from "not at all confident" (1) to "very confident" (7).

Figure 6: Original Items in the Self-Efficacy for Exercise Behaviors Scale (Sallis et al., 1988)

Resisting relapse:

Stick to your exercise program when your family is demanding more time from you.
Stick to your exercise program when you have household chores to attend to.
Stick to your exercise program even when you have excessive demands at work.
Stick to your exercise program when social obligations are very time consuming.
Read or study less in order to exercise more.

Making time for exercise:

Get up early, even on weekends, to exercise
Get up earlier to exercise
Stick to your exercise program after a long, tiring day at work
Exercise even though you are feeling depressed
Set aside time for a physical activity program for at least 30 minutes three times per week
Continue to exercise with others even though they seem to fast or too slow for you
Stick to your exercise program when undergoing a stressful life change (e.g., divorce, death in the family, moving)

Social Support

Social support is another variable from social cognitive theory that was included as a potential influence on PA. As described earlier, social support has been positively associated

with PA and exercise in numerous studies (Trost et al., 2002). Social support for PA was measured using the Social Support for Exercise Scale developed by Sallis et al. (1987). Like the self-efficacy scale described above, this instrument was developed based on interview data. Several versions of the scale have appeared in the PA literature. However, for this study, the 12 items in the 'participation and involvement' factor were employed (c.f., Orsega-Smith et al., 2003; Silver Wallace et al., 2000; Treiber et al., 1991). Several studies have reported that this version of the scale has strong internal consistency and test-retest reliability (Orsega-Smith et al., 2003; Sallis et al., 1987; Silver Wallace et al., 2000). Sallis et al. (1987) also conducted tests of criterion-related and construct validity and obtained sound preliminary evidence of both traits. Further reliability and validity tests in several racially diverse samples also showed positive results (Treiber et al., 1991).

Social support from friends and social support from family were both examined. Friends and family are the two groups most commonly studied amongst adult samples in the PA literature, and they are thought to adequately cover the sources from which the majority of adults' social support for PA might originate. Consistent with previous studies (e.g., Sallis et al., 1987), friends are defined in the scale introduction as "friends, acquaintances, and co-workers", while family is defined as "members of your household".

The social support scale used in this study appears as section C in Appendix D. The original Social Support for Exercise Scale referred, not surprisingly, to support for "exercise". However, several studies that have examined PA more broadly have also employed versions of this instrument (e.g., McNeill, Wyrwich, Brownson, Clark, & Kreuter, 2006; Oliver & Cronan, 2005; Rovniak et al., 2002). In this study, the term "physical activity" will replace "exercise" in each statement (Sylvia-Bobiak & Caldwell, 2006). For each of the 12 items, participants were

asked to rate whether they perceived that form of support in the past three months from each source of support (i.e., friends or family) on a 7-point scale ranging from strongly disagree (1) to strongly agree (7). Internal consistency for the 12-item scale was assessed using coefficient alpha and a single mean score for social support was calculated for each of the family and friends scales.

Stage of Change/Readiness for Physical Activity

As was described in Chapter Two, many studies of PA and exercise have employed the stages of change construct from the Transtheoretical Model to examine participants' levels of readiness to engage in regular PA (Prochaska & Marcus, 1994). In this study, stage of change for PA was measured by asking participants to indicate which one of five statements about their current PA participation best applies (see section B of Appendix D) The five statements representing the five stages of change were as follows (Marcus, Selby, et al., 1992):

Precontemplation:	I currently do not engage in physical activity, and I do not intend to start doing so in the next 6 months.
Contemplation:	I currently do not engage in physical activity, but I am thinking about starting to do so in the next 6 months.
Preparation:	I currently participate in some physical activity, but not regularly.
Action:	I currently participate in physical activity regularly, but I have only begun doing so in the last 6 months.
Maintenance:	I currently participate in physical activity regularly, and have being doing so for longer than 6 months.

The introduction to the scale also included a definition of "regular" PA which is consistent with recommendations for frequency of PA participation.

These statements have been used to classify participants into different stages of readiness for PA in a number of studies involving a wide range of populations (Berry, Naylor, & Wharf-Higgins, 2005; Cox, Stimpson, Poole, & Lambur, 2003; Fahrenwald & Walker, 2003; Marcus & Owen, 1992; Silver Wallace et al., 2000). When the stage of change instrument was originally

developed, Marcus, Selby, et al. (1992) asked respondents to rate *each* statement on a 5-point, disagree-agree scale and then categorized each person into the stage with which they agreed most strongly. Other similar response formats (e.g., true or false for each statement) have been used infrequently, but these options would seem to be equally inappropriate and ineffective for determining a *single* stage within which to classify respondents. In later uses of the instrument, Marcus and colleagues have employed a ladder-shaped scale (Marcus & Owen, 1992; Marcus, Eaton, Rossi, & Harlow, 1994). The statements for precontemplation, contemplation, preparation, action, and maintenance were placed on rungs 0, 2, 5, 8, and 10, respectively, with the formal stage labels not included on the diagram. However, the rationale behind the unbalanced placement of the levels on the ladder was unclear. Therefore, in this study, respondents are simply asked to check a single box to indicate which statement/stage best applies to their situation.

With a variety of response formats, two-week test-retest reliability correlations for these stage of change statements have ranged from .78 to .92 (Marcus, Selby, et al., 1992; Fahrenwald & Walker, 2003). Stages of change classifications have been validated by comparing indicated stage levels with objective measurements of functional capacities (e.g., volume of oxygen consumption) that are related to PA participation (Cardinal, 1997) as well as self-reported amounts of PA participation (Cardinal, 1997; Marcus & Simkin, 1993).

Decisional Balance

A 16-item scale developed by Marcus, Rakowski, and Rossi (1992) is the measure used most widely to assess study respondents' perceived "pros" and "cons" of exercise. Ten items assess pros of exercise (e.g., I would feel less stressed if I participated in physical activity regularly), while six items assess cons of exercise (e.g., I would have less time for my family and

friends if I participated in physical activity regularly). A high score on the pros scale indicates that the benefits of behaviour change are important, while a high score on the cons scale indicates that the costs of behaviour change are influential. Decisional balance represents the difference between summary scores for the pros and cons scales, with a positive score indicating greater perceptions of pros and a negative score indicating more cons than pros.

The decisional balance scale was originally developed based on Velicer et al.'s (1985) efforts to measure pros and cons of smoking cessation that in turn built upon earlier work by Janis and Mann (1977). In examining PA and exercise, the scale has been employed in populations as varied as middle school students, high school students, university students, older rural women, low income patients attending primary care clinics, persons in alcohol treatment programs, as well as general samples of adults (e.g., Berry et al., 2005; Carmack Taylor et al., 2003; Cox et al., 2003; Hausenblas et al., 2002; Naylor, McKenna, Barnes, & Christopher, 1995; Read et al., 2001; Wilcox et al., 2003). The original developers of the 16-item scale reported internal consistency reliabilities of .95 and .79 for the pros and cons subscales, respectively (Marcus, Rakowski & Rossi, 1992). Other close or exact variations of the scale have shown internal consistency alphas of between .85 and .93 for the 10 pros items and .67 to .84 for the 6 cons items (e.g., Berry et al., 2005; Carmack Taylor et al., 2003; Hausenblas et al., 2002; Litt et al., 2002; Nigg & Courneya, 1998; Pinto, Lynn, Marcus, DePue, & Goldstein, 2001; Wilcox et al., 2003). All of pros, cons, and decisional balance scores have shown significant concurrent validity in differentiating people at different stages of exercise adoption (Marcus et al., 1992).

In this study, like others, participants were asked to rate each of the 16 items (shown in section G of Appendix D) for how important each is in their decision as to whether or not to be regularly physically active. The response options range from "not at all important" (1) to

"extremely important" (5). As with several other psychosocial variables described above, references to "exercise" in the item stem and statements were reworded to refer to "physical activity" instead. Three summary scores were calculated by finding the total (from 10 to 50) for the pros items, the total (from 6 to 30) for the cons items, and the difference when the cons are subtracted from the pros.

Environmental Variables

The questionnaire will also include a section in which residents are asked to provide their perceptions of their neighbourhood environment. To assess the built environment as it relates to PA, several neighbourhood audit tools are available for the researcher to physically visit and rate various categories of features, such as safety, aesthetics, land use, and street design (Day et al., 2006; Pikora et al., 2002). However, due to time and other resource constraints, *objective* measurement efforts in this project were concentrated on the parks and open spaces within the study areas using a tool designed specifically for auditing these amenities (see section below on Objective Assessment of Parks and Open Spaces). Broader ratings of the characteristics of study neighbourhoods were obtained from participants themselves.

Neighbourhood Environment Walkability Survey

For this purpose, the Neighbourhood Environment Walkability Survey (NEWS) was employed (Saelens, Sallis, Black & Chen, 2003). The full NEWS instrument is comprised of 83 items within nine sections that address various features of the physical environment that are hypothesized to be related to active living. In this study, the abbreviated version of the instrument (NEWS-A) was used (see sections A1, A2, A3 and A6 of Appendix D). NEWS-A includes only seven sections, having dropped a section related to residents' ratings of satisfaction with various neighbourhood characteristics, while combining the original sections on safety from

crime and safety from traffic into a single section. Within the remaining seven sections, a total of only 10 other items are missing from the full version, bringing the total items in NEWS-A down to 56. Both versions of the instrument are available on the Active Living Research website (http://www.activelivingresearch.org/index.php/NEWS/367). NEWS-A includes sections addressing the following topics: a) residential density, b) land use mix-diversity, c) land use mix-access, d) street connectivity, e) walking/cycling facilities, f) aesthetics, and g) safety from traffic and crime (note that in section A3 of Appendix D, to visually shorten the instrument, parts d-g have been combined into a single section because they address related topics and use the same 4-point, disagree-agree response format).

The NEWS instrument was one of the first measures developed to collect information on residents' perceptions of their neighbourhood environments as they relate to PA and active living. It was created in consultation with a community group composed of transportation, environmental protection, and urban planning professionals, and was based on empirical literature describing environmental influences on PA (c.f. Pikora et al., 2002; Saelens, Sallis, & Frank, 2003; Sallis et al., 1998). Initial reliability and validity tests were conducted with a sample of 107 adults in two neighbourhoods in San Diego (Saelens, Sallis, Black & Chen, 2003). One neighbourhood was classified as high in 'walkability' with a mixture of types of residences, a concentration of commercial property (e.g., stores) along the main corridor of the neighbourhood, and a grid-like street pattern. The other neighbourhood had opposite features (primarily single-family homes and residential property, with curvilinear street patterns and more cul-de-sacs), and was classified as low in 'walkability'. Study participants in the two neighbourhoods completed a mail survey using the NEWS instrument on two occasions

approximately two weeks apart, while also wearing an accelerometer for seven days and completing several self-report PA measures.

Test-retest reliabilities (intraclass correlations) for the eight NEWS sections (including distinct sections for safety from traffic and crime) ranged from .58 to .80, with five of the subscales showing reliabilities greater than .75 (results for the aforementioned 'neighbourhood satisfaction' section of the instrument were not reported; Saelens, Sallis, Black & Chen, 2003). Residents in the high-walkable neighbourhood perceived their neighbourhood as having higher residential density, land use mix-diversity, land use mix-access, street connectivity, aesthetics, and traffic safety than did residents in the low-walkable neighbourhood. However, the latter group reported having more facilities for walking/cycling and no difference between neighbourhoods was found for perceived safety from crime. Residents in the high-walkable neighbourhood engaged in approximately 52 more minutes of moderate-intensity PA and significantly greater total PA over the seven days of accelerometer monitoring. The amount of vigorous-intensity PA was not significantly different between participants in the two neighbourhoods.

In another study in Australia, a slightly modified version of the NEWS instrument showed test-retest reliabilities for the eight subscales that ranged from .62 to .88 (Leslie et al., 2005). Like before, residents in a high walkable neighbourhood held higher perceptions than participants in a low walkable neighbourhood for the majority of the scale dimensions (residential density, land use mix-diversity, land use mix-access, connectivity, and walking infrastructure). Perceptions of aesthetics were higher in the low walkable neighbourhood, while the two safety dimensions were rated similarly in both areas.

In the present study, separate subscale scores were derived for each of the seven sections in the NEWS-A instrument: residential density (items 1-6 in section A1 of Appendix D), land use mix-diversity (items 1-23 in section A6 of Appendix D), land use mix-access (items 1-6 in section A2 of Appendix D), street connectivity (items 1-3 in section A3 of Appendix D), walking/cycling facilities (items 4-6 in section A3 of Appendix D), aesthetics (items 7-10 in section A3 of Appendix D), and safety from traffic and crime (items 11-18 in section A3 of Appendix D). Specific scoring procedures for each section of the instrument are available on the Active Living Research website. For example, in the first section, weighted values based on the approximate density of households per unit area for each type of residence are used to derive a composite score of residential density. All other subscales simply use the mean of the items (after reverse coding particular items, as appropriate). An overall environmental index for each resident was also computed by standardizing and summing the eight subscales (Atkinson et al., 2005).

Physical Activity Self-Report Assessment Methods

The previous sections have described numerous factors which are likely associated with PA and which were used as independent variables for the various research questions in this study. The dependent variable of PA in this study was assessed in three ways: i) via accelerometer with a sub-sample of study participants, ii) via the brief and widely-established Godin-Shephard Leisure Time Exercise Questionnaire, and iii) via a detailed PA log booklet designed specifically for this study. After a brief discussion of the strengths and limitations of self-report measures of PA, this section describes the latter two methods with the use of accelerometers described in the following section.

Numerous methods are available for measuring the amount of time people spend engaged in PA, including direct observation, indirect calorimetry, doubly labelled water, heart rate monitors, electronic monitoring, and self-report instruments (Welk, 2002a). By far the most commonly-used and easily applied method of measuring PA is through self-report questionnaires (Dale, Welk, & Matthews, 2002; Matthews, 2002; Sallis & Saelens, 2000). Two self-report measures of PA to be included on the questionnaire are described in this section.

Self-reported PA measures can take several forms, including self-administered questionnaires, interviewer-administered questionnaires, PA logs, diaries, or records, and proxy reports (e.g., a parent's description of a child's PA using one of these methods) (Dale et al., 2002). Numerous advantages of self-report questionnaires have been discussed in the PA literature (Dale et al., 2002; Matthews, 2002; Sallis & Saelens, 2000). These advantages and strengths include:

- The ability to collect data from a large number of people at low cost.
- It is possible to assess all the dimensions of PA (e.g., type, intensity, etc.) so patterns of behaviour can be examined.
- Recalls do not alter the behaviour under study.
- Low burden and intrusiveness for participant.
- Measures can be adapted to meet the needs of a particular population or research question.
- Can collect both quantitative and qualitative information.
- Data collected can often be adapted/converted to estimate information (e.g., energy expenditure) captured by other methods of PA assessment.

On the other hand, several weaknesses of self-report methods of measuring PA have also been noted (Dale et al., 2002; Matthews, 2002; Sallis & Saelens, 2000). These include:

- Potential reliability and validity problems as a result of several of the following concerns.
- Recalling PA is a highly complex cognitive task (Baranowski, 1988).
- Social desirability bias can lead to over-reporting of PA. Self-reports can provide very reliable and valid estimates of *relative* PA, but may lead to overestimates of *absolute* PA (Sallis & Saelens, 2000).
- There must be shared meaning of some ambiguous terms (e.g., physical activity, moderate-intensity) between the researcher and participant to ensure content validity.

- Proxy reports are limited by the reporter's opportunity to observe the PA of the subject of interest.
- Measures may not assess the primary modes of PA for certain gender, age, cultural, occupational, or income groups.

Other sources have also discussed the relative strengths and weaknesses of other methods of measuring PA, including accelerometers that are described below (Dale et al., 2002). With every method, decisions about tradeoffs in validity, reliability, practicality (e.g., cost), and intrusiveness must be considered. For the purposes of the present study, it was imperative to include self-report instruments for measuring PA for two primary reasons. First, their superior efficiency for gathering a substantial amount of data from a large sample of residents was important given the limited resources available for the project. Second, and more importantly, self-report PA measures, and especially those similar to the detailed activity record described below, facilitate the collection of information about activity episodes that cannot be captured by most other measurement methods. This desirable information includes the type of activity, location, and purpose, among other characteristics. Given these advantages, self-report methods of assessing PA provide the primary data for the dependent variable(s) in this study.

The first self-report measure of PA that was used in this study was the Godin-Shephard Leisure-Time Exercise Questionnaire (G-S LTEQ) (Godin & Shephard, 1985) which was included as part of the study questionnaire (section I of Appendix D). The G-S LTEQ consists of four brief questions and was designed as a simple means to classify people into one of several activity categories during community health and fitness studies. The first three questions address weekly frequency of strenuous exercise, moderate exercise, and mild exercise in response to the prompt: "Considering a 7-day period (a week), how many times on the average do you do the following kinds of exercise for more than 15 minutes during your free time?" Descriptions of physiological symptoms (e.g., heart beats rapidly) and several activity examples are provided for

each of strenuous, moderate, and mild exercise. The respondent simply records a weekly participation number for each of the three types of activity. A fourth and final question asks about weekly frequency of sweat-inducing PA using the categorical response options of often, sometimes, and never/rarely. These questions were developed based on a review of items used in previous prominent PA questionnaires and were able to discriminate between people above and below the 50th percentile for both maximal oxygen intake and body fat (Godin & Shephard, 1985). Numerous others have subsequently used the questionnaire and have documented its reliability and validity (e.g., Jacobs, Ainsworth, Hartman, & Leon, 1993; Miller, Freedson, & Kline, 1994; Sallis, Buono, Roby, Micale, & Nelson, 1993). In this study, references to exercise were changed to "physical activity". In interpreting the data collected from the G-S LTEQ, responses to the strenuous, moderate, and mild frequency questions are usually multiplied by 9, 5, and 3 METS, respectively, and the products summed to obtain a total 'weekly leisure activity' score.

Physical Activity Log Booklet

The second self-report PA measure used in this study was a log booklet developed by the author, based on various existing indicators as well as several new questions, in which participants were asked to record all of their episodes of PA over the course of a seven-day period (see Appendix E). The information gathered with the log was used as the primary dependent variable and provided significant detail about participants' PA patterns. As mentioned above, a plethora of self-report questionnaires have been developed for PA research (c.f. Kriska & Caspersen, 1997; Montoye, Kemper, Saris, & Washburn, 1996). Sallis and Saelens (2000) reviewed the content and psychometric properties of self-administered or interview-administered self-report questionnaires that had been developed or used in articles published in the 1990s.

They concluded that multiple self-report questionnaires exist with adequate reliability and criterion-related (concurrent) validity for use with adolescent, adult, and older adult populations. Their analysis also included an examination of the content validity of the questionnaires by assessing whether each instrument captured type, frequency, intensity, duration, and purpose of the PA. In the measures that had been used with adult populations (which appeared to be more comprehensive than those employed in youth or older adult populations), frequency and intensity of PA were commonly assessed, but data on type, duration, and context/purpose of the PA were collected less frequently by the existing instruments.

Similarly, some of the most popular self-report PA questionnaires include the G-S LTEQ described above, the Seven-Day Physical Activity Recall (7DAY PAR), the International Physical Activity Questionnaire (IPAQ), and the Minnesota Leisure-Time Physical Activity Questionnaire (MLTPAQ). Although each of these instruments has proven useful for capturing a variety of PA-related information, they were considered insufficiently-detailed in different ways for the present investigation. For example, the G-S LTEQ simply assesses frequency of four general intensity categories of activities, without regard for type of activity, total duration, or context of the activity (i.e., location, purpose). The 7DAY PAR provides somewhat greater detail in recording, via a semi-structured interview, the amount of moderate, hard, and very hard PA during the morning, afternoon, and evening on each of seven consecutive days (Sallis et al., 1985; Sallis, 1997). Again, however, the type, location, and duration of individual PA sessions are left unknown. The IPAQ was developed by a large, international team of researchers to facilitate international comparisons and global surveillance of PA levels (Craig et al., 2003). In its “long format” (the more comprehensive version), the IPAQ asks respondents to indicate the number of days in the past week and the usual number of hours on those days that they engaged

in vigorous, moderate, and walking activity. These three intensities of activities are assessed for four domains of activity: i) job-related, ii) transportation, iii) housework, house maintenance, and caring for family, and iv) recreation, sport, and leisure-time. A fifth section, as well as part of the transportation section, also asks about time spent sitting. While the IPAQ provides additional information about the context/purpose of respondents' PA (in addition to the usual intensity, frequency, and duration data), like all of the other available questionnaires, only limited information is collected about the location where the PA took place. Finally, the MLTPAQ gathers activity participation information for a list of 63 individual activities, including which months they were engaged in, the average number of times per month, and the amount of time per participation occasion (Taylor et al., 1978). Again, however, location data are not collected and the 63 activities may not comprise an exhaustive list for the participants in this study.

Consequently, to overcome some of the limitations of existing questionnaires (at least as they relate to the particular goals of this study), a comprehensive log booklet recording page was developed which includes all of the forms of PA data captured by each of these established instruments (see Appendix E). Participants were asked to include in their log booklet all episodes of PA that were 10 or more minutes in duration. The revised PA recommendations for the public put out by the CDC/ACSM indicated that the recommended daily amounts of PA could be accumulated in bouts as short as 8 to 10 minutes (Pate et al., 1995; see Chapter Two). For the purposes of the log, it was thought that a 10-minute minimum episode length would be a simpler guideline for participants to remember than an 8-minute minimum episode length. Other recently-developed questionnaires use this 10-minute minimum as well (e.g., IPAQ).

The initial pages in the log booklet were comprised of detailed PA recording instructions, a map of the participant's specific neighbourhood/planning district (four different booklets were

developed), and sample log pages depicting how to record PA episodes (Appendix E). The remainder of the booklet was comprised of blank log pages. As shown in Appendix E, for each PA episode, participants were asked to indicate the date and start time of the activity, type of activity, duration and intensity of participation, location where the activity took place, method of transportation (if applicable), point or origin, co-participants, purpose of the activity, as well as responses to two 2-item scales measuring "flow" (challenge, skills) and situational involvement (pleasurable, enjoyable). Collection of such comprehensive, disaggregated information about each episode facilitates almost any type of detailed analysis/description about what, when, where, why, how, and for how long participants engage in PA.

Measurement of Physical Activity via Accelerometers

In addition to the participant questionnaire and PA log booklet, the third major component of the study involved objective measurement of PA using accelerometers with a sub-sample of study participants. Thirty accelerometers manufactured by Manufacturing Technology Inc. (MTI), formerly Computer Science and Applications Inc. (CSA), were borrowed from the University of Waterloo's Centre for Behavioural Research and Program Evaluation.

Similar to the more ubiquitous and inexpensive pedometers, accelerometers are an electronic device for monitoring movement of the body. Usually worn on the hip, they capture changes in velocity over time, or acceleration, which is usually expressed in multiples of gravitational force ($g=9.8m/s^2$ or 32 ft/s^2) (Welk, 2002b). Accelerometers have been used in PA research since the late 1970s (LaPorte et al., 1979; Montoye et al., 1996) and their technology has advanced substantially over the past quarter-century. In short, an accelerometer contains a sensor that detects changes in acceleration. When acceleration occurs, an electric charge is produced that is proportional to the force exerted (Welk, 2002b). This information is recorded,

stored, and converted into activity ‘counts’, and can easily be displayed in tables and charts which are viewable in a graphical user interface (including Microsoft Excel). Accelerometers also contain filters to avoid detection of acceleration which is outside the range of human movement (Welk, 2002b).

Although accelerometers have become one of the most widely used methods of objectively assessing ‘free-living’ PA, these devices are not without their limitations (Dale, Welk & Matthews, 2002; Welk, 2002b). For example, the high cost of purchasing accelerometers (about $200-500 each) is often prohibitive for larger, field-based studies. Further, the quality of the data obtained is dependent on proper wearing and care of the activity monitor by participants. As well, translation equations must be estimated in order to convert accelerometer data into certain PA outcomes (e.g., energy expenditure). Finally, accelerometers often do not accurately capture physical activities when the part of the body where the monitor is worn is not moving (e.g., the hip does not move substantially during cycling). As well, they cannot be worn during water-based activities.

Nevertheless, accelerometers have numerous advantages which have contributed to their growing popularity in PA research over the past decade (Dale, Welk & Matthews, 2002; Welk, 2002b). To begin, they provide an objective indicator of body movement that can supplant, supplement, or validate self-reports or other measures of PA. As well, although efforts must be made to ensure participant compliance, accelerometers are non-invasive and constitute a relatively simple method to collect and interpret PA data in field-based research (e.g., in contrast to other more-physiological methods). Further, they can be programmed easily to provide minute-by-minute PA data (or even shorter intervals) and this data can often be recorded for up to several weeks before downloading to a computer. Finally, PA data related to intensity,

frequency, and duration are all recorded by an accelerometer, which provides advantages over pedometers, for example, which only capture a total amount of PA (i.e., steps) without the additional detail.

In this study, objective PA data was collected via the use of accelerometers from a total of 87 participants, including the 19 pretest participants. To estimate habitual physical activity, at least three to five days of accelerometer wearing are necessary (Trost, McIver, & Pate, 2005). In this study, participants were instructed to wear the monitor for three days. Although a longer monitoring period would have been preferable, the number of available accelerometers, concerns about participant burden, and a desire to involve at least 60 main study participants during the course of the study week limited objective PA measurement to three days of accelerometer use. Objective measurement of PA is still relatively rare in ecological PA research, but this three-day time period is consistent with other studies examining accelerometer-measured PA in relation to characteristics of the built environment (e.g., Frank et al., 2005; Jago, Baranowski, Zakeri, & Harris, 2005).

At the outset, 60 households were randomly selected from the list of 1000 households initially selected for sampling. These addresses received a modified introduction letter in the mail which also mentioned this additional component of the study (see Appendix A). Only one adult per household was requested to wear the accelerometer and this was left to the discretion of the household members. If a household was not home during data collection or refused to participate in all or any components of the study, someone from the next house on the initial list of addresses was asked to wear the accelerometer. For participants who were agreeable to wearing the monitor for the three-day period, a package including the accelerometer and use instructions was presented and reviewed (Appendix F). The three days of accelerometer wearing

concurred with three of the seven days for which PA episodes were recorded in the log booklet described above. At the end of the study week, the accelerometers were picked up in person along with participants' study booklets.

Several different models of accelerometers are available and have been studied in PA research. However, the most commonly used and studied model is the CSA 7164 (Welk, 2002b), which is now produced as the MTI Actigraph AM7164. It has demonstrated adequate reliability and validity for assessing PA in several previous studies with both adults and children (Focht, Sanders, Brubaker, & Rejeski, 2003; Janz, 1994; Patterson et al., 1993; Puyau, Adolph, Vohra, & Butte, 2002; Trost et al., 1998). Different studies have tested the validity of accelerometer-measured PA with activity monitors worn at the ankle, wrist, and hip, among other locations on the body. However, the hip has become by far the most common placement for research using accelerometers (Ward, Evenson, Vaughn, Rodgers, & Troiano, 2005), and it has been recommended that placement on the wrist or ankle should be avoided (Trost et al., 2005). To standardize protocols, participants were directed to consistently wear the monitor on their right hip. To help increase compliance with wearing the accelerometer, participants were given two signs to display within their homes (e.g., on a fridge, bedroom mirror) to serve as reminders (Trost et al., 2005). As well, consistent with recent recommendations, accelerometers were checked for accurate functioning before each use (Ward et al., 2005).

The accelerometers were initialized to begin recording movement data at 12:01 a.m. on the day on which they were to be handed out to participants. The common epoch length of 1 minute was used (Ward et al., 2005), such that a movement reading was taken every 10 seconds and these values averaged to produce a mean activity score for each minute of usage. When the

accelerometers were returned, data were downloaded using the Actigraph software and subsequently outputted as minute-by-minute activity readings in Microsoft Excel.

A SAS program developed elsewhere (Suzy Wong, personal communication, September 15, 2006) was used to transform these raw data files into a summary of i) the number of minutes that the accelerometer was worn during each day of usage, and ii) the number of minutes of low, moderate, and high-intensity activity that were recorded each day. To complete this process, the SAS program code included two key user-defined parameters. First, for any period of ten consecutive zero counts (i.e., no movement was registered for 10 minutes), it was assumed that the accelerometer was not being worn, given that participants were instructed to take it off when sleeping. Consequently, the SAS program removed these periods in calculating the total number of minutes per day that the accelerometer was worn. Second, activity "cut-points" were included in the algorithm to denote the lower thresholds for low, moderate, and high-intensity activity (Swartz et al., 2000). Additionally, the SAS program included a lower bound on the low intensity category that was set at 50 counts to differentiate between completely sedentary readings (<50) and low intensity movement.

These procedures produced an Excel file for each participant showing the number of minutes that the accelerometer was worn during each day of usage, and the number of minutes of low, moderate, and high-intensity activity that were recorded each day. To be counted as a valid day, the data had to show that the accelerometer was worn for a minimum of 10 hours (600 minutes) per day (Schmidt, Freedson, & Chasan-Taber, 2003).

Objective Assessment of Parks and Open Spaces

The fourth and final data collection component of the study involved objective assessment of parks and open spaces within the study areas. To facilitate this process, the

recently-developed Environmental Assessment of Public Recreation Spaces (EAPRS) instrument was used (Saelens et al., 2006). The EAPRS instrument allows a researcher to physically visit a park and to rate the elements within and surrounding the park (e.g., trails) and their qualities (e.g. cleanliness) in order to facilitate examinations of the association between this particular type of behaviour setting and the PA levels of park users and/or nearby residents. It was developed, in part, to respond to the concern that studies examining the influence (e.g., proximity) of parks on PA "have generally by default considered all parks and playgrounds to have the same elements and qualities, despite the awareness that they may differ substantially on these characteristics" (Saelens et al., 2006, p. 191). The following paragraphs describe the EAPRS instrument and how it was employed in this study.

In developing the EAPRS instrument, initially both professionals with the Ohio Parks and Recreation Association (n=34) and frequent park users (25 or more times in the past year; n=29) provided input as to important elements and qualities of parks for promoting park use and PA (Saelens et al., 2006). Specifically, a two-phase process of open-ended surveys first asked respondents to identify important elements (e.g., trails) of parks, and then to describe the constituent elements (e.g., which aspects of trails) and qualities (e.g., safety) of the identified elements. The responses within and across respondents were compiled (and duplicates removed) and the initial version of the EAPRS instrument contained 1088 items that described park and playground environments.

For initial instrument testing and use, a stratified random sample of 80 parks and 12 playgrounds were selected within urban, urban periphery, and suburban locations in Hamilton County (Cincinnati), Ohio (Saelens et al., 2006). After classroom and on-site training, observations were conducted independently by two raters in each park or playground within four

weeks of each other. Resulting amendments to the instrument for items with low inter-rater reliability included clarification of definitions and instructions provided to raters, rescaling of several variables from ordinal to 3-point response formats, and the removal of several park features that were not observed at least three times across the 92 sites. A revised instrument containing 646 items was then used by two new independent raters to observe 21 of the original parks and 20 new playgrounds.

Inter-rater reliability for each of the items in the revised scale was assessed using the kappa statistic, percent agreement, or interclass correlation coefficients, as appropriate for the type of data collected (Saelens et al., 2006). However, reliability statistics were only calculated for the 609 items that were rated at least three times across the 41 sites in the second round of observation. For reporting purposes, reliability values were categorized into one of three categories – good-excellent, moderate, and poor – using established cut-off values for each statistic (Landis & Koch, 1977). In the revised instrument, 65.6% of the reliability statistics or percent agreement values were classified as good-excellent. In the end, the authors concluded that "the EAPRS instrument is a comprehensive direct observation instrument that provides a reliable assessment of the physical environments of public parks and playgrounds" (p. 205-206). The following paragraphs describe the instrument in further detail.

The full EAPRS instrument can be found on the Active Living Research web site (retrieved June 15, 2006 from www.activelivingresearch.org/index.php/EAPRS_Tool/327. It is comprised of 16 sections labelled A-P that each address a different *element* of parks or playgrounds. These major elements include trails, paths, general areas (e.g., wooded areas), water areas, eating/drinking features, facilities (e.g., restrooms), educational/historical features, (non-trail) sitting or resting features, landscaping, general aesthetics, access-related features (e.g.,

parking lots), directives and information-related features, safety-related features (e.g., telephones), play set or structure features, other play components (e.g., swings), and athletic fields and other recreation areas. Each major element is described using numerous sub-elements relevant to the element (e.g. signage on trails). *Aspects* of each sub-element are rated based on their presence or absence and their *qualities*. For example, in section A1 of the instrument which addresses paved trails, the presence of a paved trail is assessed first (yes/no), and then, if this element is present, other aspects of the trail are rated on various qualities (e.g., condition, cleanliness, continuity). Section A2 then continues with the presence or absence of another sub-element of trails (signage), and various ratings of its qualities (e.g., visibility, content). Many aspects of each sub-element are rated on a dichotomous (e.g., yes/no), while many others use three- or five-point rating scales with descriptors that are relevant to the particular aspect (e.g., poor, fair, or excellent for a condition rating).

In this study, the EAPRS instrument was used to examine all of the municipal parks within each of the four selected City of Waterloo planning districts. Two raters (the author and his supervisor) conducted the observations of the parks. The majority of the parks were observed during the same four-week period that the questionnaires and PA log booklets were being completed by study participants. A guidebook of instructions for using the EAPRS instrument is provided with the tool, which provides general tips on observation strategies as well as definitions of numerous elements and qualities (retrieved May 15, 2006 from http://www.activelivingresearch.org/downloads/eaprs_guidebook_saelens_051205.pdf). Prior to observation and rating of the parks, the two observers clarified definitions and other details of the instrument by practicing in a single park.

Research Questions and Data Analysis Strategies

This section describes several research questions to be addressed in this study that examine the associations between the numerous variables described above and study participants' PA levels. Data analysis strategies to address each question are also briefly discussed.

- How are psychosocial variables related to PA?

This question aims to examine the relationship between psychosocial variables and PA. The five psychosocial variables included in this set of analyses were self-efficacy, social support from family, social support from friends, decisional balance, and involvement. These variables were examined in relation to a total PA measure comprised of recreational and transportational PA. When recording each episode of PA, in addition to the duration and intensity of the episode (among other details), participants indicated the purpose of the episode – recreation, transportation, household, or job-related (see Appendix E). Specifically then, total weekly minutes of recreational and transportational PA (combined) in each intensity category (mild, moderate, strenuous, and moderate-to-strenuous) served as the multiple PA variables examined in relation to the five psychosocial variables. Including only PA episodes engaged in for recreation or transportation, while excluding household and job-related PA, was deemed prudent because the psychosocial variables included in the analysis likely relate more to discretionary PA, rather than PA around the house or on the job which is likely more compulsory.

Because for each intensity category (mild, moderate, strenuous), a large number of participants indicated zero minutes of recreational or transportational PA, the distributions of these dependent variables were significantly positively skewed. Thus, a two-step process was used to examine the relationship between psychosocial variables and recreational/ transportational PA (rec/trans PA). First, multivariate analyses of covariance (MANCOVA)

tested whether differences existed between participants with *no* rec/trans PA and those with *any* rec/trans PA with respect to their self-ratings on the five psychosocial variables. Four separate MANCOVAs were analysed, each with the five psychosocial variables as dependent variables and using one of either mild, moderate, strenuous, or moderate-plus-strenuous rec/trans PA as the grouping (factor) variable[7]. This allowed one to see, for example, if participants with *zero* minutes of mild (or moderate, or strenuous, or moderate-to-strenuous) rec/trans PA differed from those with *any* mild rec/trans PA with respect to their levels of each of self-efficacy, social support, decisional balance, or involvement. In each MANCOVA, age (continuous), gender, and the presence of a temporary injury that might limit PA were included as covariates.

If the overall MANCOVA model for each intensity category of rec/trans PA (independent variable) showed significant differences between those who reported none vs. some activity, a second analysis was undertaken using only those participants who reported some activity. Specifically, multiple regression was performed using total weekly minutes of rec/trans PA within each intensity category (as a continuous measure) as the dependent variable and the five psychosocial variables as independent variables. For all regressions (including those described in subsequent sections), all of the psychosocial variables were centred at their respective means and the dependent PA variable was transformed using a log+1 transformation to improve the normality of its distribution (Blair et al., 1991; Frank et al., 2005). This analysis allowed observation of which psychosocial variables were significantly related to particular intensities of rec/trans PA (among participants who reported at least some rec/trans PA within that intensity category).

[7] Although the grouping (factor) variable contained only two groups, MANCOVA was still considered superior to conducting multiple t-tests using each of the psychosocial dependent variables to avoid inflating the familywise error rate.

- Is the relationship of psychosocial variables with PA moderated by perceptions of environmental attributes?

Several authors have suggested a greater need exists to examine how psychological, social, and environmental factors interact to influence PA participation (Bauman, Sallis, Dzewaltowski, & Owen, 2002; McCormack et al., 2004; Owen, Humpel, et al., 2004; Saelens, Sallis, & Frank, 2003). This research question asks whether the relationships between psychosocial variables and PA change depending on how supportive one's environment is. For example, are people who are higher in self-efficacy for PA more active when they also have positive perceptions of how conducive their neighbourhood is to PA participation? The idea of moderation implies an interaction (Baron & Kenny, 1986). To answer this question, the interaction between participants' perceptions of their neighbourhood environment and each of self-efficacy, social support, decisional balance, and involvement was tested and, when significant, graphed.

Specifically, multiple linear regression models were created in which age, gender, and the presence of a temporary injury were included on the first step. The second step of the regression included the psychosocial variable (self-efficacy, social support, decisional balance, or involvement) as well as a "total neighbourhood environment index", described below, which was a compilation of ratings on several dimensions of participants' neighbourhoods. Finally, the third step of the model contained the interaction term for the cross-product between the environment index and the particular psychosocial variable. As above, all psychosocial variables or the environment index score were centred at their respective means to reduce problems related to multicollinearity (Cohen, Cohen, Aiken & West, 2002). As well, like in the previous analyses examining the associations between psychosocial variables and PA, combined weekly minutes of recreational and transportational PA served as the dependent variable. However, for these

analyses, not all intensities of rec/trans PA were examined, only the total of moderate-to-strenuous rec/trans PA. If the addition of the interaction term to the model resulted in a significant increment in R-squared and if the interaction term was significant in the final step of the model, the interaction was graphed to examine its nature.

- How are environmental variables related to PA?

Like the first question related to psychosocial variables above, a two-step process was used to examine the association between neighbourhood characteristics and PA that occurred in participants' neighbourhoods. The seven dimensions of the NEWS instrument described above were included as the neighbourhood characteristics in the analyses. They were examined in relation to four PA variables that were derived from aggregating the total weekly minutes of each of mild, moderate, strenuous, and moderate-to-strenuous PA episodes that occurred *within the neighbourhood* (either in whole or in part). In contrast to almost all previous studies that have examined the association between neighbourhood characteristics and PA by using a global and acontextual measure of PA, it was deemed more prudent for these analyses to only include PA episodes that occurred within the participants' planning district (either in whole or in part, as determined based on the open-ended location descriptions provided for each episode – see Chapter Four).

The same two-step process was employed as was used to examine the association between psychosocial variables and rec/trans PA that was described above. Four separate MANCOVAs were analysed using the seven NEWS dimensions as dependent variables. In each MANCOVA, one of mild, moderate, strenuous, or moderate-to-strenuous neighbourhood PA (n'hood PA) was used as the grouping variable, dichotomized into zero vs. some minutes of n'hood PA within that intensity category. If the overall model for the intensity independent

(factor/grouping) variable suggested that participants reporting some n'hood PA perceived their neighbourhood environments differently than those reporting no n'hood PA, follow-up multiple regressions were run using only those participants who reported at least some n'hood PA within that intensity category. For these regressions, total weekly minutes of n'hood PA within the particular intensity category served as the dependent variable (after being log+1 transformed) and the independent variables were the centred summary scores for the seven NEWS dimensions. For both the MANCOVAs and regressions, the analyses controlled for age, gender, and the presence of a temporary injury that might limit PA.

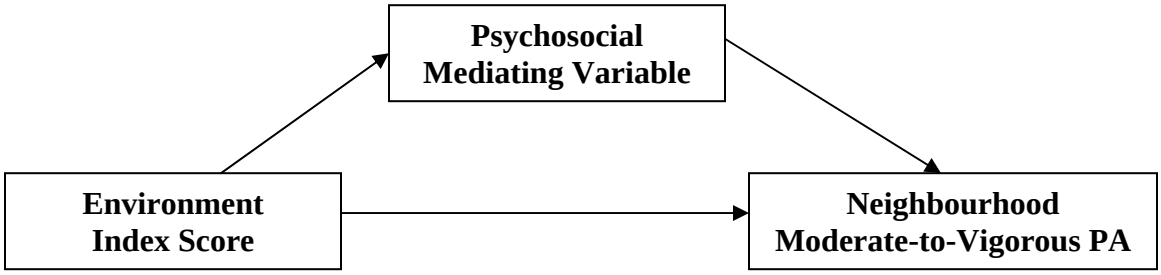
Finally, a "total neighbourhood environment index" was also computed by standardizing each of the summary scores for the seven NEWS dimensions and then summing them (Atkinson et al., 2005). This variable was also included in the MANCOVAs described above along with each of the individual NEWS dimensions. It was also then included independently in multiple regression analyses predicting total weekly minutes of each of the four intensities of n'hood PA. As above, these analyses included only those participants who reported some n'hood PA in the particular intensity category and they controlled for age, gender, and the presence of a temporary injury.

- Do psychosocial variables mediate the relationship between environmental attributes and PA?

This question also begins to address how psychosocial and environmental variables are related in influencing PA. Specifically, it attempts to answer whether positive perceptions of the neighbourhood environment influence PA on their own or via associated increases in psychosocial predictors of PA. The primary independent variable in these analyses was the total environment index described above that was a summary measure of participants' ratings of the seven facets of their neighbourhood's walkability. The four psychosocial variables used as

mediators included self-efficacy, social support from family, decisional balance, and involvement. The dependent variable in these analyses was total weekly minutes of moderate neighbourhood PA. Again, because a significant number of participants in the abridged sample reported no moderate neighbourhood PA during the study week, only those participants who engaged in some PA of this type were included in the analyses to improve the dependent variable's normality.

Figure 7: Mediation of Environment-Physical Activity Relationship by Psychosocial Variables



Mediation was tested using the widely-used four-step process described by Baron and Kenny (1986). A sample diagram of the relationships that were tested is shown in Figure 7. The first step in testing mediation involves examining the significance of the correlation between the independent variable (IV) of interest – in this case, the total environment index – and the dependent variable (DV) – in this case, total weekly minutes of moderate-intensity neighbourhood PA. The second step involves examining the correlation between the mediator and the IV. The third step involves examining the relationship between the DV and the mediator while controlling for the primary IV. If all three of these steps show significant relationships, some level of mediation exists. If the relationship between the DV and the IV examined in step 1 is completely nullified when controlling for the mediator (according to the step 3 analysis), then full mediation is present. If the relationship between the IV and the DV is reduced in the

presence of the mediator as compared to their bivariate association examined in step 1, then partial mediation has occurred (Baron & Kenny, 1986). In situations of partial mediation, the significance of the difference between the IV-DV relationship observed in step 1 and the IV-DV relationship observed in step 3 can be examined using the Sobel (1980) test.

- What are the characteristics of PA that occurs in parks and trails?

This set of questions uses data from the PA episodes that included the use of parks and trails to examine the nature of PA that occurs in these settings. As is described further in Chapter Four, participants' episodes were classified as including the use of a neighbourhood park or trail using some simple decision rules. The initial question simply asked what percentage of the total PA episodes reported by participants in the abridged sample included the use of a park or trail. Following from that, different characteristics of those episodes, including their duration, intensity, and purpose, were examined. The specific analyses are outlined in greater detail in Chapter Four.

- What features of parks are related to PA?

Data collected in parks using the EAPRS instrument were used to examine the features of parks that are related to parks being used for PA. The focus of the present study was on the presence or absence of 28 specific features in the parks (those that comprised the major elements of the EAPRS instrument)[8]. These elements were divided into two categories. *Facilities* were features that were considered to be primary settings in parks for PA. In this study, 13 facilities were examined: paved trail, unpaved trail, path, open space, wooded area, meadow, water area, playground, ball diamond, soccer pitch, tennis court, basketball court, pool. *Amenities*, on the other hand, were features of parks that might support opportunities for PA. Fifteen amenities

[8] Ratings of the 'quality' of elements (e.g., cleanliness of open space) lacked variability in that the features in most parks were rated quite high on the three-point quality scales that are common in the EAPRS. Thus, the present analyses focus solely on the presence or absence of the different elements/features.

were examined in this study, including: drinking fountain, picnic area, restroom, table, bench, trash can, shelter/pavilion, historical/educational feature, landscaping, bike rack, parking lot, rules sign, sidewalk adjacent, roadway through, and having more than one entrance. In the present analyses, the facilities and amenities were dichotomized as either 'present' or 'absent'.

As is described further in Chapter Four, analyses of the relationship between park features and PA were undertaken at both the park and participant level. At the park level, the number of facilities, amenities, and total features in each park were calculated by totalling the number of the 13 facilities and 15 amenities that were observed at least once in each location. At the participant level, the number of unique features that existed within parks within 1 km of each participant was also tallied (see next section for a description of how distance to parks from each participant's home was calculated). For example, if a park within 1 km of a participant's home contained a ball diamond, the variable 'ball diamond' was coded '1' (rather than '0') in the database for that person. All facility and amenity variables were coded as binary (present/absent) variables, rather than as a count of the number of each park feature within 1 km of participants' homes[9].

Three analyses were used to examine the association between park features and PA. First, at the park level, simple t-tests were undertaken to examine whether parks experiencing some use for PA (according to participants' PA records) differed from parks experiencing no use for PA in terms of the number of facilities, amenities, and total features found within them. Following from that, the specific facilities and amenities that were related to parks being used for at least some PA were examined. Logistic regression analyses involving the dependent variable of "some PA in park vs. no PA in park" and individual facility or amenity variables as predictors

[9] Because of the way the data were available and entered, obtaining the cumulative number of each feature within 1 km of participants' homes would have required manual counts and entry for all 384 participants.

were first used to obtain the unadjusted odds of some PA occurring in that park according to the presence of each feature. Then, those facilities or amenities which displayed significant bivariate associations with the outcome variable of 'some PA in park' were entered together into multivariate logistic regression models (separately for the facilities and amenities) to obtain adjusted odds ratios. A similar two-step process was undertaken at the participant level as well. In this case, the dependent variable was again dichotomized as 'participant engaged in some PA in neighbourhood parks' or 'participant engaged in no PA in neighbourhood parks'. The odds of falling into the former category were examined according to whether the participant had particular facilities or amenities within a park within 1 km from his/her home. Those facilities and amenities which were individually related to increased odds of having engaged in some neighbourhood park-based PA were entered into multivariate logistic regression models to examine their relative influence in predicting the same outcome measure.

- How is proximity to parkland related to physical activity?

The final research question addresses the relationship between proximity to park space from home and PA. As is described further in the following paragraphs, three independent variables were of particular interest: i) number of parks within 1 km of participants' homes, ii) total area of parks within 1 km of participants' homes, and iii) distance to the closest park from participants' homes. Three dependent variables were also examined: i) total PA, ii) neighbourhood PA, and iii) park-based PA. The former two PA variables were described earlier, and computation of the latter is described below.

To facilitate distance analyses, the location of each participant's home address was coded by the author and a research assistant using Cartesian coordinates (x,y) on a commercially-produced map. Inter-coder reliability of 98% was established by the two coders independently

coding 50 homes. A total of 52 parks were included in the analyses. These included 33 municipal parks within the four study areas, as well as another 19 parks within a buffer zone of 800 metres around each neighbourhood that were also included in the analysis to account for participants' potential use of parks that fell outside the relatively artificial boundaries of the neighbourhood. The locations of parks within the neighbourhoods and 800m buffer zones were also coded using the centroid of each park as a reference point. Euclidean distance between each home and each park was calculated and a tally of the number of parks within a one kilometre radius was obtained. Distance to the closest park was also noted. Finally, the size of each park was obtained from City of Waterloo documents and the combined area of all parks within a 1 km radius of each participant's home was obtained by aggregating the area of parks whose centroids fell within this distance.

In addition to the total and neighbourhood PA variables that were described above, a variable labelled park-based PA was computed to serve as a third dependent variable for these analyses. Episodes for each participant that included use of a park within the participant's district (or buffer zone) were included in this total. Minutes of moderate and strenuous PA (MSPA) in each of the three contexts – total, neighbourhood, and park-based – were aggregated to form the three dependent variables.

Because a significant number of participants reported zero minutes of MSPA during the week, values were recoded into two categories for each context. For total and neighbourhood PA, the two categories were "no MSPA" and "150+ minutes MSPA" (the threshold of 150 minutes was selected to be consistent with *Healthy People 2010* guidelines). For park-based PA, the two categories were simply "none" and "some". Multinomial and binary logistic regression analyses, controlling for age, gender, and the presence of a temporary injury, were used to

examine the association between MSPA group membership and three park-related variables of (i) number of parks within 1 km of participants' homes, (ii) park area within 1 km, and (iii) distance to the closest park.

CHAPTER FOUR: RESULTS

This chapter presents the study's findings, including the participant response rate, sample characteristics and other preliminary analyses such as tests of the criterion-related validity of the PA log booklet. Finally, results of the analyses designed to investigate the study's specific research questions are described.

Household Participation and Package Return Rates

Chapter Three described the methodology used to distribute study materials to residents of the four districts. Table 4 below depicts the household acceptance rate and package return rate for each of the four districts and the total sample. In total, study team members visited 1394 addresses, including the 1000 houses in the initial sample and extra houses which received study introduction letters when a household in the initial sample was not home during the first contact (see Chapter 3) [10]. The results of these visits can be disaggregated into one of three categories. First, 564 houses (40.4%) were not reached, primarily because no one was home during any of the contacts (but also because the address may have been inaccessible or non-existent). Second, 314 (22.5%) houses refused to participate in the study when visited by a study team member. Approximately one-third of these houses provided a reason for their refusal, with a wide variety of reasons mentioned (e.g., not interested, too busy). Finally, 550 (39.4%) households agreed to participate in the study and accepted one or more study packages for the adults in the home. The household acceptance rate is shown toward the end of Table 4 and was calculated using the following formula: houses accepted/(houses visited-houses not reached). This formula removes

[10] For ease and consistency of reporting both response rate and total participant figures, pretest data have been included in the tallies reported in this section and Table 4.

Table 4
Household Acceptance Rate and Package Return Rate by District

District	Houses visited	Houses accepted	Houses refused	Houses not reached	Packages distributed	Packages completed	Packages incomplete	Packages not home	Household Acceptance Rate	Package Return Rate
Eastbridge	338	137	79	127	235	144	55	36	64.9%	61.2%
Beechwood	371	148	71	150	268	159	89	19	67.0%	59.7%
Central	336	133	73	140	233	135	53	44	67.8%	58.4%
Willowdale	349	132	91	147	224	147	64	15	65.3%	64.7%
Total	1394	550	314	564	960	585	261	114	66.3%	60.9%

those houses for which a participation decision was not available and permits direct comparisons of the household acceptance versus refusal rate. The household acceptance rate was 66.3% across the entire sample, with all of the four districts at or above 65% (Table 4).

A total of 960 study packages were handed out across the four districts. After taking into account the removal of 16 incomplete surveys, a total of 585 participants provided useable questionnaire booklets (10 of these contained only 50-80% data), with 144, 159, 135, and 147 booklets returned from the Eastbridge, Beechwood, Central and Willowdale districts, respectively. This resulted in an overall package return rate of 60.9% (585/960). In this case, packages that were not useable either because they were not returned, were found to be incomplete when opened, or because no one was ever reached for pick-up at the address were all treated the same and counted against the package return rate. The package return rate was relatively consistent at approximately 60% or higher across the four districts. These results were considered satisfactory given the relatively arduous nature of participating in the study (i.e., 13-page questionnaire and 7-day PA log booklet) and the minimal $5 per participant compensation.

Multiple adult respondents were garnered from many of the households that participated in the study, and in total, the 585 respondents represented 384 distinct households. It may reasonably be assumed that participants from the same household may share similar perspectives on variables related to PA and/or similar PA patterns, thus violating the assumption of independence among the observations that is assumed for most statistical tests. Consequently, for the purposes of the remaining analyses reported in this chapter, *only one respondent per household was randomly selected to be part of the study sample*. Table 5 shows the distribution of the 384 participants according to the four districts.

Table 5
Distribution of Study Participants by District in the Abridged Sample

District	N
Central	91
Willowdale	101
Beechwood	100
Eastbridge	92
Total	384

Sample Description

The following paragraphs describe selected characteristics of the abridged study sample based on data provided in the last section of the questionnaire (section J of Appendix D). For all variables, less than 2% of responses were missing. Therefore, percentages described below are the "valid percent" for the respective categories such that the total of these sums to 100%.

With respect to gender, 63.8% of the sample was female. This differs somewhat from the full sample of respondents in which only 55.4% were female. Therefore, it appears that when only one adult in the household participated in the study, it was more likely to be a female who did so. The proportion of male and female participants in the abridged sample was relatively equal across the four study districts (Table 6), as confirmed by chi-square tests (X^2=1.05, p=.789). Comparable data on gender percentages in each district were not available from the City of Waterloo.

Table 6
Percentage of Female Participants by District

District	Percent Female
Central	61.1%
Willowdale	61.6%
Beechwood	65.0%
Eastbridge	67.4%
Total (study sample)	63.8%

Table 7
Percentage of Participants by Age Group by District

District	Mean Age	Median Age	18-24 years[1]	25-34 years	35-44 years	45-54 years	55-64 years	65+ years
Central	48.0	49.0	4.5% (13.7%)	23.6% (25.0%)	19.1% (15.4%)	21.3% (11.8%)	14.6% (9.1%)	16.9% (25.0%)
Willowdale	48.2	48.0	9.1% (10.4%)	14.1% (17.3%)	19.2% (17.4%)	24.2% (16.7%)	14.1% (12.8%)	19.2% (25.4%)
Beechwood	49.4	49.0	14.0% (13.0%)	7.0% (15.3%)	15.0% (17.8%)	22.0% (23.2%)	18.0% (16.6%)	24.0% (14.2%)
Eastbridge	37.3	35.0	1.1% (5.6%)	41.1% (41.8%)	40.0% (29.5%)	16.7% (14.6%)	1.1% (3.8%)	0.0% (4.6%)
Total (study sample)	45.6	44.0	7.4%	20.9%	23.0%	21.2%	12.2%	15.3%

Table 7 Notes:
1. City of Waterloo age data are available for the categories of 15-19 years and 20-24 years. In calculating the city age category proportions (found in parentheses) for the 18-24 years column in Table 7, only the 20-24 years numbers from the city data were used.

The ages of study participants, however, varied greatly across the four regions (Table 7). Eastbridge contained zero senior citizen participants (65 years and older) and over 80% of Eastbridge participants were under the age of 45. In contrast, almost two-thirds of participants (64.0%) from Beechwood were 45 years or older. The age representation of participants from Willowdale and Central was split much more evenly across the six categories shown in Table 7. The mean and median ages of participants in Central, Beechwood and Willowdale were similar, but were markedly less in Eastbridge. Chi-square tests confirmed that significant variation in ages of participants (X^2=90.39, p<.001) existed across the four study districts. The percentages in parentheses in Table 7 represent City of Waterloo figures for the proportion of the population in each district that fell into each age category. Overall, the sample and city percentages are quite similar, although there is some indication that younger persons were slightly less inclined to participate in the study (unknown if this was due to refusals or not being home or the fact that the

city's universities were not in session during the August data collection period; also see Table 7 footnote with respect to the 18-24 years category).

Table 8 lists the percentage of participants in each district who indicated that they were either married or were living in a marriage-like relationship (e.g., common-law), in contrast to the other potential response options of single, retired, divorced, and widowed. The data show that 74.9% of the adult study sample was living with a partner, while only 21.8% indicated being single, divorced, separated, or widowed. The proportion of 'married' participants was much higher in Eastbridge (87.8%) and somewhat lower in Willowdale (67.3%), and chi-square tests confirmed a difference existed between the districts. (p=.009) The percentage of 'married' participants in the study sample is substantially higher for all four districts than that which was found in the 2001 Census. However, this is at least partially due to the fact that the Census data proportions include persons aged 15-17 years, who are presumably less likely to be married (see Table 8 footnote).

Table 8
Percentage of Participants Married or Living in a Marriage-Like Relationship by District

District	Percent 'Married'	2001 Census[1]
Central	73.3%	45.1%
Willowdale	67.3%	51.9%
Beechwood	72.0%	55.4%
Eastbridge	87.8%	70.7%
Total (study sample)	74.9%	

Table 8 Notes:
1. The 2001 Census reported marital status category proportions for all persons aged 15 years and older, whereas the study sample was limited to adults aged 18 years and older.

With respect to level of education, Table 9 illustrates that participants in the study sample, much like the City of Waterloo as a whole, were highly-educated. Almost two-thirds

(64.8%) of the overall sample graduated from college or university (including those who obtained post-graduate degrees). However, while a similar proportion of Central (64.4%) and Beechwood (63.6%) residents had obtained such degrees, the level of education was higher among Eastbridge participants (82.4%) and lower among Willowdale participants (50.0%). Chi-square tests confirmed that the proportion of college- or university-educated study participants differed across the districts (p=.000). Comparable education data were not available from the City of Waterloo.

Table 9
Percentage of Participants Graduated College or University by District

District	Percent Graduated
Central	64.4%
Willowdale	50.0%
Beechwood	63.6%
Eastbridge	82.4%
Total (study sample)	64.8%

Table 10
Percentage of Participants Employed Full-time and Retired by District

District	Employed FT	Retired
Central	50.0%	17.8%
Willowdale	52.5%	23.2%
Beechwood	38.4%	23.2%
Eastbridge	65.9%	0.0%
Total (study sample)	51.5%	16.4%

Table 10 shows the percentage of study participants in each of the four districts who were either employed full-time or retired. Other response options for this question (see section J of Appendix D) included part-time employment, homemaker, student, and unemployed, but aside from part-time employment (12.7%), none of these represented more than 5% of the study sample in any district. Overall, 51.5% of participants were employed full-time and 16.4% were

retired. Once again, Eastbridge was dissimilar from the other three districts in that it had a substantially higher percentage of participants who were employed full-time (65.9%) and no one in the study sample who was retired. Chi-square tests once again confirmed differing employment statuses across the four districts ($p<.01$). Comparable employment data were not available from the City of Waterloo.

Finally, Table 11 describes participants' mean self-ratings (and standard deviations) of their physical fitness and overall health relative to people their age (see section J in Appendix D). On the 7-point scales ranging from "very poor" (1) to "very good" (7), participants held more positive perceptions of their overall health (5.26) than their physical fitness (4.74). Analysis of variance tests for each variable confirmed that ratings of both variables were not significantly different *between* the four districts. However, paired samples t-tests showed that health ratings were significantly higher than fitness ratings amongst the participants *within* all four districts.

Table 11
Participants' Mean Ratings of Physical Fitness and Overall Health by District

District	Self-Reported Physical Fitness	Self-Reported Overall Health
Central	4.97	5.32
	(1.43)	(1.23)
Willowdale	4.57	5.20
	(1.50)	(1.35)
Beechwood	4.74	5.26
	(1.31)	(1.10)
Eastbridge	4.69	5.24
	(1.48)	(1.33)
Total (study sample)	4.74	5.26
	(1.43)	(1.25)

Descriptions of Variables

This section provides descriptive statistics for key study variables, including physical activity measures. The tables below describe mean ratings for each variable as well as reliability

statistics (coefficient alpha) for the different scales used to assess those variables. Inevitably, complete responses were not received for all variables from all participants in the abridged sample. Unless otherwise noted, the effective sample size for each variable ranges from 365-380 of the 384 study participants in the abridged sample, with the districts represented by approximately 85-95 participants each (proportional to the total participants per district in the full abridged sample as shown in Table 4 above).

Psychosocial Variables

Table 12 below shows mean ratings (and standard deviations) by district for the scales measuring self-efficacy, social support, and decisional balance. Coefficient alphas for each of the scales in Table 12 were adequate to excellent. For these scales and the others reported below, a scale summary score was only computed if responses were received for at least 80% of the items in the scale (e.g.., 4 out of 5 items). Mean self-efficacy for PA scores fell slightly above the mid-point of the scale (4.34 for the entire abridged sample) and were very similar across the four districts. Participants perceived that the social support they received from family (3.32) was somewhat higher than that which they received from friends (2.68), although the means for both measures fell well below the midpoint of the 7-point scale. With respect to social support from family, significantly greater perceptions of support were observed in Eastbridge than in the Willowdale district. For both social support scales, noticeably fewer participants completed these measures (e.g., 344 compared to approximately 375 for the other scales). This poorer response may have been the result of an altered response format for these two scales (see section C of Appendix D).[11] Finally, the 10 items representing the 'pros' dimension of the decisional balance measure and the 6 items measuring the 'cons' dimension were summed to obtain a scale total out

[11] Concern about the response format was raised by one participant in the pretest phase of the study, but the decision was made to retain the scales' formatting to save space in the questionnaire.

of 50 or 30, respectively (Marcus et al., 1992). The totals for each dimension were similar across the four districts, with agreement with the 'pros' items falling well above the midpoint of the scale (38.96 out of 50) while lesser agreement was observed for the 'cons' items (13.14 out of 30).

Table 12
Mean Ratings and Standard Deviations of Self-Efficacy, Social Support and Decisional Balance by District

District	Self-efficacy[1]	Social Support[1]		Decisional Balance[1]		
		Family	Friends	Pros Sum	Cons Sum	Pros-Cons
Total sample	4.34	3.32	2.68	38.96	13.14	25.82
	(1.30)	(1.54)	(1.53)	(7.06)	(4.33)	(9.20)
Central	4.45	3.31[ab]	2.61	38.81	12.62	26.19
	(1.41)	(1.60)	(1.59)	(7.55)	(3.73)	(9.04)
Willowdale	4.30	2.98[a]	2.57	38.32	13.04	25.29
	(1.34)	(1.54)	(1.49)	(7.21)	(4.47)	(10.02)
Beechwood	4.27	3.29[ab]	2.81	38.57	12.80	25.77
	(1.20)	(1.48)	(1.58)	(6.69)	(4.03)	(7.99)
Eastbridge	4.36	3.75[b]	2.74	40.22	14.12	26.10
	(1.27)	(1.46)	(1.52)	(6.75)	(4.91)	(9.75)
ANOVA F test[2]	.32	3.75	.46	1.34	2.79	.18
	(.81)	(.01)	(.71)	(.26)	(.09)	(.91)
Coefficient Alpha	.92	.93	.95	.90	.74	n/a

Table 12 Notes:
1. Self-efficacy and social support items rated on 7-point scales and decisional balance items rated on 5-point scales, with higher scores indicating a greater amount of the variable. Mean scale scores are presented for self-efficacy and social support, while responses to decisional balance pros (10) and cons (6) items are summed as suggested by Marcus et al. (1992).
2. ANOVA F test represents a test of the between district differences for each summary variable. The F value is reported on the top line with its associated significance (p) reported below in parentheses. For variables with significant ($p<.05$) differences among the group means, different superscript letters are used to denote groups which differed significantly.

Table 13 describes mean ratings (and standard deviations) for the five involvement dimensions and the total involvement scale score (section F of Appendix D) and the five physical activity motivation dimensions (section G of Appendix D). Ratings for none of the five involvement dimensions differed across the four districts, but, for the whole sample, 'attraction '(3.45) and 'identity affirmation' (3.11) ratings fell above the midpoint of the scale, while the

mean scores for the 'centrality', 'social bonding', and 'identity expression' dimensions were slightly below the midpoint of the scale. Acceptable internal consistency was observed for all five involvement dimensions.

Table 13
Mean Ratings and Standard Deviations of Involvement Dimensions and Physical Activity Motivations by District

District	Involvement Dimensions and Total[1]						Physical Activity Motivations[2]				
	A	C	SB	IA	IE	Total	E	F	S	A	C
Total sample	3.45	2.92	2.95	3.11	2.87	3.06	3.72	4.35	2.97	3.59	3.50
	(1.01)	(1.10)	(.92)	(.91)	(.93)	(.85)	(.87)	(.69)	(.94)	(.92)	(.97)
Central	3.54	3.01	2.91	3.10	2.87	3.07	3.67	4.33	2.91	3.49[a]	3.55[ab]
	(1.07)	(1.19)	(1.00)	(1.01)	(1.00)	(.94)	(1.02)	(.83)	(1.04)	(1.04)	(1.08)
Willowdale	3.35	2.87	2.91	3.07	2.86	3.01	3.64	4.29	3.03	3.48[a]	3.42[a]
	(1.08)	(1.14)	(.96)	(.90)	(1.00)	(.90)	(.87)	(.72)	(.92)	(.96)	(.96)
Beechwood	3.36	2.80	2.91	3.01	2.75	2.97	3.64	4.39	2.87	3.44[a]	3.30[a]
	(.88)	(.91)	(.81)	(.83)	(.87)	(.73)	(.72)	(.57)	(.94)	(.77)	(.91)
Eastbridge	3.55	3.01	3.08	3.25	3.02	3.19	3.93	4.39	3.08	3.95[b]	3.75[b]
	(1.01)	(1.14)	(.92)	(.89)	(.84)	(.84)	(.85)	(.63)	(.86)	(.83)	(.88)
ANOVA F test[3]	1.11	.87	.726	1.15	1.34	1.20	2.48	.52	1.00	6.69	3.93
	(.35)	(.46)	(.54)	(.33)	(.26)	(.31)	(.06)	(.66)	(.39)	(.00)	(.01)
Coefficient Alpha	.88	.85	.69	.70	.77	.94	.90	.90	.84	.89	.93

Table 13 Notes:
1. Involvement dimension abbreviations: A=attraction, C=centrality, SB=social bonding, IA=identity affirmation, IE=identity expression, Total=mean of all five dimensions; all scales rated on a 5-point scale ranging from strongly disagree (1) to strongly agree (5).
2. Physical activity motivation abbreviations: E=enjoyment, F=fitness, S=social, A=appearance, C=competence; all items rated on a 5-point scale ranging from strongly disagree (1) to strongly agree (5).
3. ANOVA F test represents a test of the between district differences for each dimension of involvement or physical activity motivation. The F value is reported on the top line with its associated significance (p) reported below in parentheses. For variables with significant ($p<.05$) differences among the group means, different superscript letters are used to denote groups which differed significantly.

With respect to PA motivations, 'fitness' was by far the strongest motivator for study participants (4.35 out of 5), although mean ratings of 'enjoyment' (3.72), 'appearance' (3.59), and 'competence' (3.50) were also quite high (Table 13). The 'social' dimension of motivation was rated as less important (2.97). Ratings of the 'appearance' and 'competence' dimensions differed somewhat across the four districts, largely because Eastbridge participants rated these

factors as more important motivators (indeed, Eastbridge participants had the highest ratings for all five motivation dimensions).

Environmental Variables

As mentioned in Chapter Three, a guide to using the NEWS scale provided by the original authors describes how to aggregate the items within the instrument to create summary variables for the dimensions of density, access, streets, facilities, aesthetics, safety, and diversity. Table 14 shows the mean values for each characteristic of their neighbourhood as reported by participants in the abridged sample. Although the original authors (and others) describe the instrument's test-retest reliability, the internal consistency of these dimensions has not been previously examined. In this sample, because coefficient alphas for some dimensions were somewhat low (especially those with only two or three items), minor adjustments were made to the composition of some dimensions prior to calculating the means shown in Table 14.

Significant differences between the four districts were observed for all of the neighbourhood characteristics except aesthetics (Table 14). Overall, for the other six dimensions, the mean values were generally found to be highest (indicating greater walkability) in the older neighbourhoods (Central and Willowdale), similar to what previous research would suggest. For example, participants in the Central district were always part of the group that provided the highest ratings for each variable (see superscript letters in Table 14). With respect to "access" (a measure indicating that stores and other facilities are close to home), significant differences were observed across all four groups, with the Central district rated highest, followed by Willowdale, Beechwood, and Eastbridge, respectively. Indeed, the newer Eastbridge district was rated lowest on both access and diversity. However, Eastbridge residents did rate their neighbourhood rather highly with respect to the presence of walking and cycling facilities and safety.

Table 14
Mean Ratings of Neighbourhood Characteristics by District

District	Density[1]	Access[2]	Streets[2]	Facilities[2]	Aesthetics[2]	Safety[2]	Diversity[3]
Total sample	229.63 (70.42)	3.29 (.35)	2.96 (.64)	3.49 (.68)	3.27 (.62)	3.18 (.40)	3.05 (.68)
Central	245.35[a] (69.00)	3.65[a] (.35)	3.39[a] (.52)	3.54[a] (.56)	3.37 (.59)	3.27[a] (.38)	3.66[a] (.54)
Willowdale	255.52[a] (90.44)	3.47[b] (.52)	2.96[b] (.60)	3.61[a] (.59)	3.23 (.59)	3.11[b] (.41)	3.07[b] (.60)
Beechwood	227.09[b] (66.93)	3.15[c] (.57)	2.67[c] (.64)	3.27[b] (.84)	3.25 (.69)	3.12[b] (.43)	2.91[c] (.56)
Eastbridge	191.25[c] (9.65)	2.72[d] (.61)	2.87[b] (.55)	3.52[a] (.63)	3.24 (.60)	3.22[ab] (.34)	2.56[d] (.55)
ANOVA F test[4]	25.45 (.00)	74.49 (.00)	25.81 (.00)	4.80 (.01)	1.10 (.35)	4.10 (.01)	59.52 (.00)
Coefficient Alpha	n/a	.61	.42	.45	.79	.55	n/a

Table 14 Notes:
1. Density scores represent an unlimited value with higher scores indicating greater density in the neighbourhood (see scoring description in Chapter Three).
2. Rated on a 4-point scale ranging from strongly disagree (1) to strongly agree (5).
3. Rated on a 5-point scale with higher values indicating greater land use diversity in closer proximity to respondent.
4. ANOVA F test represents a test of the between district differences for each NEWS dimension. The F value is reported on the top line with its associated significance (p) reported below in parentheses. For variables with significant ($p<.05$) differences among the group means, different superscript letters are used to denote groups which differed significantly.

Physical Activity

This section provides descriptive statistics for the two different measures of PA that were used in the study – the Godin-Shepard Leisure Time Exercise Questionnaire (GSLTEQ) and the detailed PA log booklet developed specifically for this study. The GSLTEQ is discussed first below, but PA data collected via the latter method form the primary dependent variables for most of the analyses that follow in this chapter. Correlations between the two measures are also discussed below as preliminary evidence of the log booklet's concurrent validity.

The GSTLEQ simply asks respondents to indicate how frequently they participate in different intensity categories of PA during the course of a typical week during their free time for

at least 15 minutes (see description in Chapter Three and section I in Appendix D). The first three columns of Table 15 show the mean weekly frequency with which participants in each district in this study reported engaging in episodes of mild, moderate and strenuous physical activity. As evident from the large standard deviations (shown in parentheses) and the histograms (not shown) for each variable, the data for all three categories of PA were positively skewed, due to a large number of people reporting few or no episodes for each intensity. The latter column in Table 15 shows the GSLTEQ product when mild, moderate, and strenuous episodes are allotted a value of 3, 5, and 9, respectively.

Table 15
Participants' Frequency of Participation in Mild, Moderate, and Strenuous Physical Activity Episodes by District as Reported using the Godin-Shepard Leisure Time Exercise Questionnaire

District	Mild	Moderate	Strenuous	Total
Central	6.26	3.47	1.88	53.06
	(5.34)	(2.92)	(2.28)	(33.46)
Willowdale	4.85	3.22	1.56	44.63
	(6.11)	(3.74)	(2.19)	(39.26)
Beechwood	5.82	3.93	1.41	49.76
	(6.90)	(4.09)	(2.28)	(44.50)
Eastbridge	3.70	2.59	1.94	41.56
	(3.26)	(2.18)	(2.01)	(22.06)
Total (study sample)	5.16	3.31	1.69	47.23
	(5.68)	(3.37)	(2.20)	(36.23)

Participants in all districts indicated that they engage in a greater number of mild PA episodes, followed by moderate and strenuous episodes, respectively. For the mild and moderate categories, Eastbridge residents reported participating in significantly fewer episodes than participants in the other districts. Analysis of variance tests also showed that Eastbridge residents' total GSLTEQ score (41.56) was significantly lower than that of participants in the other three districts. Residents in the Central district reported the highest number of mild

episodes and total GSLTEQ score, although the differences between Central, Willowdale, and Beechwood were not significant for any of the four variables.

Physical Activity Log Booklets

In addition to the GSLTEQ described above, a second PA measure was collected via the use of a log booklet (see Appendix E). It was noted above that 585 of the 600 questionnaire booklets that were returned were useable. With respect to the PA log booklet, twenty incomplete or unusable booklets were returned. Six of these were from residents who also did not complete the yellow questionnaire booklet; therefore, 594 people completed at least one component of the study, with 571 completing both components. In total, 580 completed log booklets were obtained, with 142, 160, 135, and 143 of these from Eastbridge, Beechwood, Central, and Willowdale, respectively.

Table 16
Correlations between Number of Episodes of Mild, Moderate and Strenuous Physical Activity Reported via Log Booklets and Godin-Shepard Leisure Time Exercise Questionnaire

			Godin-Shepard LTEQ		
			Mild	Moderate	Strenuous
Physical Activity Log Booklets	Mild	r	.28	.02	-.11
		p	.00	.64	.01
	Moderate	r	.07	.45	.01
		p	.12	.00	.86
	Strenuous	r	-.02	.07	.63
		p	.68	.09	.00

Initial examinations of the log booklet's concurrent validity were conducted by comparing the number of mild, moderate, and strenuous episodes reported in the log booklet by each participant with his or her responses to the GSLTEQ. As described in Chapter Three, the GSLTEQ has been validated via various other physical activity measurement methods and is widely used in large-scale PA research. Table 16 shows the correlations between the number of

mild, moderate, and strenuous episodes of PA reported in the log booklet over the course of the study week and the weekly frequency of participation in each intensity category as reported in the GSLTEQ. For all three intensity categories, the correlations were relatively strong (mild=.28, moderate=.45, strenuous=.63) and highly significant (all $p<.01$).

Additionally, it was fairly evident that participants were recording their PA episodes on a regular basis over the course of the study week. Before the log booklets were analyzed in any way, the data were 'cleaned' to ensure that only PA episodes within a one-week period were included in participants' weekly totals (approximately 15% of participants recorded PA episodes that extended more than seven days beyond the date of their first recorded episode, as they continued to fill out their log booklet until it was actually picked up). After various aggregate procedures were performed, it was found that participants recorded at least one PA episode on an average of 5.92 out of a possible seven days. Almost half the sample (46.9%) recorded at least one episode on all seven days, while an additional 25.7% and 13.3% recorded at least one episode on six and five days, respectively. Therefore, it appears that participants were relatively diligent in filling out their log booklets.

Finally, a question on the back of the green PA log booklet asked participants to rate the extent to which the study week represented a typical week in terms of their physical activity level. This was done on a scale from 1 (not at all typical) to 5 (very typical). Overall, although almost one-third of the sample neglected to answer this question, more than 80% of those who did respond indicated at least "3" on the five-point scale. This percentage was very similar across all four districts in the study. Those who answered "1" or "2" on this question were asked to indicate whether they "usually do more" or "usually do less". For the less than 20% of participants for which this follow-up question was applicable, responses to the two options were

split quite evenly in all districts. Given these findings, it would appear that the PA amounts recorded by participants were fairly representative of a typical week's activity level.

After eliminating those participants who were not selected to be part of the abridged study sample described above, 380 of the 580 log booklets were retained, including 90, 100, 91, and 99 from Eastbridge, Beechwood, Central, and Willowdale, respectively. Tables 17 and 18 describe reported PA participation in number of episodes (Table 17) and minutes (Table 18) for study participants in the abridged sample, with their total PA, neighbourhood PA, and home-based PA disaggregated into mild, moderate, and strenuous amounts. When recording each PA episode, participants indicated the duration of the episode, its intensity (mild, moderate or strenuous), and location, among other details (see Chapter Three and Appendix E). With respect to location, the open-ended data provided for each episode were coded by a research assistant to indicate the different contexts in which they took place (e.g., park, home, etc.). Neighbourhood PA includes those episodes which occurred, either in whole or in part, within the respondent's planning district, whether this was in parks, on streets, or in other neighbourhood areas. Home-based PA includes those episodes which occurred inside the home or on the respondent's property. Total PA includes all episodes reported by participants, including the former two categories, as well as 'other' contexts, such as those episodes that occurred outside their planning district but still in Kitchener-Waterloo, in other cities, and so forth. Number of episodes and mean total weekly PA amounts were obtained by aggregating individuals' PA episodes within each context. Additional information about PA that occurred in park and trails is described in the next section.

Table 17 shows the number and proportion of episodes in each district that occurred in the neighbourhood, at home, or in another location (percentages across rows sum to 100%). A

total of 3815 episodes were described by the 380 participants in the abridged sample who completed log booklets. However, the context in which 65 of these occurred was indeterminable due to missing or unspecific location descriptions provided by participants (therefore, the number of episodes which are classified into neighbourhood, home, and other in Table 17 sum to 3750 rather than 3815). Participants in three of the four districts – Willowdale, Beechwood, and Eastbridge – reported very similar proportions of PA episodes in each of these three summary categories. In these areas, approximately 30% of episodes occurred in the neighbourhood (in whole or in part), 30% occurred at home, while 40% occurred in 'other' settings (e.g., work, out of town, other areas of Kitchener-Waterloo). In the other district, Central, a similar percentage of participants' PA episodes occurred at home (30.4%), but a greater proportion occurred in the neighbourhood (40.3%), while less occurred in 'other' locations (29.3%). Chi-square tests confirmed that significant differences existed in the proportions of episodes in each location category that were reported across the districts (X^2=52.85, p<.01).

Table 17
Participants' Reported Number of Physical Activity Episodes in Each Location by District

	Total	Neighbourhood		Home		Other	
District	Episodes	Number	%	Number	%	Number	%
Central	987	386	40.3%	291	30.4%	281	29.3%
Willowdale	938	281	30.5%	246	26.7%	393	42.7%
Beechwood	1095	334	30.8%	308	28.4%	441	40.7%
Eastbridge	795	234	29.7%	222	28.1%	333	42.2%
Total (study sample)	3815	1235	32.9%	1067	28.5%	1448	38.6%

Table 18 shows the mean weekly minutes (and associated standard deviations) of mild, moderate and strenuous PA that were reported in total, and that occurred in the neighbourhood or at home (as subsets of the total PA amount). Within every district and for each location and intensity category (i.e., each cell of Table 18), there were a few extreme outliers that drastically increased the mean amounts. When a participant's weekly total was defined as an extreme outlier

in SPSS (more than three interquartile ranges above the IQR for the sample) in comparison to the rest of the data for participants in that particular district, it was reduced to the highest value that did not violate this outlier criterion. This was done for the amounts in each category (total, neighbourhood, home) before the means in Table 18 were reported. Even with this adjustment, the PA data were positively skewed. This is very common in physical activity measurement and, as such, for subsequent analyses, a log+1 transformation was performed on each total which greatly improved the normality of the distributions. However, the analysis of variance tests reported in Table 18 below were conducted before such transformations, nor do they control for confounding variables such as age, so the results of those tests should be interpreted with caution.

Table 18
Participants' Mean Weekly Participation in Mild, Moderate, and Strenuous Physical Activity by Location and District as Reported in Physical Activity Log Booklets (minutes)

	Total PA			Neighbourhood PA			Home PA		
District	Mild	Mod	Stren	Mild	Mod	Stren	Mild	Mod	Stren
Central	274.2	282.8[a]	80.1	67.9[a]	72.2[a]	12.8	75.7	94.8[a]	22.3
Willowdale	245.2	285.2[a]	97.6	39.7[b]	38.7[b]	8.59	57.7	83.8[a]	22.6
Beechwood	317.5	307.6[a]	71.5	43.9[b]	51.2[b]	14.5	60.5	97.9[a]	17.6
Eastbridge	236.5	196.9[b]	94.0	36.7[b]	37.9[b]	23.2	73.3	43.7[b]	18.6
Total sample	275.7	272.4	87.7	46.8	49.8	14.6	66.5	80.6	20.3
ANOVA F test	1.68	2.95	.845	3.75	4.82	1.93	.67	3.20	.15
	(.17)	(.03)	(.47)	(.01)	(.00)	(.12)	(.57)	(.02)	(.92)

With respect to total PA, participants in the abridged sample reported engaging in a similar number of mean minutes of mild (275.7) and moderate (272.4) activity (Table 18). For both the mild and strenuous intensity categories, no significant differences were found between the four districts. However, for the middle intensity category, participants from Eastbridge, on average, reported engaging in significantly fewer minutes of moderate activity (196.9) during the study week than participants from Central (282.8), Willowdale (285.2), or Beechwood (307.6).

When the average minutes of PA that occurred in the neighbourhood (in whole or in part) was examined, significant differences were found across the districts for both mild and moderate intensity activity (Table 18). For both categories, participants from the Central district reported a greater amount of PA than did participants from the other three districts. Finally, for PA that occurred in and around the home, very similar mean amounts of mild and strenuous activity were reported across the four districts (Table 18). However, for moderate PA in and around the home, Eastbridge residents reported engaging in significantly fewer minutes during the study week than residents from the other three districts.

Research Question Analyses

This section describes the results of the analyses designed to investigate the various research questions outlined in Chapter Three. It begins with sub-sections examining the association of psychosocial factors and environmental factors with PA, as well the interactions (moderation and mediation) among particular variables of each type in predicting PA. Analyses pertaining more specifically to parks as features of the built environment are then described, including descriptive analyses of park- and trail-based PA, relationships between proximity to parkland and PA, and associations between park features and PA.

Association of Psychosocial Variables with Physical Activity

As was outlined in greater detail in Chapter Three, a two-step process was used to explore the relationship between five psychosocial variables – self-efficacy, social support from family, social support from friends, decisional balance, and involvement – and participants' total combined weekly minutes of PA episodes that were engaged in for the purposes of recreation or transportation (rec/trans PA). The first step involved multivariate analysis of covariance (MANCOVA) in which participants in the abridged sample were grouped into one of two groups

– those who engaged in zero minutes of rec/trans PA within the particular intensity category and those who engaged in at least some rec/trans PA. Four separate MANCOVAs were run using the 'zero vs. some' groups for the four different intensities of rec/trans PA (mild, moderate, strenuous, and moderate-to-strenuous). The dependent variables in each of the MANCOVA tests were the five psychosocial variables, and age, gender, and the presence of a temporary injury were included as covariates in all four situations.

The initial section of Table 19 shows the results of the MANCOVA tests (with the regression tests described below). The first row shows the number of participants in the abridged study sample included in the MANCOVA analysis who reported at least some rec/trans PA in each intensity category (the number in parentheses in the same row shows the number of participants included in the analysis who reported no rec/trans PA of each intensity[12]). The row labelled "multivariate" shows the results of the MANCOVA analysis examining the equivalence of the two groups (some rec/trans PA vs. no rec/trans PA) when examining the combined effects of the five psychosocial variables. When the multivariate test was significant, differences between the two groups on each of the five psychosocial variables were explored further, and are shown in the rows that follow the main test.

For the moderate, strenuous, and moderate-to-strenuous categories, significant differences existed between participants reporting some rec/trans PA and those reporting no rec/trans PA with respect to their overall ratings of the five psychosocial variables (Table 19). No difference existed between the two groups when looking at the *mild* rec/trans PA category. In examining the five individual psychosocial variables, each variable differed significantly between the 'some' vs. 'none' groups for all three intensities categories (Table 19), with those

[12] Note that the two numbers do not sum to 384 (the number of participants in the abridged sample) because participants with missing values on one or more of the independent or dependent variables used in each analysis were excluded listwise.

participants reporting some rec/trans PA always reporting higher levels of the variable than those reporting no rec/trans PA. The only minor exception was social support from friends in the moderate rec/trans category, which approached but did not reach the traditional $p<.05$ level of significance ($F=2.67$, $p=.10$).

Table 19
Differences in Psychosocial Variables by Level of Recreational/Transportational Physical Activity

	Total Weekly Minutes of Recreational/Transportational PA							
	Mild		Moderate		Strenuous		Moderate/Strenuous	
	F or t	p	F or t	p	F or t	p	F or t	p
Number reporting some PA in category	230 (80)		241 (69)		131 (179)		259 (51)	
Multivariate	1.27	.28	3.08	.01	16.79	<.01	6.50	<.01
Family support			7.82	.01	6.45	.01	8.60	<.01
Friends support			2.67	.10	22.27	<.01	8.47	<.01
Self-efficacy			6.39	.01	51.43	<.01	18.42	<.01
Dec. Balance			12.02	<.01	48.48	<.01	26.27	<.01
Involvement			7.88	.01	70.24	<.01	23.53	<.01
Regression	1.53	.15	2.09	.04	2.90	.01	6.21	<.01
Family support			-.37	.71	1.23	.22	.42	.68
Friends support			1.10	.27	1.65	.10	1.80	.07
Self-efficacy			1.63	.10	.77	.44	2.15	.03
Dec. Balance			-.77	.44	.90	.37	.29	.77
Involvement			.94	.35	-.05	.96	1.83	.07

Given that several of the psychosocial variables were significantly related to which rec/trans PA group (none vs. some) participants belonged to, linear regressions were conducted to determine if the five psychosocial variables were significant predictors of the (continuous) amount of rec/trans PA. As described above, these analyses included only participants who recorded some rec/trans PA of each intensity. The latter half of Table 19 shows that the overall

regression models (which included the three covariates on the first step and the five psychosocial variables on the second step) were significant for all three of the moderate, strenuous, and moderate-to-strenuous rec/trans PA categories (see "regression" row in Table 19). As well, the addition of the five psychosocial variables produced a significant increment in R-squared over and above the three covariates included in the models (age, gender, and temporary injury). However, when examining the five psychosocial variables individually, very few were significant predictors of the amount of rec/trans PA engaged in by participants. Only in the moderate-to-strenuous analysis were self-efficacy (t=2.15, p=.03), social support from friends (t=1.80, p=.07), and involvement (t=1.83, p=.07) significant (or near-significant) predictors of the amount of rec/trans PA engaged in by participants (Table 19). Overall then, the five psychosocial variables were significantly related to whether participants engaged in 'some' vs. 'no' rec/trans PA in the moderate, strenuous, and moderate-to-strenuous intensity categories, but largely failed to discriminate among participants reporting at least some rec/trans PA in all intensity categories.

Association of Environmental Variables with Physical Activity

Using a similar process to that described in the previous section, this section describes associations between participants' ratings of their neighbourhood environments and the PA they engaged in within the neighbourhood. Four separate MANCOVAs were analysed using the seven NEWS dimensions as dependent variables. In each MANCOVA, one of mild, moderate, strenuous, or moderate-to-strenuous neighbourhood PA (n'hood PA) was used as the grouping variable, dichotomized into zero vs. some minutes of n'hood PA within that intensity category. If the overall model for the intensity independent (factor/grouping) variable suggested that participants reporting some n'hood PA perceived their neighbourhood environments differently

than those reporting no n'hood PA, follow-up multiple regressions were run using only those participants who reported at least some n'hood PA within that intensity category. For these regressions, total weekly minutes of n'hood PA within the particular intensity category served as the dependent variable (after being log+1 transformed) and the independent variables were the centred summary scores for the seven NEWS dimensions. For both the MANCOVAs and regressions, the analyses controlled for age, gender, and the presence of a temporary injury that might limit PA.

The first row of Table 20 again shows the number of participants in the abridged study sample included in the MANCOVA analysis who reported at least some n'hood PA in each intensity category (while the number in parentheses in the same row shows the number of participants included in the analysis who reported no n'hood PA of each intensity). As is shown in the "multivariate" row of Table 20, significant differences existed in overall neighbourhood ratings for participants reporting some vs. no *moderate* n'hood PA ($F=3.23$, $p<.01$ and some vs. no *moderate-to-strenuous* n'hood PA ($F=2.85$, $p=.01$). When examining the individual dimensions of neighbourhood environments, several factors significantly discriminated between the two groups for both intensity categories of n'hood PA. For both moderate and moderate-to-strenuous n'hood PA, street connectivity, aesthetics, safety, land use diversity and land use access all approached or reached significance ($p<.05$) in differentiating between the two groups in each intensity category (Table 20). Additionally, density ratings were different between the some vs. none groups in the moderate-to-strenuous n'hood PA category. Ratings of walking facilities were not significantly different between the some vs. none groups for either intensity category. For almost all of the neighbourhood variables where significant differences were observed between the two groups, the group of participants reporting at least some n'hood PA

had higher ratings on those neighbourhood dimensions than those reporting no n'hood PA. The only exception to this was the density variable in the moderate-to-strenuous analysis, as participants reporting some moderate-to-strenuous n'hood PA actually had lower perceptions of their neighbourhood's density than those reporting no n'hood PA.

Table 20
Differences in Neighbourhood Variables by Level of Neighbourhood Physical Activity

	Total Weekly Minutes of Neighbourhood PA							
	Mild		Moderate		Strenuous		Moderate/Strenuous	
	F or t	p	F or t	p	F or t	p	F or t	p
Number reporting some PA in category	191 (159)		170 (180)		54 (296)		198 (152)	
Multivariate	1.01	.42	3.23	<.01	.39	.91	2.85	.01
Density			1.66	.20			4.34	.04
Streets			6.96	.01			6.36	.01
Aesthetics			5.51	.02			4.58	.03
Safety			3.24	.07			5.11	.02
Land use diversity			5.84	.02			3.80	.05
Land use access			8.99	<.01			3.35	.07
Walking facilities			.33	.56			1.72	.19
Environment index	5.81	.02	10.26	<.01	.01	.98	7.80	.01
Regression	.36	.96	1.67	.09	1.20	.32	1.45	.16
Density			-1.76	.08				
Streets			-.68	.49				
Aesthetics			3.14	<.01				
Safety			-1.32	.19				
Land use diversity			1.68	.09				
Land use access			.19	.85				
Walking facilities			-.49	.63				
Environment index	.66	.62	.82	.52	1.11	.36	.77	.54

When linear regression models were examined using only those participants who reported some n'hood PA of each intensity, none of the overall regression models reached the

traditional ($p<.05$) level of significance (Table 20). However, the model in which the seven neighbourhood variables predicted *moderate* n'hood PA approached significance ($F=1.67$, $p=.09$) and the increment in R-squared above and beyond the three covariates when the seven neighbourhood variables were added to the model also approached significance ($p=.055$). In examining the individual neighbourhood variables for that model, only the aesthetics dimension ($t=3.14$, $p<.01$) was significantly and positively related to the amount of moderate-intensity n'hood PA engaged in by participants, while the land-use diversity ($t=1.68$, $p=.09$) and density ($t=-1.76$, $p=.08$) variables also approached significance, though the relationship for the latter dimension was in the opposite direction to what might be expected (Table 20). Overall then, it appears that participants' perceptions of neighbourhood walkability significantly discriminated between those who engaged in some vs. no moderate and moderate-to-strenuous n'hood PA, but not amongst the (continuous) amount of PA undertaken within each intensity category.

Finally, as was described in Chapter Three, a total neighbourhood "environment index" was calculated by standardizing and then summing the seven individual dimensions of the NEWS instrument. This summary measure was then used in MANCOVA and linear regression analyses in the same ways as described in this section. Table 20 shows that participants reporting at least some n'hood PA in the mild, moderate, and moderate-to-strenuous intensity categories rated their environments significantly more positively than participants reporting no n'hood PA of the respective intensity level. However, when the environment index was added to linear regression models predicting the (continuous) amount of n'hood PA at each intensity level, a significant increment in R-squared was not observed (over and above the three covariates of age, gender, and injury) and the total models were not significant for any of the four categories of n'hood PA.

Moderation of Relationship between Psychosocial Variables and Physical Activity

The following two sections describe tests of the interactions between particular variables discussed in the previous sections. Specifically, this section examines the extent to which participants' perceptions of their total neighbourhood environment moderate the relationship between psychosocial variables and recreational/transportational PA (rec/trans PA), while the next section below addresses potential mediation of the relationship between environmental perceptions and neighbourhood PA by psychosocial characteristics of the individual participants.

Moderation relationships, discussed in this section, were investigated using multiple linear regressions in which the three covariates of age, gender, and injury were entered on the first step, followed by one psychosocial variable and the total environment index on the second step (both centred), and finally the interaction term for the environment index and the psychosocial variable on a third step (see Chapter Three for a complete description). Total weekly minutes of moderate-to-strenuous rec/trans PA served as the dependent variable for each analysis, as this was the intensity of rec/trans PA with which the psychosocial variables showed the strongest relationships (see Table 19). As was described above, a significant number of participants in the abridged sample reported no moderate-to-strenuous rec/trans PA for the study week, so the distribution for this PA variable was substantially positively skewed. Therefore, these analyses involve only those participants who reported at least some moderate-to-strenuous rec/trans PA and the amount for each person was transformed using a log+1 transformation which greatly improved the normality of the dependent variable.

Table 21 shows the results of the four similar tests involving the different psychosocial variables. The psychosocial variable used in each analysis is shown across the top of the table. The rows in the table depict the independent variables used in each model. The three covariates were always included as the first step in the models and, thus, values for these are included in

each column. The values listed under step two of the model are those for the environment index as well as the particular psychosocial variable used in each analysis. Finally, the third step of the model provides the values for the interaction term created from the product of the psychosocial variable and the environment index. The three "regression: step #" rows in Table 21 provide the F test statistic and associated significance value for the regression sums of squares at each step of the model. For example, the "regression: step 2" value of 6.61 (p=.00) in the self-efficacy column indicates that the set of variables in the model at step 2 – the three covariates as well as self-efficacy and the environment index – significantly predicted rec/trans PA. Further, relative comparisons of the F statistic for the sums of squares at each step of the model provide an indication of improvements (or reductions) in predicting rec/trans PA with the addition of more variables. An asterisk (*) for the F statistic for the regression sums of squares indicates that a significant increment in R-squared was observed over the previous step in the model.

The results from Table 21 are relatively clear and consistent across the four analyses involving the different psychosocial variables. At the initial step of the four models, none of the three covariates was significantly associated with the dependent variable of total weekly minutes of moderate-to-strenuous rec/trans PA. At the second step of each model, all four psychosocial variables – self-efficacy, social support from friends, decisional balance, and involvement – were significantly related to the dependent variable, but the environment index was not. Nevertheless, the addition of this set of variables to the model produced a significant increment in R-squared. At the final step of each model, the interaction of the environment index and each psychosocial variable was not significantly related to rec/trans PA nor did adding this term result in a significant increment in R-squared. Overall, then, participants' perceptions of their neighbourhood environments do not appear to moderate the relationship

between their ratings of the four psychosocial variables and the amount of weekly moderate-to-strenuous rec/trans PA they engage in.

Table 21
Multiple Regression Models of Interactions between Total Environment Index and Psychosocial Variables in Predicting Moderate-to-Strenuous Recreational/Transportational Physical Activity

	Psychosocial Variable Included in Model							
	Self-efficacy		Social Support from Friends		Decisional Balance		Involvement	
	F or t	p	F or t	p	F or t	p	F or t	p
Model total df	288		266		290		291	
Regression: Step 1	.16	.92	.08	.97	.27	.85	.27	.85
Injury	-.42	.68	-.33	.74	-.45	.65	-.26	.80
Gender	.21	.84	-.06	.95	.24	.81	.16	.87
Age	-.54	.59	-.35	.72	-.76	.45	-.86	.39
Regression: Step 2	6.61*	<.01	5.92*	<.01	4.90*	<.01	8.69*	<.01
Psychosocial variable	5.70	<.01	5.41	<.01	4.86	<.01	6.52	<.01
Environment index	-1.08	.28	-.32	.75	-.68	.50	-1.07	.28
Regression: Step 3	5.50	<.01	4.94	<.01	4.08	<.01	7.48	<.01
Environment index x psychosocial variable	.26	.80	-.34	.73	.29	.77	1.16	.25

Table 21 Notes:
1. Each model step included the variables listed as being added at that step *as well as* all variables in previous steps. However, test statistics and associated significance values reported for individual variables in Table 21 are the values at the step of the model when the variable was first added (i.e., the step under which they are listed). Thus, variables' significance in later steps of the model may be different, although no notable differences were found.
*=significant increment in R-squared at that step of the model

Mediation of Relationship between Environmental Variables and Physical Activity

As was described in Chapter Three, mediation of the relationship between neighbourhood walkability and neighbourhood PA (n'hood PA) by individual psychosocial characteristics was also tested using Baron and Kenny's (1986) four-step process. The four psychosocial mediators considered were social support, self-efficacy, decisional balance, and involvement. The primary independent variable was the neighbourhood environment index described above, which was a

compilation of the seven individual facets of the environment rated by participants. The dependent variable was total weekly minutes of *moderate* n'hood PA, as this was the intensity of neighbourhood PA most related to neighbourhood environment factors in previous analyses (see Table 20). For the four-step analysis, which involved either correlation or multiple regression analyses, only those participants who reported at least some moderate-intensity n'hood PA were included, in order that the dependent variable be continuous and have a sufficiently normal distribution.

Table 22
Mediation of the Relationship between Total Environment Index and Moderate Neighbourhood Physical Activity by Individual Psychosocial Variables

	Psychosocial Mediator Used							
	Self-efficacy		Social Support from Family		Decisional Balance		Involvement	
Mediation Analysis Step	r or *B*	p	r or *B*	p	r or *B*	p	r or *B*	p
Step 1								
IV-DV Correlation	.06	.41	.06	.41	.06	.41	.06	.41
N	173		173		173		173	
Step 2								
IV-Mediator Correlation	.21	.01	.11	.15	.12	.12	.16	.04
N	165		156		167		167	
Step 3								
DV-Mediator Correlation (controlling for IV)	.12	.14	-.07	.39	.04	.59	-.05	.49
df total	164		159		166		166	
Step 4								
Partial or Full Mediation of IV-DV Relationship	neither		neither		neither		neither	

Table 22 shows the results of each step of the analysis using each of the four psychosocial variables. The first step examined the correlation between the exogenous independent variable (IV) – the total environment index – and the dependent variable (DV) of

total weekly minutes of moderate n'hood PA. The second step examined the correlation between the IV and the particular mediator of interest for that set of analyses, with the mediators shown across the top of Table 22. The third step examined the relationship between the DV and the psychosocial mediator, while controlling for the IV which was also predicting the DV according to Figure 7 shown in Chapter Three. Finally, if the previous three steps were passed successfully, step four involved examining the whether the psychosocial variable partially or fully mediated the relationship between the total environment index (IV) and moderate n'hood PA (DV).

The results for each Step 1 of the analyses in Table 22 show that the total environment index was not significantly correlated with the dependent variable of total weekly minutes of moderate neighbourhood PA when using the portion of the abridged sample which reported at least some moderate ($r=.06$, $p=.41$). Although this finding violates Baron and Kenny's (1986) first criterion for establishing mediation, more recent studies by MacKinnon, Lockwood, Hofman, West and Sheets (2002) and Shrout and Bolger (2002) suggest that mediation can still exist in the absence of an observed relationship between the primary independent variable and the dependent variable of interest. Shrout and Bolger (2002) state that passing this initial test "should not be a requirement when there is a priori belief that the effect size is small or suppression is a possibility" (p. 422). Additionally, MacKinnon et al. (2002) evaluated 14 methods of testing mediation and concluded that simply testing the significance of the relationships between the IV and the mediator and between the DV and the mediator (steps 2 and 3 from Baron & Kenny's guidelines) provides the best test of mediation. Consequently, the analyses proceeded with step two examining the relationship between the IV (total environment index) and each of the four psychosocial mediators.

Table 22 shows that the total environment index (IV) was significantly correlated with two of the four mediators – self-efficacy (r=.21, p=.01) and involvement (r=.16, p=.04) – but was not significantly related to social support from family (r=.11, p=.15) or decisional balance (r=.12, p=.12). In step three of each analysis, the dependent variable of moderate n'hood PA was not significantly related to any of the four psychosocial variables when also controlling for the total environment index. Therefore, step four examining the extent of the mediation was irrelevant as mediation was not apparent in any of the four analyses given that none of the psychosocial variables was significantly related to the DV in step three. As an aside, when all participants in the abridged sample were included (not just those who reported some moderate n'hood PA), the nature of the relationships at all four steps of the analyses were very similar for all four psychosocial mediators (except step 1 which did show a significant correlation between moderate n'hood PA and the total environment index).

Description of Park and Trail-Based Physical Activity

This section looks at several descriptive analyses related to the frequency and characteristics of PA episodes that included the use of a neighbourhood park or trail. Table 23 shows the percentage of total PA episodes recorded by participants in the abridged sample that included use of a park or trail. A smaller number of episodes included both a park and a trail and these are shown in the third row of the table. The first column in the table depicts episodes that included *any* park or trail, while the latter column shows those episodes that included use of a park or trail that was *within the participant's planning district* (hereafter referred to as "neighbourhood" parks or trails). For example, the "any" park or trail column included locations such as Victoria Park in Kitchener, provincial parks, or the Bruce Trail, as well as parks and trails within the four study areas, while the latter column is comprised only of episodes that

included a neighbourhood park or trail. A park was assigned to a planning district, and thus classified as a neighbourhood park for participants within that district, if its centroid fell either within the boundaries of the district or within a 800m buffer zone around the district[13]. Neighbourhood trails were more difficult to define. To classify a PA episode as including the use of a neighbourhood trail, an algorithm was used which first identified the episode as including use of a trail and second identified the episode as occurring with the neighbourhood, either in whole or in part (as was described above). However, because of the linear nature of trails, they almost always span multiple neighbourhoods (or planning districts) and it could not be determined with certainty if the trail use portion of the episode occurred within the participant's neighbourhood (or buffer zone). Therefore, unlike parks which could be assigned with a great deal of confidence to particular districts (including their 800m buffer zones), the term 'neighbourhood trails' should be interpreted with caution.

It should also be noted that in contexts where a trail was located within a park (e.g., Clair Lake Park, RIM Park), such episodes were classified as occurring in a park and not on a trail. This was done at least partly to be consistent with the analyses reported later related to the associations between PA and specific features (e.g., trails) within parks. Therefore, those episodes classified as "park and trail" in Table 23 included mention of a park as well as a trail *outside* of the park (e.g., Waterloo Park and the Walter Bean Trail).

As shown in Table 23, 308 of the total 3815 PA episodes (8.1%) reported by participants in the abridged sample included the use of a park of some kind and location. Another 43 episodes (1.1%) included a park and trail, while 97 (2.5%) solely mentioned a trail. *Neighbourhood* parks were mentioned in 236 or 6.2% of the total episodes, while 71 episodes (1.9%) included a

[13] As a result of this decision, the number of "neighbourhood park" episodes will not capture those episodes in which a participant visited a park proximal to a context other than his or her home (e.g., school, workplace, etc.), unless, of course, that other context was in the same district as his or her home address.

neighbourhood trail. Therefore, approximately 67% (236/(308+43)) of the total park episodes included a neighbourhood park and approximately 73.2% (71/97) of all exclusively trail episodes included a neighbourhood trail. Because a significant number of the "any parks or trails" episodes listed in the first column of Table 23 include very diverse locations (including many outside of Kitchener-Waterloo), the remaining descriptive analyses in this section focus exclusively on *neighbourhood* parks and trails[14].

Table 23
Percentage of Total Episodes that Included Any Parks and Trails and Neighbourhood Parks and Trails

	Any Parks or Trails		Neighbourhood Parks or Trails	
	N	% of total	N	% of total
Park	308	8.1%	236[1]	6.2%
Trail	98	2.6%	72	1.9%
Park and Trail	42	1.1%	n/a*	n/a

Table 23 Notes:
1. Because of the different algorithms used to classify park or trail episodes as 'in the neighbourhood', it was not possible to create an aggregated total for episodes that included 'parks and trails in the neighbourhood' (thus the n/a code in that cell of the table). Therefore, if an episode included use of a neighbourhood park, with or without a neighbourhood trail, it was grouped in the neighbourhood park total (236). Therefore, if the reader wishes to examine episodes that included a neighbourhood park as a proportion of total episodes that included any park, the appropriate denominator would = number of episodes including any park (308) + number of episodes including any park and trail (43).

Table 24 shows the number of PA episodes in which a neighbourhood park or neighbourhood trail was used that were classified by participants as mild, moderate, or strenuous in intensity (note again that episodes which included a neighbourhood park, with or without a trail, are included in the 'park' row). For parks, a very similar proportion of mild (42.4%) and moderate (44.6%) episodes were reported, with strenuous episodes including the use of a neighbourhood park being less common (13.0%). For trails, a similar proportion of episodes were classified as moderate (43.7%) to that which was reported for park episodes. However, a

[14] See previous footnote.

greater proportion of neighbourhood trail episodes were strenuous (19.7%), while fewer trail episodes were mild in their intensity (36.6%).

Table 24
Intensity of Physical Activity Episodes that Included Neighbourhood Parks and Trails

	Mild		Moderate		Strenuous	
	N	%	N	%	N	%
Parks	98	42.4%	103	44.6%	30	13.0%
Trails	26	36.6%	31	43.7%	14	19.7%

Table 25 below shows the average duration of mild, moderate, and strenuous episodes that included neighbourhood parks and trails (as based on the episodes of each intensity reported in Table 24 above). Interestingly, for both episodes that included parks and those that included trails, the more intense the episodes were, the longer they were in duration. As well, for all three intensity categories, episodes that included neighbourhood parks were longer in duration than those that included trails.

Table 25
Average Duration of Physical Activity Episodes that Included Neighbourhood Parks and Trails by Intensity

	Mild (minutes)		Moderate (minutes)		Strenuous (minutes)	
	Mean	St. Dev.	Mean	St. Dev.	Mean	St. Dev.
Parks	40.15	32.88	49.10	50.01	53.53	53.61
Trails	33.85	16.81	44.93	16.74	48.21	31.96

Finally, Tables 26 and 27 below examine episodes of PA that included use of neighbourhood parks or trails according to the purpose for which participants engaged in the bout of activity. Table 26 shows that for both parks and trails, approximately 80% of the episodes were engaged in for recreational purposes. The proportion of neighbourhood trail episodes that were engaged in for transportational purposes (11.1%) was just slightly higher than

the proportion of episodes used for transportation (9.3%), while a small proportion of park episodes (2.1%) and no trail episodes (0.0%) were engaged in for job-related purposes.

Table 26
Purpose of Physical Activity Episodes that Included Neighbourhood Parks and Trails

	Recreation		Transportation		Household		Job-Related	
	N	%	N	%	N	%	N	%
Parks	191	80.9%	22	9.3%	13	5.5%	5	2.1%
Trails	59	81.9%	8	11.1%	3	4.2%	0	0.0%

Table 27
Purpose of Physical Activity Episodes that Included Neighbourhood Parks and Trails by District

	District			
	Central	Willowdale	Beechwood	Eastbridge
Parks				
Recreation	33	35	54	69
Transportation	19	0	3	0
Household	3	4	3	3
Job-related	5	0	0	0
Total Parks	60	39	60	72
Trails				
Recreation	16	13	9	21
Transportation	6	2	0	0
Household	0	0	1	2
Job-related	1	0	0	0
Total Trails	23	15	10	23
Total Park or Trail Episodes	83	54	70	95

Table 27 extends the above analysis by examining the proportion of park and trail episodes engaged in for different purposes within each of the four study districts. In Willowdale, Beechwood, and Eastbridge, almost all of the physical activity that included use of a neighbourhood park or trail was done for recreational purposes. However, in the Central district, a much greater proportion of park and trail episodes were engaged in for other purposes,

especially transportation. Indeed, separate chi-square analyses showed significant differences between the districts for both park and trail episodes with respect to the frequency with which the different purposes were reported. This finding is likely explained by the fact that Waterloo Park is located directly between the city's two universities, central business district, and much of the housing in the Central Planning district.

Relationship of Park Features with Physical Activity

As was described in Chapter Three, the number of different facilities (out of 13) and amenities (out of 15) in each of the 33 parks in the four study districts was tallied using the EAPRS instrument. Three analyses were undertaken to examine whether parks with more features were used more often for PA, and what features of parks were significantly associated with parks being used for PA. Fourteen of the 33 parks were used for at least some PA by participants in the abridged study sample, whereas 19 were not used for PA in any of the participants' episodes.

Initially, t-tests were employed to investigate whether parks that were used for 'some PA' (i.e., they were mentioned in the location text for participants' PA episodes) had a greater number of facilities, amenities, and total features than parks that were not used at all for PA by participants in the (abridged) study sample. Table 28 below shows that parks in which some PA occurred had a significantly greater number of facilities, amenities, and facilities. Parks that were used for PA had an average of 5.86 facilities compared to only 2.74 facilities for parks that were not used for PA ($t=3.48$, $p=.003$). With respect to amenities, parks that were used for PA had an average of 6.57 amenities compared to only 4.00 amenities in parks that were not used for PA ($t=2.50$, $p=.021$). Finally, summing facilities and amenities together, parks that were used for PA

had a total of 12.43 features compared to only 6.74 total features in parks that were not used for PA (t=3.08, p=.007).

Table 28
Comparison of Parks with Some vs. No Physical Activity on Number of Facilities, Amenities, and Features

Dependent variable	Parks with some PA	Parks with no PA	df	t	p
Number of facilities	5.86	2.74	31	3.48	<.01
Number of amenities	6.57	4.00	31	2.50	.02
Total features	12.43	6.74	31	3.08	<.01

Given that both the number of facilities and amenities differed significantly between parks with some PA and those with no PA, further analyses were undertaken to examine the specific features within each category that were related to at least some PA occurring in a park. Table 29 shows the results of unadjusted and adjusted logistic regression models in which the dependent variable of some PA occurring in the park was examined according to the presence or absence of the 28 features. In the unadjusted models, in which each park feature served as the lone independent variable, having a paved trail, unpaved trail, and wooded area each significantly increased the odds of some PA occurring in the park (Table 29). The other 10 facilities – path, open space, meadow, water area, playground, ball diamond, soccer pitch, tennis court, basketball court, and pool – were not significantly related to increased odds of the park being used for PA. With respect to amenities, only one feature – the park having more than one entrance – was significantly related to the park being used for some PA. All of the other amenities – drinking fountain, picnic area, restroom, shelter/pavilion, historical/educational feature, landscaping, bike rack, parking lot, sidewalk adjacent, roadway thru, rules sign, bench, table, trash can – were not significantly related to PA occurring in the park. When the three significant facility variables were entered simultaneously into a similar logistic regression model, only having a paved trail

(OR=25.93) remained significantly related to increased odds of the park experiencing at least some use for PA (Table 29). An adjusted, multivariate model was not run for the amenities category of features because only one amenity was significantly related to the outcome measure in the unadjusted analyses.

Table 29
Unadjusted and Adjusted Odds Ratios for Park Features within Parks' Prediction of Any PA Occurring in that Park
(only significant predictors shown in table)

Park Features	Number of parks with feature (out of 33)	Unadjusted Odds Ratios for Predicting Any PA in the Park		Adjusted Odds Ratios for Predicting Any PA in the Park	
		B	95% CI	B	95% CI
Facilities					
Paved trail	10	32.41	(3.27,320.36)	25.93	(2.15,312.51)
Unpaved trail	11	7.11	(1.40,36.12)		
Wooded area	13	6.75	(1.43,31.90)		
Amenities					
More than one entrance	20	8.25	(1.43,47.58)	n/a	

Non-significant features: path, open space, meadow, water area, playground, ball diamond, soccer pitch, tennis court, basketball court, pool, drinking fountain, picnic area, restroom, shelter/pavilion, historical/educational feature, landscaping, bike rack, parking lot, sidewalk adjacent, roadway thru, rules sign, bench, table, trash can

Finally, a comparable analysis was undertaken to examine how park features were related to park PA at the individual (rather than park) level. In this case, as was described in Chapter Three, for each participant, the presence of each of the features within a park within 1 km of his/her home was used as the binary independent variable in the analyses. The dependent variable in the logistic regression models was whether or not the participant recorded at least one PA episode that included use of a neighbourhood park.

Table 30 shows the results of the unadjusted and adjusted analyses (as well as the number of participants who had each of the significant features within 1 km of their homes). Having five facilities within a nearby park – unpaved trail, meadow, water area, basketball court, and soccer

pitch – were significantly related to increased odds of the participant recording at least some park-based PA. One other facility – ball diamond – was related to significantly lower odds of engaging in at least some PA in neighbourhood parks. Having the other seven facilities – paved trail, path, open space, wooded area, playground, tennis court, and pool – in nearby parks was not significantly related to participants engaging in PA in neighbourhood parks. When the multivariate, adjusted model was examined using only the six significant facilities, only having a water area within a park within 1 km was significantly related to increased odds of participants engaging in park-based PA (OR=4.70).

Table 30
Unadjusted and Adjusted Odds Ratios for Park Features within 1 km of Participants' Prediction of Any PA in Neighbourhood Parks (only significant predictors shown in table)

Park Features	Participants with feature within 1 km (out of 384)	Unadjusted Odds Ratios for Predicting Any Participant PA in Neighbourhood Parks B	95% CI	Adjusted Odds Ratios for Predicting Any Participant PA in Neighbourhood Parks B	95% CI
Facilities					
Unpaved trail	211	2.31	(1.40,3.80)		
Meadow	346	2.94	(1.02,8.53)		
Water area	305	4.86	(2.04,11.58)	4.70	(1.05,21.05)
Basketball court	206	1.81	(1.11,2.93)		
Soccer pitch	116	2.90	(1.78,4.73)		
Ball diamond	173	0.47	(0.29,0.76)		
Amenities					
Restroom	116	2.27	(1.40,3.70)		
Historical/Educ.	213	5.02	(2.83,8.92)	5.10	(2.11,12.36)
Landscaping	306	2.90	(1.39,6.07)		
Bike rack	173	1.68	(1.05,2.69)		
Parking lot	228	2.39	(1.42,4.01)		
Roadway thru	116	2.90	(1.78,4.73)		

Non-significant variables: paved trail, path, open space, wooded area, playground, tennis court, pool, drinking fountain, picnic area, shelter/pavilion, sidewalk adjacent, rules sign, bench, table

With respect to amenities, six features – restroom, historical/educational feature, landscaping, bike rack, parking lot, and having a roadway through the park – were significantly

related to participants using neighbourhood parks for PA in the unadjusted analyses (Table 30). The other nine amenities – drinking fountain, picnic area, shelter/pavilion, sidewalk adjacent, rules sign, bench, and table – were not significantly related to participants engaging in park-based PA. In the multivariate model, only having an historical/educational feature in a nearby park was significantly related to increased odds of participants reporting some PA in parks (OR=5.10).

Relationship of Parkland Proximity with Physical Activity

The final research questions addressed the association between three indicators of parkland proximity – i) number of parks within 1 km of participants' homes, ii) total park area within 1 km, and iii) distance to the closest park – and three PA dependent variables measured in minutes per week: i) *total* moderate-to-strenuous PA (MSPA), ii) *neighbourhood* MSPA, and iii) *park-based* MSPA. As described in Chapter Three, each dependent variable was dichotomized due to the large number of people who reported no MSPA in each of the three contexts. Binary and multinomial logistic regression were used to examine the association between each of the three park variables and each of the three MSPA variables, while controlling for age, gender, and the presence of a temporary injury.

Table 31
Odds Ratios for Park-Related Variables Prediction of Total, Neighbourhood, and Park-Based PA

Park Covariate (adjusted for age, gender, and temporary injury)	Total MSPA (none vs. 150+ min)		Neighbourhood MSPA (none vs. 150+ min)		Park-Based MSPA (none vs. some)	
	B	95% CI	B	95% CI	B	95% CI
Number of parks within 1 km	1.09	(.84,1.42)	1.16*	(1.01,1.34)	1.14*	(1.01,1.28)
Park area within 1km	1.02*	(1.01,1.03)	1.00	(.99,1.01)	1.01*	(1.00,1.02)
Distance to closest park	0.96	(.71,1.32)	1.07	(.86,1.32)	1.07	(.86,1.33)

*indicates odds ratio significant at the .05 level for predicting membership in higher PA group

Table 31 shows the odds ratios (B) and associated confidence intervals (95% CI) for the association between each park-related predictor variable and each of the three MSPA variables,

after controlling for the three covariates. In each case, the “none” category served as the referent group. For “total MSPA” (all locations), only the amount of park area within 1 km of participants’ homes was a significant predictor, with each additional hectare increasing the odds of achieving 150 minutes of weekly MSPA by 2%. For “neighbourhood MSPA”, the number of parks within 1 km of participants’ homes was the only significant predictor of the three park-related variables, with each additional park increasing the odds of engaging in 150 or minutes of MSPA in the neighbourhood by 16%. Finally, both the number and total area of parks within 1 km were significant predictors of “park-based MSPA”, with each additional park within 1 km of participants’ homes increasing the odds of engaging in some park-based PA by 14%, and each additional hectare of parkland within the same area increasing the odds of some park-based PA by 1%. Distance to the closest park was not significantly related to weekly minutes of MSPA in any of the three contexts.

CHAPTER FIVE: DISCUSSION

The following discussion is divided into four major sections: interpretation of study findings; implications for practice; study limitations; and suggestions for future research.

Interpretation of Study Findings

This initial section of the discussion reviews the findings of the current study, including their relationship to previous findings in similar studies.

Association of Psychosocial Variables with Physical Activity

In this study, the relationship between a variety of psychosocial variables and PA undertaken for recreational and transportational purposes (rec/trans PA) was examined. The preceding analyses reported that participants who engaged in at least some rec/trans PA of various intensities during the study week differed significantly in their ratings of all five psychosocial variables (social support from family, social support from friends, self-efficacy, decisional balance, and involvement) from those participants who reported no rec/trans PA (see Table 19 in Chapter Four). Follow-up regression analyses were then conducted to examine whether the various psychosocial variables significantly predicted the amount of rec/trans PA when only those participants who engaged in at least some rec/trans PA were included in the analysis. These analyses reported that the *set* of psychosocial variables significantly predicted the amount of moderate, strenuous, and moderate-to-strenuous rec/trans PA engaged in by participants, but rarely were the *individual* variables significantly related to the amount of any intensity of rec/trans PA (see Table 19).

These results largely contrast the findings of previous studies. Numerous studies have reported that these types of individual-level psychosocial variables, especially self-efficacy, social support, and decisional balance, were related to the amount of PA engaged in by study

participants (e.g., Allison et al., 1989; Leslie et al., 1999; Orsega-Smith et al., 2003; Sallis et al., 1989; Sylvia-Bobiak & Caldwell, 2006; Wilcox et al., 2003). However, several methodological explanations for the somewhat discrepant results in the current study can be offered. First, most studies of PA determinants – whether they focus on psychosocial variables or other factors – collect global measures of PA behaviour using relatively brief and aggregated instruments. For example, the widely-used Godin-Shepard Leisure Time Exercise Questionnaire (Godin & Shepard, 1985) asks respondents to simply state their frequency of weekly participation in mild, moderate, and strenuous activities. However, in this study, participants were also asked to indicate the purpose of their activity episodes and only PA undertaken for recreation or transportation was included in the analyses pertaining to psychosocial variables. Although the GSLTEQ asks people to consider only leisure-time activity (and, thus, is somewhat similar, to the present dependent variable with the exception of transportational PA being added into the present total), other summary questionnaires and most objective measures of PA (e.g., pedometers, accelerometers) are less discriminating about contextual information such as purpose. As is described further below, it was thought that the psychosocial constructs/scales used in this study related more to non-compulsory PA (i.e., recreation and transportation) and, therefore, that excluding PA undertaken for other purposes (i.e., household and job-related) was appropriate. However, it is possible that psychosocial variables may be more strongly related to a measure of total PA undertaken for all purposes, or, as is discussed further below, to only PA undertaken for recreational purposes (excluding transportation).

Another potential methodological explanation for the disparate results may be related to the adaptation of instruments that were originally designed to capture attitudes about *structured exercise programs*. The scales used to measure social support, self-efficacy, and decisional

balance were developed with (and have often been used with) participants involved in exercise intervention programs. As was described in Chapter Three, in the present study, slight modifications in wording were made such that the items in these instruments referred to "physical activity" rather than "exercise". Despite this change, it is still possible that the items (which were otherwise unchanged), and participants' responses to them, capture attitudes toward factors related to structured exercise participation rather than a more holistic construct such as physical activity or active living. In this study, following the definitions used in the new International Physical Activity Questionnaire (see Chapter Three and Appendix E), exercise was included in the "recreation" purpose category. However, it is quite possible that physical activity undertaken for exercise and recreation are two different things, and that responses to the items used in the psychosocial variable instruments relate more strongly to one type of PA than the other. Moreover, when the additional facet of transportational PA is added to the dependent variable (along with "recreation" PA, which may be multi-faceted in and of itself), the difference between the scales' original use and the associations examined in the present study may be magnified further.

Similarly, there may have been some abuse of the conceptual foundations of the psychosocial constructs in these analyses. For example, self-efficacy is thought to be task-specific and should be measured as such (Bandura, 1986). Consequently, it is hypothesized that constructs and measures that are more specific will show greater congruence with behaviours of a similar type and that share a similar level of specificity (McAuley & Mihalko, 1998). In this study, self-efficacy to overcome various factors related to *physical activity* participation was measured (using, as was described above, items that were developed more in the context of *exercise* programs). However, the dependent variable in these analyses was the more specific

construct of *rec/trans* PA. In these ways, slight discrepancies between the traditional psychosocial measures employed and the particular dependent variable used in these analyses may account for some of the differences between the present study's results and past findings.

Finally, the two-step process employed in these analyses may have limited the sample such that sufficient power was not available to detect differences in rec/trans PA according to the five psychosocial variables. The entire abridged sample, comprised of a single respondent per household, included 384 participants. In the second step of the analyses described above, the data from only those participants who reported some rec/trans PA were included in the regression models. This led to the exclusion of approximately 30-40% of the potential sample (see Table 19 for number of participants reporting no rec/trans PA of each intensity). Given that participants were also excluded in a listwise fashion if they did not have values on any of the nine variables used in the analysis (three covariates, five psychosocial variables, and one DV), the sample for step two of the analyses was often made up of only 230-260 participants. This two-stage analysis was undertaken because such a large number of people reported no rec/trans PA and, therefore, including all participants' data produced a bi-modal (i.e., severely non-normal, positively skewed) distribution for the dependent variable. Many authors of PA studies report that they transformed their skewed data (though many do not), but they often fail to clarify if, like in this study, a large number of people had zero values (which can't be 'fixed' by usual transformations) and, if so, whether they were included in the analyses. As such, differences in treatment of the PA outcome variable may have produced contrasting results between this and previous studies. Interestingly, when all participants in the abridged sample were included in identical analyses (including those who reported no rec/trans PA), all of the psychosocial variables showed frequent and significant relationships with the PA variables examined.

Association of Environmental Variables with Physical Activity

Similar analyses in this study examined the association between perceptions of environmental attributes and PA of varying intensities that occurred within participants' neighbourhoods. In the initial step of the analyses, it was found that participants who engaged in at least some amount of moderate and moderate-to-strenuous neighbourhood PA had significantly more positive perceptions overall of their neighbourhood's walkability (see Table 20 in Chapter Four). Ratings of most of the specific components of their neighbourhoods (e.g., street connectivity, aesthetics, safety, land use diversity, and land use access) were also significantly higher among people who engaged in some neighbourhood PA. However, when mild or strenuous neighbourhood PA was examined, there was no overall difference in neighbourhood ratings between the group that engaged in some activity and the group that engaged in no activity of that intensity. This finding is consistent with some past research showing that environmental perceptions are more strongly related to moderate-intensity activity than to PA that is more vigorous in nature (Saelens, Sallis, Black & Chen, 2003).

In the follow up analyses examining only those individuals who engaged in at least some moderate-intensity neighbourhood PA, the set of neighbourhood characteristics was found to be a relatively significant predictor of the amount of moderate neighbourhood PA engaged in by participants ($p=.09$; see Table 20). However, only one of the individual elements of the environment (aesthetics) was a significant predictor of moderate neighbourhood PA. When the composite environment index was used, it was found that this summary measure of neighbourhood walkability differentiated between those engaged in some vs. no mild, moderate, and moderate-to-strenuous neighbourhood PA but was not a significant predictor of the amount of any intensity of neighbourhood PA engaged in by participants.

These findings that perceptions of environmental attributes significantly differentiate between those who engage in *some* neighbourhood PA versus those who engage in *no* neighbourhood PA are nevertheless interesting from both a conceptual and practical vantage point. Conceptually, it is possible that having a proximal neighbourhood environment that is conducive to walking may act as a trigger that stimulates action, in this case PA in the form of active recreation or transportation. For example, persons living close to an aesthetically-pleasing neighbourhood trail may be more inclined to venture to a local shopping centre on foot. However, although perceptions of having (and/or actually having) a highly 'walkable' neighbourhood may make the difference for engaging in at least some (vs. no) neighbourhood PA, other factors may better explain the *amount* of neighbourhood PA engaged in by residents. For example, psychosocial attributes such as self-efficacy or familial responsibilities contributing to a lack of time or energy may be more responsible than environmental features for differentiating between those persons who engage in *some* neighbourhood PA and those who are *highly* active in the areas around their homes.

More practically, the finding that sedentary persons hold poorer perceptions of their neighbourhood environments has important implications for health promotion and the growing crisis of physical inactivity. As of 2004, more than one-half of Canadian adults were classified as inactive (<1.5 KKD or 15 minutes walking per day) by the Canadian Fitness and Lifestyle Research Institute (2004). Similarly, according to 2005 statistics from the Centers for Disease Control and Prevention (2005b), 14% of American adults were classified as inactive and another 37% engaged in less than the recommended amount of weekly PA (i.e., somewhere between 10 minutes to 150 minutes of moderate-intensity activity per week). Much research has suggested that the greatest gains in PA promotion may come from stimulating this bulging group of largely

inactive persons to initiate some activity, rather than by convincing moderately active people to do more (Blair & Connelly, 1996; Blair, LaMonte, & Nichaman, 2004; Pate et al., 1995; USDHHS, 1996). Better understanding the mechanisms by which positive neighbourhood environments stimulate PA may help in efforts to get the large percentage of sedentary residents to initiate and maintain more active lifestyles.

The various capacities in which neighbourhood environments influence PA may be captured by Lynch's (1960) theory of urban imageability. This theory posits that both the imageability and legibility of an area are positively related to the level of visitation or activity that occurs there. Imageability refers to the capacity of an area to arouse vivid memories among people who visit or live in that location. A neighbourhood's imageability, for example, may be influenced by its aesthetic appeal, either due to natural scenery or architecture, or by the presence of particular amenities, such as parks or shopping districts. Related to this, legibility refers to how comprehensible the geography of an area is for both residents and visitors. Neighbourhoods in which the streets follow a predictable (e.g., grid-like) pattern are likely to be perceived as more legible. Increased legibility may also promote recreational and transportational PA by assisting people to know which areas of a neighbourhood are safe and where to find what they're looking for (e.g., park, shopping area) more efficiently. The theory of urban imageability has not been tested in research examining environmental influences on PA, but it may be valuable for understanding why some people engage in neighbourhood-based PA and others do not.

Finally, it is possible that improving the specificity of neighbourhood attributes and related PA variables may uncover stronger relationships between environmental perceptions and neighbourhood PA. In this study, all seven elements of the NEWS instrument were examined in relation to a measure of n'hood PA that comprised activity undertaken for all purposes (e.g.,

recreation, transportation, job-related and household). However, it is possible, for example, that certain environmental attributes are more strongly related to transportational PA (e.g.., street connectivity, land use diversity, etc.) and others to recreational PA (e.g., aesthetics, walking and cycling facilities). Giles-Corti, Timperio, Bull and Pikora (2005) lamented that "most research examining environmental correlates uses context-free behavioural outcome measures" and, supported by findings by Humpel, Owen, Iverson, et al. (2004), "a general approach to studying environmental correlates may underestimate the association between environmental and behavioural variables". Indeed, Giles-Corti et al. (2007) reported that "stronger associations were evident when there was greater correspondence between the outcome variable and the environmental correlate of interest" (p. 60). For example, perceived access to services was significantly associated with walking for transport (OR=1.44) while perceived access to recreational destinations was significantly related to walking for recreation (OR=1.11). These findings suggest that improving the specificity and correspondence of environmental factors and behaviours can contribute to the development of more accurate models of how neighbourhood attributes influence PA.

Relationships among Psychosocial and Environmental Variables in Predicting Physical Activity

Two research questions in this study addressed the interrelationships among psychosocial and environmental variables in understanding PA behaviour. The first examined whether environmental perceptions moderate the relationship between psychosocial variables and PA, while the second looked at whether psychosocial attributes mediate the relationship between environmental perceptions and PA. These questions were designed to address recent calls for an improved understanding of how psychological, social, and environmental factors interact to influence PA participation (Bauman et al., 2002; Owen et al., 2004; McCormack et al., 2004).

With respect to moderation, no significant interactions were found between participants' perceptions of their overall environments, as reflected by the summary environment index score, and their ratings of any of the four psychosocial variables that were examined (see Table 21 in Chapter Four). As mentioned above, few previous studies have investigated variables at different levels of the social ecological spectrum concurrently in examining PA, and none have examined interaction effects. However, this finding is largely inconsistent with the premise of social ecological models that multiple levels of influence interact to affect behaviour (Sallis & Owen, 2002). Again, however, the lack of association may be attributable to methodological factors such as reduced sample size, problems created by using an aggregated measure of the environment, or a lack of congruence between the predictor and dependent variables examined in the moderation regression models.

With respect to mediation, the relationship between environmental perceptions and PA was neither fully nor partially mediated by psychosocial attributes (see Table 22 in Chapter Four). At least one previous study showed contradictory results to the present analyses. McNeill et al. (2006) used structural equation modeling to examine the associations between self-efficacy and motivation (individual-level factors), social support, and neighbourhood environment ratings in predicting walking, moderate, and vigorous PA. They found that both the social and neighbourhood environment factors influenced PA indirectly through the individual-level factors, which were related to the PA outcomes themselves, and that neighbourhood ratings also influenced PA directly.

A small number of other studies have examined the relative importance of individual, social, and environmental variables in predicting PA using multivariate regression analyses. For example, among a sample of college students, Leslie et al. (1999) found that social support from

family and friends were the strongest predictors of participants falling into the insufficiently active category, while awareness of facilities was not a significant factor in the same models for either males or females. Duncan and Mummery (2005) used a stepwise regression procedure in which socio-demographic variables were first entered into the regression model, followed by psychosocial variables, and then environmental variables on subsequent, separate steps of the analysis. They reported that few socio-demographic variables, other than gender, were significantly related to being sufficiently active or the amount of walking engaged in by participants, but having high self-efficacy and social support were significant predictors. When environmental variables (e.g., neighbourhood cleanliness, distance to parkland, parkland connectivity, distance to a newsagent) were added on the final step of the model, most of these were significantly related to the PA variables, while the significant associations with the psychosocial variables remained so. Finally, in their study that examined the relative influence of a variety of variables at all levels, Giles-Corti and Donovan (2002b) concluded that "the likelihood of exercising as recommended was greatly enhanced in those with positive individual factors and a positive social environment … [while] a supportive physical environment … had a significant, but more moderate, influence" (p. 1804).

Overall, the findings of the present study and past articles paint a relatively muddled picture of the ways in which socio-demographic, psychological, social, and environmental factors interact to help understand PA behaviour. Consistent with the premise of social ecological models, most studies, including the current one, suggest that a variety of factors at all levels of influence are important, although psychosocial characteristics tend to be moderately more influential in most of the analyses. As research in this area advances, more studies of the interrelated effects of different variables are needed, including intervention studies that attempt

to sort out the relative impact of improving both psychosocial and environmental attributes, perhaps concurrently.

Description of Park and Trail-Based Physical Activity

Chapter Four described several descriptive statistics related to the frequency and characteristics of PA episodes that included the use of a neighbourhood park or trail. It was reported that 6% of all PA episodes included the use of a neighbourhood park and 1.9% included the use of a neighbourhood trail (see Table 23). Most park and trail episodes were mild or moderate in intensity, and the average duration of episodes that included neighbourhood parks or trails was approximately 40-45 minutes (see Tables 24 and 25). Over 80% of parks and trail episodes were engaged in for the purpose of recreation (including exercise), and another 10% approximately facilitated transportational objectives (see Table 26). The diversity of purposes for which parks or trails were used was much greater among participants living in the Central study district (see Table 27).

Although a great deal of past research has examined the association of nearby parks and trails with PA (as described in Chapter Three and below), relatively few studies have examined the PA participation of people in parks themselves. Indeed, leisure researchers have often focused on other behaviours and outcomes when examining park use and have instead largely assumed that park users are active during their visits to these areas (Godbey et al., 2005). Much of the research that has been done on park and trail users has primarily examined the activities they engage in. For example, with respect to trails, Moore, Scott, and Graefe (1998) classified users of a Cleveland greenway into walkers (50%), skaters (20%), bikers (17%), and runners (13%). In a study in Cleveland Metroparks, Scott (1997) reported that the four most frequently pursued activities were relaxing (49% of users interviewed), walking or hiking (44%), picnicking

(19.7%), and observing nature (12.7%). Less than 10% of respondents in that study said they engaged in more active activities, such as swimming, running, jogging or bicycling. In examining older adults (50+ years) in the same park district, Raymore and Scott (1998) reported very similar rates of activity participation (e.g., walking, 55%; relaxing, 40%; observing nature/birdwatching, 11%; running/jogging, 4%; bicycling, 3%; swimming, 2%). Tinsley, Tinsley and Croskeys (2002) also interviewed older adults, but in Chicago's Lincoln Park, and focused on the context of their use rather than the specific activity. They reported that natural park areas such as trees, water/lakefront, flower gardens, and beaches were some of the most highly used facilities (27-54% of park users reported using each facility that day). Bicycle/foot paths were used by 43% of respondents, but other active areas such as ball fields, a driving range, and fieldhouses were much less popular (3-6% each). In another interview study (Gobster, 2002) in Chicago's Lincoln Park (ages not specified), 55% of users reported engaging in passive activities (e.g, sightseeing, picnicking), 45% in active individual activities (e.g., walking, bicycling), 23% in active group activities (e.g., soccer, Frisbee), 31% in water sports (e.g., swimming, fishing), and 18% in miscellaneous other activities (e.g., watching zoo animals, studying). Also in Chicago, an observation study in 13 parks recorded data on 18,000 racially-diverse user groups engaged in more than 300 different activities (Hutchison, 1987). Mobile activities (e.g., walking dog, jogging) were observed in 52% of white groups, 50% of Black groups, and 25% of Hispanic groups. The percentages for stationary activities (e.g., sunbathing, sitting on benches) were 37%, 37% and 56% for Whites, Blacks, and Hispanics, respectively. Finally, for sports (e.g., tennis, basketball), the proportions of observations for Whites, Blacks and Hispanics were 10%, 12%, and 20%, respectively.

Other more recent studies have also employed systematic observation protocols (e.g., McKenzie et al., 2006) to document PA that occurs in parks. Cohen et al. (2007) recorded between 524-4628 observations in each of eight parks in Los Angeles over the course of a week. Of all park users they observed, 66% were sedentary, 19% were walking, and 16% were engaged in more vigorous PA. The average estimated MET value for park users was 2.5, which is slightly less than the lower boundary of usual classifications (3.0-6.0 METs) for moderate-intensity PA (Pate et al., 1995). In another study in four parks in eastern North Carolina, 42% of park users were observed being sedentary, 17% were walking, and 41% were engaged in vigorous activity (Shores & West, under review). Finally, observations of 29 total parks in Chicago and Tampa found that 11% of park users engaged in vigorous activity, 23% were observed walking, and 65% were classified as sedentary (Floyd, Spengler, Confer, Maddock, & Gobster, 2007).

Overall, these findings of past research are largely consistent with the data collected in the present study with respect to the intensity of park users' PA. In the present study, over 85% of episodes that included neighbourhood parks were classified as either mild (43%) or moderate (44%). Similarly, the activities reported or observed in past park research were largely passive to moderate. The difference, of course, is that the present study tracked only those park-related episodes that were engaged in for PA, whereas much past research has also included descriptions of sedentary activities in parks. Although these cumulative findings suggest that park-based PA is usually moderate in intensity at best, the number of users that parks attract and their ubiquity throughout communities likely still renders them important resources as part of the overall health delivery system (Godbey et al., 2005; Cohen et al., 2007). Moreover, the contributions of parks to psychological well-being further support their value as important mediums for health

promotion (Kaplan, 1995; Orsega-Smith, Mowen, Payne, & Godbey, 2004; More & Payne, 1978).

Relationship of Park Features to Physical Activity

This study also took an initial look at how the quantity and type of features within parks were related to PA in those environments. It was found that parks with a greater number of facilities, amenities, and total features were significantly more likely to be used for PA by participants than parks with fewer facilities, amenities, and total features (see Table 28 in Chapter Four). Only a small number of studies to date have examined the relationship between park features and PA, but these findings are largely congruent with the existing literature. Giles-Corti, Broomhall, et al. (2005) created a composite index of park attractiveness using five factors related to environmental quality (e.g., presence of a water feature), three amenity factors (e.g., presence of walking path, sports facilities, and playground), and two safety factors (e.g., lighting and quiet surrounding roads). Based on ratings by an expert panel comprised of local government planners (in Australia), park attributes were assigned weights based on their presence and estimated importance to PA participation. Using ratings of over 500 public open spaces (POS) and observations of physical activity participation in 12 of these areas, the authors reported that "even in smaller POS of equivalent size, POS with more attributes attract more users" (p. 174). However, when various self-reported PA indicators were examined among a sample of nearby residents (rather than by observing PA directly in the parks), the authors found that models that included this element of attractiveness in addition to proximity measures were only useful when the additional factor of park size was taken into account. Nevertheless, their "small observational study confirmed that fewer people use POS with fewer attributes" (p. 174).

Similar findings occurred in a study of four suburban parks in the southeastern U.S. that included the observation of activities for 2,113 park visitors (Shores & West, 2006). The lowest level of activity intensity was observed at the park with the fewest improvements and least acreage. On average, park visitors were significantly more likely to participate in moderate and vigorous PA when using parks with the most site improvements. While all parks had numerous site improvements, they varied in size, suggesting that site improvements may be more important than site acreage in promoting active visits. In addition, when socio-demographic and environmental variables were entered into a hierarchical regression model, the socio-demographic block alone explained 26.7% of the variance in activity intensity, while another 40.5% was accounted for by the numbers of site improvements at the parks.

These relatively consistent, though preliminary results suggest that park environments that possess a multitude of features are more conducive to particular behaviours, in this case physical activity. Research examining the influence that settings with different characteristics have on behaviour is not common in leisure studies, but not an entirely new idea either. For example, the Recreation Opportunity Spectrum (ROS) was developed because "recreationists seek a variety of recreational opportunity settings, and through their participation in different activities in these settings, derive a variety of experiences and benefits" (Stankey, McCool, Clark, & Brown, 1999, p. 437). As this suggests, the ROS is structured along three dimensions – activity opportunities, setting opportunities, and experience opportunities. By participating in their desired behaviour in a desired setting, participants can achieve desired experiences (Driver, Brown, Stankey & Gregoire, 1987). In the present study, it would appear that parks which are more developed and include a greater number of features offer the preferred settings for PA. However, it is not known how or why an increased number of features are related to PA. The

goal-directed nature of leisure participation (Driver & Tocher, 1970) and ideas such as expectancy-valence theory (Ajzen & Fishbein, 1980) would suggest that people seeking PA opportunities may be drawn to parks with more features because they expect those settings to be more likely to meet their needs for this purpose. However, whether participants who use parks for PA cognitively engage in such a decision-making process requires further investigation. Moreover, as is discussed further below, to better understand the causal influence of park attributes on PA, it will be important in future to monitor changes to park design to examine how PA behaviour in those settings is altered before and after the modifications (e.g., transition of an outlying natural area into an urban park as development encroaches on it).

This study also found that certain features were related more strongly to park-based PA than others. With respect to facilities, parks with a paved trail, unpaved trail, or wooded area were more than seven times more likely to be used for PA than parks without those facilities (see Table 29 in Chapter Four). In the analyses at the individual level, participants living within 1 km of a park with the following facilities were significantly more likely to have engaged in some PA in neighbourhood parks during the study week: unpaved trail, meadow, water area, basketball court, soccer pitch (see Table 30 in Chapter Four). Interestingly, these significant facilities consist of a variety of both natural (e.g., unpaved trail, wooded area, meadow, water area) and built (e.g., sports facilities) features. With respect to amenities, having more than one entrance was the only significant predictor of PA occurring in a park at the park level (see Table 29), while having a restroom, historical/educational feature, landscaping, bike rack, parking lot, and roadway within a park within 1 km from home were all significantly related to park-based PA at the participant level (see Table 30). Again, the list of significant amenities was quite diverse and reflects a variety of potential reasons why supporting amenities in parks may influence PA.

Studies examining the association of particular features of parks with PA are quite rare to date. Cohen et al. (2006) used accelerometers to measure minutes of non-school weekly moderate-to-vigorous PA among a sample of 360 adolescent girls and reported that several park amenities were related to varying increments in PA. With respect to facilities, girls who lived near (<0.5 miles) parks with playgrounds, basketball courts, multi-purpose rooms (usually gymnasia), walking paths, swimming areas, and tracks had higher levels of non-school PA. However, living near parks with skateboard areas and areas for lawn games were negatively related to PA. With respect to amenities, nearby parks with streetlights, floodlights, shaded areas, and drinking fountains were all related to greater weekly minutes of PA. In another study, Shores and West (2006) reported that PA intensity in parks was significantly and positively related to the presence of supervision, activity organization, trails/paths, play structures, and sport fields or courts, while neither open space fields nor the presence of play equipment (e.g., balls) were significantly related to activity intensity. As well, the presence of picnic shelters with grills was significantly related to lower PA intensity. However, aside from the present investigation, these are the only studies of which the author is aware that have examined the association of specific park features with PA.

In the current study and others, trails were a consistent and strong predictor of park-based PA. Numerous previous studies have examined the association between trails and PA, though rarely in the context of parks. As was described in greater detail in Chapter Three, past research has shown frequent and strong associations between trails and PA. For example, Troped et al. (2001, 2003) used GIS to calculate distance to the nearest trail head from participants' homes and reported that this figure was inversely related to both use of the trail in the past month and the number of minutes of transportational PA engaged in during the past week. Other studies of

trail *use*, more specifically, have also reported that trail users are more likely to engage in recommended amounts of PA (Deshpande et al., 2005; Reed et al., 2004; Sharpe et al., 2004). Anecdotally, paved trails appear to be extremely versatile facilities because of their ability to support a wide variety of physical activities (e.g., brisk walking, running, cycling, etc.) performed by people of different ages and skill levels for both transportational and recreational purposes. Unpaved trails, as well, may also be favoured by some runners and walkers who seek out softer surfaces, perhaps especially those users who are older and/or who use them more frequently. Overall, minimal research has explored the nature of trail use, including the amount and intensity of activity that occurs there, motives for using the trail, or the specific features of trails that are conducive to PA (Brownson et al., 2000; Mumford, Contant & Foreman, 2007). For this latter purpose, a tool has recently been developed (Troped et al., 2006) to audit trails for their activity-promoting features (similar to the EAPRS instrument used in this study), but its use in PA research to date has not been reported. As more detailed research on specific behaviour settings is conducted, the features of parks and trails (and other environments) that best promote PA will become better understood.

Parkland Proximity and Physical Activity

The final analyses reported in Chapter Four described associations between three variables related to parkland proximity – number of total parks within 1 km, total parkland area within 1 km, and distance to the closest park – and three summary measures of participants' weekly moderate-to-strenuous physical activity (MSPA) in different contexts (with each analysis controlling for age, gender, and presence of an injury). It was found that for MSPA that occurred in all locations, only the amount of park area within 1 km of participants' homes was a significant predictor out of the three park-related variables, with each additional hectare

increasing the odds of achieving 150 minutes of weekly MSPA by 2% (see Table 31 in Chapter Four). For MSPA that occurred in the participant's neighbourhood, the number of parks within 1 km of participants' homes was the only significant predictor, with each additional park increasing the odds of engaging in 150 or minutes of MSPA in the neighbourhood by 16%. Finally, both the number and total area of parks within 1 km were significant predictors of park-based MSPA, with each additional park within 1 km of participants' homes increasing the odds of engaging in some park-based PA by 14%, and each additional hectare of parkland within the same area increasing the odds of some park-based PA by 1%. Distance to the closest park was not significantly related to weekly minutes of MSPA in any of the three contexts.

Overall, these findings support and extend the results of past research that suggested parks are important community resources for fostering PA. A previous summary by Kaczynski and Henderson (in press) found that 8 of 13 articles prior to 2006 that included parks as an environmental correlate of PA reported at least some significant and positive effect of having proximal parkland. However, most of these articles used a simple, single-item indicator of park proximity (e.g., is there a park within walking distance of your home?), without exploring the total number or availability of parkland within a specified distance or a more discrete measure of park proximity. Those articles which have examined the aggregate number of parks or amount of parkland in proximity to study participants have generally reported strong associations. For example, studies by Fisher et al. (2004) and Li, Fisher, Brownson and Bosworth (2005) investigated neighbourhood walking activity in 56 districts in Portland, Oregon. Both studies found significant relationships between parks and walking activity, with the former examining the total number of parks and trails per neighbourhood acre and the latter looking at total area of green space within the neighbourhood and within 0.5 miles of participants' homes. A

comparable, but more macro-scale analysis by Zlot and Schmid (2005) used secondary data collected from adults in 34 U.S. cities to examine the association between parkland acreage as a percentage of total city acreage and the prevalence of both utilitarian and recreational walking and bicycling within the past week. The authors reported that parkland acreage was significantly related to the rate of utilitarian walking and bicycling among residents, but not the rate of recreational walking and bicycling. Similarly, Wendel-Vos et al. (2004) reported that the total hectares of park space within 300 metres of participants' homes was related to bicycling for commuting purposes, but unrelated to walking or bicycling for recreation.

However, in contrast to the number and total area of parks, the present data suggested that distance to the closest park from participants' homes was unrelated to total MSPA, neighbourhood MSPA, or park-based PA. Again, few studies have examined distance as a continuous variable, but those that have done so have reported mixed findings about the importance of park proximity. Giles-Corti, Broomhall, et al. (2005) found that adults in Perth, Australia who had poor access to public open space (as indicated by GIS-measured distance) were no less likely to achieve recommended levels of PA than their counterparts with better access. However, when the additional components of park attractiveness and size were added to the distance aspect of the model, those participants with improved proximity to large, attractive parks were more likely to engage in high levels of walking than people with poorer access. Another study actually showed an inverse effect of proximal parkland on PA. Among adults in Rockhampton, Australia, Duncan and Mummery (2005) reported that those participants with parkland beyond 600 metres from home were significantly more likely to achieve recommend levels of PA than those who lived within 600 metres of parkland. Additionally, in the same study, parkland proximity was unrelated to a separate measure of recreational walking. These

results differ, however, from those reported in other previous studies, such as Mowen and Confer's (2003) finding that distance to an urban in-fill park was negatively related to residents' intentions to regularly visit the park.

When examining the different MSPA contexts, total MSPA was significantly related to the total area of nearby parks, while neighbourhood MSPA was significantly related to the number of nearby parks. Not surprisingly, however, *park-based* MSPA was significantly associated with more of the park-related variables (total number and total area) than either of the other two MSPA contexts. This finding further highlights the need to match environmental correlates and behaviours as much as possible in order to understand which aspects of the built environment are related most strongly to which activity outcomes (Giles-Corti, Timperio et al., 2005).

In summary, these findings suggest that the number and total area of parks within 1 km of residents are both important correlates of engagement in moderate-to-strenuous PA, but that having parks in the immediate proximity of residents is less important than one might think. Li, Fisher, Brownson and Bosworth reported somewhat similar results about recreation facilities in that the *number* of recreation facilities (out of 11) their respondents reported being in the the neighbourhood was significantly associated with walking, but having parks, playgrounds, or gyms *close by* was not a significant factor. It may be that participants who value or use parks as resources for PA derive a significant amount of their activity from transporting themselves to those settings. Thus, while having parks within a reasonable distance (e.g., 1 km) appears important, there may be an optimal threshold level of proximity for encouraging park use that also fosters or permits the additional PA that results from transportation to those destinations.

Implications for Practice

The findings described above suggest a number of implications for the design of neighbourhoods and the amenities within them. Mounting evidence substantiates the idea that communities designed to be more 'walkable' have the capacity to encourage and support increased levels of PA and active living among their residents. In this study and others, higher neighbourhood ratings of factors such as aesthetic appeal, street connectivity, safety, and land use diversity were found to be significantly and positively related to greater neighbourhood PA (especially moderate-intensity PA). Such conditions are generally more prevalent in older neighbourhoods characterized by mature landscaping, diverse zoning patterns, and grid-like street formations. However, city planners concerned about community health can and should take conscious steps to incorporate these design principles into new subdivisions and retail complexes. Similarly, politicians have the capacity to legislate environmental regulations that encourage PA. Indeed, many of these principles are being incorporated into the City of Kitchener's new "Neighbourhood Design Project" that provides a checklist of characteristics the city expects future suburbs to include (as taken from Pender, 2007, p. B4):

- Walkability – convenient pedestrian access to major destinations such as focal points, schools, shops, and parks
- Density – a variety of housing types.
- Character – creating a sense of place
- Conservation – preservation of natural, historic, and cultural features
- Connectivity – integrated routes for all types of transport such as walking, biking, transit and cars
- Safety – having eyes on the street and decent lighting
- Transit-friendly – ensuring the development has enough people to support regular bus service
- Livability – support neighbourhood designs that are sustainable, healthy, and form a complete community

Although not yet adopted, city officials also noted that the policy further stipulates that any resident in a future suburb should be no more than a five-minute walk, or 400 or 500 metres from

a ‘point of major interest’, such as shopping, parks, trails, or a transit hub (Pender, 2007). As well, a fully-developed park will be required from developers *prior* to residents moving into any subdivision. Guidelines such as these are and should become increasingly common as municipalities work to reverse the trend toward urban sprawl.

This study and others also suggest that park planning can have implications for residents’ PA participation. Both the amount of parkland and number of parks create a setting conducive to both neighbourhood and park-based PA. As well, in general, parks developed with more amenities and facilities are more likely to attract users for active purposes. Supporting amenities such as restrooms, bicycle racks, and attractive landscaping facilitate a comfortable and supportive environment for active pursuits. Also, among this sample of adults, natural park facilities were more strongly associated with parks being used for PA (see Tables 29 and 30 in Chapter Four). Although future research is necessary to corroborate these findings, incorporating elements such as trails, water areas, wooded areas, and meadows can also facilitate an appealing environment for activity. Trails, in particular, were the most consistent and strongest predictors of park-based PA. Consequently, these findings about park proximity and features suggest that a system of attractive, natural parks interconnected by trails that run through them may be effective for PA promotion among adults.

Finally, a variety of individual, interpersonal, and environmental factors were found to be important in explaining participants’ PA participation in a variety of contexts. Consequently, the adoption of a social ecological perspective on the part of health promotion officials is important for fully understanding and intervening to change sedentary lifestyle habits. Incorporating theories and ‘programs’ to address the different correlates of PA at each level while drawing on

the expertise of staff in departments such as planning, transportation, and parks and recreation should prove valuable for increasing active living in the decades to come.

Limitations

This study was subject to several limitations that may have impacted the findings reported herein. The following paragraphs describe issues related to study design, sampling, instrumentation, and site selection, among other related concerns.

To begin, with the mild exception of the week-long PA log, this study was largely cross-sectional in design, which limits the conclusions that can be drawn from the data about causality. For example, although proximity to parkland was found to be significantly correlated with various indicators of PA, an intervention or other longitudinal study design would provide more convincing evidence of this association. Some of the criteria necessary for causality include demonstrating that factor A and factor B share an association (strength of relationship), that the relationship is logical (plausibility), that as A changes, B changes in a consistent direction (dose-response relationship), and that factor A precedes factor B (temporal relationship) (Hill, 1965). Most of the relationships documented in this study satisfy only the first two or three of these criteria. However, demonstrating that one factor (e.g., diversity of land uses in a neighbourhood) precedes a particular behaviour (e.g., active living) is more problematic. For example, rather than neighbourhood design influencing activity levels, it is not known if people who are already more active choose neighbourhoods that would be supportive of such a lifestyle. Such conundrums are common in the relatively young field of ecological PA research. One strategy for countering the prevalence of cross-sectional designs in ecological PA research is discussed in the next section.

The self-reported nature of the primary PA data collected in this study may also have been problematic. Self-reports of PA behaviour frequently produce inflated estimates relative to

other objective methods (Sallis & Saelens, 2000). Such over-reporting may have been particularly probable given certain features of the present study. In particular, although there were many advantages to the empathy-building, door-to-door method of participant recruitment and data collection, some degree of social desirability bias may have been present among research participants who had to return their study materials to a study team member in-person. As well, perhaps for similar reasons, more active people may have self-selected themselves into the study, thus inflating the self-reported data, and/or less active people may have elected not to participate in the study. As was described in Chapter Three, accelerometers worn by some participants provided more-objective PA data, although their associations with the self-reported data or with the various PA correlates collected in this study were not thoroughly examined as of yet.

Other limitations of the present study relate to the composition of the study sample. For example, due to the potential for autocorrelation among the responses of multiple participants within a household, the data from only one person per household were used in this study. This limited the sample size from 585 to approximately 384 participants for most analyses, a figure which was often reduced further when examining only those participants who reported at least some amount of a particular type of PA (e.g., neighbourhood, moderate-to-vigorous, etc.). Consequently, there was an increased opportunity for Type II errors, which may help to explain the lack of significant results in several of the analyses reported above. In future analyses that use fewer variables, it may be desirable and more feasible to examine the intraclass correlations among responses from individuals within the same household. If the responses of household members' are not similar for those variables, using the data collected from the full sample of participants may be regarded as more appropriate.

Differences in characteristics of the abridged sample relative to those of the full sample may also have influenced the results of the study. For example, among the full sample of 585 participants from which questionnaires were received, 56% were female. However, within the abridged sample, 64% of respondents were female, thereby suggesting that when only one person in the household chose to participate in the study, that person was more likely to be female. Much PA data shows that female adults are less active than male adults (Trost et al., 2002), although gender differences were not analyzed in the present study. Less, if anything, is known about how men versus women are aware of and perceive their neighbourhood environments. Therefore, to the extent that PA behaviour or environmental perceptions are different among men and women, limiting the sample to only one person per household may have altered the relationships between variables in the present study.

Some of the results related to the association between environmental perceptions and neighbourhood PA may have been affected by the less-than-optimal psychometric properties of the measures used to capture participants' ratings of their neighbourhoods. Somewhat surprisingly, although test-retest reliability and criterion-related validity of the Neighbourhood Environment Walkability Survey (NEWS) have been examined (Leslie et al., 2005; Saelens, Sallis, Black, & Chen, 2003), internal consistency statistics for the instrument's dimensions have not been previously reported. In this study, coefficient alphas for the seven dimensions ranged from .42 to .79 after some minor modifications to the composition of the factors. Consequently, some dimensions may not be reliably capturing the constructs they are intended to measure. However, as was described in the initial descriptive statistics for the NEWS instrument in Chapter Four, participants from the four study areas rated most of the NEWS dimensions in a manner consistent with what previous research and theories related to walkability would suggest.

For example, participants from the largely grid-patterned Central district provided the highest ratings on most neighbourhood variables. In the time since the analyses for the present study were conducted, Cerin, Saelens, Sallis and Frank (2006) published a confirmatory factor analysis of the NEWS dimensions which provides additional guidance on how to aggregate the instrument's items. In the present study, many of the modifications made to the dimensions to improve their internal consistency were consistent with the results of Cerin et al.'s analyses. Additional modifications based on their findings may further improve the reliability of factors constructed from the present study's data, thus making them more useful for future multivariate research.

Finally, certain issues related to the selection of parks to be studied are worth noting. First, only a limited number of parks were studied in relation to participants' PA behaviour. In the analysis of park features, only the 33 parks within the four districts were observed. For the analysis related to parkland proximity, only municipal parks within a 1 km radius of participants' homes were included (distances were calculated from each person's home to a total of 52 potential parks that were found within 800m of the boundaries of the four districts). Due to time and financial constraints, all the parks listed by participants in their PA logs could not be mapped, observed, and analysed. However, examining only parks within a certain area inherently presumes that activity only occurs within and/or is influenced by parks within the predefined distances. This is an error of what has been referred to as the "container effect" (Nicholls & Shafer, 2001; Talen & Anselin, 1998) and potentially excludes other important activity sites that are less proximal to the participants' homes. Second, and with similar potential consequences, other open spaces besides municipal parks, such as schoolyards, were not included in the present analyses, although mentions of such settings were relatively infrequent within the data.

As well, the 33 parks for which detailed features data were collected lacked variability on most of the indicators related to cleanliness and condition. Almost all of the parks surveyed received the highest possible ratings with respect to maintenance of facilities, absence of debris and graffiti, quality of landscaping, and related issues. Consequently, the analyses in the present study focused solely on the presence or absence of various facilities and amenities, and could not make judgments about how condition or cleanliness of park areas was related to PA. Most of the indicators related to condition and cleanliness found in the EAPRS instrument use ordinal three-point scales to capture those characteristics of the parks. Changing the response format to an equidistant 5-point interval-level scale may increase the variance in such measures, although this may also result in reduced reliability in park ratings across raters or parks. Purposefully selecting parks with varying degrees of cleanliness and disrepair will also provide greater insight into the relative importance of these factors in influencing PA behaviour in outdoor settings.

Suggestions for Future Research

As was described above, several characteristics of the study sample created some potential limitations which should be ameliorated with future research. For example, this study only examined the PA behaviour of adults, over 70% of whom were under the age of 55. Future research should explore the importance of neighbourhood attributes, including park proximity, size, and features, in promoting PA among youth. In general, studies of the built environment and PA have examined youth populations much less frequently (Kaczynski & Henderson, in press). However, in those few studies which have used non-adult samples, characteristics of the built environment have been relatively salient predictors of PA. For example, Timperio et al. (2004) found that the absence of nearby parks and sports venues was related to fewer walking and cycling trips among 10 to 12 year olds. Similarly, in their sample of seventh to twelfth grade

students, Mota et al. (2005) reported that a significantly greater percentage of active (49.3%) than non-active (41.6%) respondents agreed that their neighbourhood had several public recreation facilities. Finally, Gomez et al. (2004) reported that among seventh grade students in San Antonio, the straight line distance from participants' homes to the nearest open play area was inversely and significantly related to the number of outdoor bouts of PA per week for boys in their study (though not girls). In summary, neighbourhood amenities, including public parks and recreation facilities, may be important for encouraging PA among adults, as was the case in the current study, but these examples suggest their ubiquity and low cost may make them an especially valuable resource for promoting PA among youth.

Similarly, studies focusing on neighbourhood environments have also been valuable in understanding older adults' PA behaviour (Booth et al., 2000; Fisher et al., 2004; Li, Fisher, & Brownson, 2005; Michael, Beard, Choi, Farquhar, & Carlson, 2006). In this study, differences in findings across adult age groups were not examined, but could be in future research. For both youth and older adults whose mobility may be impeded to a greater degree than younger adults, proximal neighbourhood environments may be especially important for facilitating daily opportunities for active living.

Similarly, in addition to age, gender and race are two other primary determinants of PA behaviour (Trost et al., 2002) that should be studied further in relation to parks, recreation facilities, and the built environment. Some research has showed that different racial groups exhibit differential PA patterns in parks (Hutchison, 1987; Gobster, 2002; Shores & West, under review), and different racial groups exhibit varied preferences for outdoor activities that may have implications for PA behaviour and energy expenditure (Floyd, Shinew, McGuire, & Noe, 1994; Ho, Sasidharan, Elmendorf, Willits, Graefe, & Godbey, 2005). Despite this, most of the

active living research to date has involved middle class, mostly white adults living in urban and suburban setting (Sallis et al., 2006). As well, gender is a well-established correlate of PA, with female rates of participation lower than those of males (Caspersen et al., 2000). In examining the eight of fifty studies in their review that reported findings disaggregated by gender, Kaczynski and Henderson (in press) found that in many of these, the relationship between parks or recreation amenities and PA was different between the two genders. Consequently, when examining associations between various facets of the built environment and PA, future research should investigate the potential for interaction effects between neighbourhood variables and personal attributes such as race and gender.

In future, efforts related to the observation of PA in parks and recreation facilities should also be expanded. In the present study, information about park-related PA (e.g., frequency, duration, intensity, etc.) was inferred based on participants' descriptions of the locations where their PA episodes took place. The PA log booklets used to collect such information, combined with the questionnaires assessing a wealth of additional personal and neighbourhood characteristics, provided a comprehensive and expedient means of collecting a wide range of data from a large number of people. However, direct observation within parks would have allowed the collection of more comprehensive information about park-based PA specifically. Certainly, as was mentioned above, some research in recent years has employed systematic observation protocols to document PA behaviours within park settings (Cohen et al., 2007; Floyd et al., 2007; Shores & West, 2006). In future, however, these methodologies should be combined more often with interviews (either qualitative or closed-ended) of park participants to gather additional information about their use of parks and other personal attributes. Similarly, behaviour observation data should also be paired with setting observation data, like that which is collected

via the EAPRS instrument. In general, the use of complementary methodologies in future studies can provide a more comprehensive picture of park-based PA.

Another priority for future research related to the relationship of environmental attributes to PA is to develop and implement ongoing surveillance systems to monitor changes in neighbourhood and community design. Annual surveys in the United States and Canada (e.g., Youth Risk Behavior Survey, Behavioral Risk Factor Surveillance System, CFLRI Physical Activity Monitor) track health behaviours, including PA, as well as information related to numerous determinants of those behaviours. However, at present, very little data are collected on environmental attributes, using either objective measures or subjective perceptions, through such surveys or other consistent methods. Much intervention research in the behavioural and social sciences involves planned and relatively controlled manipulations of individual-level factors such as self-efficacy and health-related knowledge, while far fewer environmental interventions for promoting PA have been studied (Marcus et al., 2007). However, much can also be gained from observing 'natural experiments' that involve planned or unplanned changes in community design or attitudes, and greater efforts should be undertaken to support a system of population-based approaches to chronic disease prevention (Cameron, Jolin, Walker, McDermott, & Gough, 2001). For example, the monitoring, compilation, and reporting of data related to park space within municipalities (by the Trust for Public Land, for example) would allow researchers to observe how changes in parkland area influence PA in communities. Doing this at a more detailed (e.g., park by park) or disaggregated (i.e., census track) level may prove even more useful. Similarly, tracking residents' perceptions of the attractiveness of local parks in surveillance systems over many years can help in better understanding how park features and quality influence neighbourhood and park-based PA. Other similar measures of residents'

broader neighbourhoods can also be captured in health surveys to understand how changes in safety, street design, land use diversity or other neighbourhood attributes are related to changes in PA behaviours over similar intervals (Humpel, Marshall, et al., 2004). To date, health behaviour surveillance systems are relatively devoid of such indicators, but adding questions or modules related to environmental perceptions can help to address the need for longitudinal data to combat some of the limitations of cross-sectional research designs.

This study was also limited in that it primarily considered activity spaces, such as parks, in and around participants' neighbourhoods while largely ignoring the potential for PA that originates from work, school, or other locations. For example, in examining the effects of proximal parkland, the parks analyzed included only those within the four districts (or the 800 metre buffer zones around the districts) while one of the dependent variables for that component of the study focused only on PA that occurred in parks within the respective participant's district. For the same reason, the estimates in this study of the number of PA episodes that occurred in "neighbourhood parks" are likely conservative indicators of the frequency of total park-based PA. Future studies and analyses should consider the point of origin for PA episodes and take into account parks, recreation facilities, and other neighbourhood attributes not only in participants' neighbourhoods, but also those surrounding schools, workplaces, or other common points of departure.

As well, future research should examine the ways that other elements of the marketing mix – including those related to programming, pricing, and promotion - interact with the place or distribution issues investigated here to influence PA patterns. For example, much research has investigated the efficacy of promotional efforts such as media campaigns for increasing citizens' health knowledge and health-related behaviours (Marcus, Owen, Forsyth, Cavill, and Fridinger,

1998; Owen, Bauman, Booth, Oldenburg, and Marcus, 1995). However, few studies have taken into account both promotional and built environment factors in examining PA and active living. As the use of media messages related to active living has been significantly renewed in recent years, examining their effect in combination with neighbourhood factors would be valuable. Similarly, pricing issues, including price increases or reductions and/or offering incentives for PA behaviour, could also be studied in combination with the influence of the built environment. The present study primarily addressed issues related to the 'place' or distribution component of the marketing mix, but a more holistic understanding of factors that influence PA may come from examining several marketing mix elements in concert.

Additionally, research is needed that helps to explain the mechanisms responsible for the associations observed between different variables in the social ecological model and PA behaviours. Although several individual-level and environmental factors were found to be important in this study, the ways in which these factors translate into increased activity among residents are less clear. This is similar to Stokols (1987) distinction between contextual and noncontextual research. He stated:

> noncontextual research focuses entirely on the relationship between target predictor and outcome variables … Contextual research, on the other hand, incorporates supplementary predictor variables drawn from the immediate situation … or from other areas of a person's life situation … that presumably qualify the relationship between the target variables (p. 44).

This study attempted to address contextual factors by examining, for example, the park features most related to people using parks for PA. This effort went beyond previous research that has simply tracked associations between proximal parks and PA while largely ignoring their contextual properties. Parks may also promote increased duration of PA in so much as their attributes enhance attentional capacity and cognitive restoration (Kaplan, 1995; Tennessen &

Simprich, 1995). Future research should incorporate additional social psychological and environmental theories and concepts to better understand the complexity of factors that affect PA at each level of the social ecological model (Sallis & Owen, 2002).

Finally, and perhaps most importantly, there is a pressing need to take advantage of the potential for cross-fertilization between research in leisure studies and public health in order to better understand and influence PA behaviour (Mannell & Loucks-Atkinson, 2005). Until recently, leisure researchers have largely eschewed topics related to physiological health, including PA, perhaps in an effort to differentiate themselves from their roots that frequently lie in schools of physical education (Henderson & Bialeschki, 2005). However, tremendous opportunity exists for those who study parks, recreation, and leisure behaviour to contribute to the public dilemma of physical inactivity. For example, most research on the built environment and PA that adopts a social ecological perspective is inherently spatial. Research that is strictly spatial is commonly associated with distance, direction, size and shape and is isolated from cultural and social interpretation (Gieryn, 2000). These foci accurately depict the primary areas of emphasis in the relatively nascent field of environmental PA research. In contrast, researchers in leisure and environmental studies, among other fields, have a salient interest in the meanings people imbue on cherished spaces, such as parks, through the study of constructs related to *place* (Kyle, Graefe, Manning, & Bacon, 2003; McAvoy, 2002; Stedman, 2002; Stokowski, 2002). However, leisure studies researchers, at least, have largely failed to fully engage *spatial* questions and methodologies, and even their conceptions of *place* may often be inconsistent with the epistemological roots of these concepts (Nichols & Shafer, 2001; Smale, 2006). As summarized by Smale (2006), “only relatively recently has place, and to a lesser extent space, been considered in the leisure studies literature as an important contextual factor influencing

behaviour, shaping perceptions, and defining experiences" (p. 370). In future, research on the influence of parks on PA can benefit from combining the perspectives of both place and space to better understand the myriad factors that shape residents' use patterns in these settings.

As well, other concepts in leisure studies show significant parallels with ideas from public health. For instance, the widely-studied notion of constraints in leisure studies – including the three facets of intrapersonal, interpersonal, and structural constraints (Crawford, Jackson & Godbey, 1991) – closely mirrors the different levels of the social ecological model at which exercise and health behaviours have been studied. For example, self-efficacy (or a lack thereof) is one type of intrapersonal constraint on PA, while poor social support and neighbourhood walkability may be seen as interpersonal and structural constraints, respectively. The theoretical underpinnings of most constraints and PA research also overlap substantially, both being largely grounded in social cognitive theory (SCT) (Mannell & Loucks-Atkinson, 2005). Researchers from exercise sciences have certainly employed SCT variables and principles more explicitly in studying PA, but leisure constraints researchers may be responsible for more significant conceptual advances in the application of SCT to PA through ideas such as negotiation (e.g., Frederick & Shaw, 1995; Henderson & Bialeschki, 1993; Hubbard & Mannell, 2001). Given that they have such a great amount of common ground, it is not hard to envision constraints and exercise behaviour researchers coming together more frequently and productively in future to better understand people's participation or nonparticipation in physically active leisure.

Finally, one last component of leisure studies to be discussed here is the value of further exploring notions of community connectedness and social capital in relation to PA and overall health. At least a few studies in the area of community health have examined such links. For example, Kim, Subramanian, Gortmaker, and Kawachi (2006) reported that social capital scales

constructed from items in the 2001 Behavioral Risk Factor Surveillance System survey of 167,000 adults in 48 states were related to lower odds of obesity and physical inactivity at the state level and lower physical inactivity at the county level (when controlling for several individual and state-level covariates). As well, in a study of 3377 adults in Malmo, Sweden, Lindstrom, Moghaddassi and Merlo (2003) used an index of participation in 13 different types of formal and informal groups to measure social capital. They reported that respondents with low scores on this variable (three or fewer groups) were more than three times more likely to be completely sedentary in their leisure time. Studies such as these suggest that community connectedness and PA may be positively correlated. Leisure studies researchers, however, would appear to have made even more significant conceptual and empirical advancements in examining ideas related to community and social capital (Glover & Hemingway, 2005; Yuen, Pedlar, & Mannell, 2005), perhaps due to the suggestion that leisure is central to the development of community and social capital (Hemingway, 1999; Putnam, 2000). Some research in leisure studies has proposed a link between social capital and overall health (Glover & Parry, 2005), but there clearly exists room to further explore associations between concepts of community, PA, and other aspects of physical health.

In conclusion, this study built upon the growing body of literature examining the impact of the built environment on PA by examining relationships among a variety of psychosocial and environmental factors, with a particular emphasis on parks and recreation amenities. Consequently, it was possible to see how factors at different levels of the social ecological model worked both individually and in concert to influence PA and active living behaviours. Methodologically, unlike previous research on the built environment and PA, this study employed a detailed PA log booklet to investigate participants' activity patterns. In addition to

the usual measures of activity, duration, and intensity, the booklet provided a great deal of additional contextual information, not the least of which was the location where participants' PA episodes occurred. As a result, it was possible to observe both the frequency and characteristics of park- and trail-based PA among a representative sample of community residents. As well, it was found that proximity to parkland and particular features of parks were positively related to PA levels in parks and surrounding neighbourhoods. These and other neighbourhood factors that are associated with active living should continue to be studied as effective design of the built environment, including parks and recreation amenities, has the potential to create significant and long-lasting population-level impacts that can foster healthier lifestyles for all community residents.

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Appendix A: Study Introduction Letter

August 7, 2006

Dear Waterloo resident:

This letter is to introduce you to a study being conducted by researchers in the Faculty of Applied Health Sciences at the University of Waterloo, in association with the Department of Recreation and Leisure Services at the City of Waterloo, on the physical activity patterns of Waterloo residents. We are interested in learning more about where, why, and how people participate in physical activity, and about what personal and community factors are related to people being active. With your assistance, we can gain valuable knowledge about how to better design programs and neighbourhoods that can help people to be more active and that can improve the health of our community.

Within the next week, a member of the research team will be contacting you in person at your home to explain the study and to request your participation. Approximately 1000 households, including yours, have been randomly selected from a list of all the households in Waterloo to participate in this study. Participation is entirely voluntary. However, to ensure that we gain a representative picture of Waterloo residents' physical activity patterns, it is important that we hear from as many of these 1000 households as possible. The study involves two components. The first part is a questionnaire that will take approximately 30 minutes to complete. The second part involves a physical activity log book in which you're asked to keep track of all of your episodes of physical activity for a period of seven days. This will obviously require some effort but we are confident that the questions will be interesting for many people and that the data collected will be very valuable for understanding Waterloo residents' physical activity patterns.

We would like all of the people who are 18 years and over in the selected households to participate in the study, so please share this letter with all of the adults in your house. Each participant will receive **$5** as a small thank you for their time and effort, and one person who participated from each of the four neighbourhoods involved in the study will win a **$50** gift certificate to a restaurant of his or her choice. Additionally, at the end of the project, you will receive a detailed, personalized summary of your physical activity over the course of the study week, including a map of all the places you engaged in physical activity. We are hopeful that study participants will find this feedback both interesting and helpful in learning about the ways we can all become healthier as a community.

[the following paragraph appeared only in letters for households selected to receive accelerometers]

In addition to the questionnaire and log booklet, approximately 100 households have been randomly selected to participate in a third component of the study, and your household is one of them. This additional component involves wearing a small device called an accelerometer on your waist for a period of three days (similar to a pedometer). We would like only one adult from your household to participate in this component of the study. The accelerometer is practically weightless and comes with a belt to attach it to your hip. It captures detailed information on

levels of movement and provides important data in addition to the physical activity log booklet. After we process all of the data, we will provide a detailed printout (in graph form) of your hour-by-hour physical activity level on each of the three days. Although we hope you will also assist us with this component of the study, you can choose to do only the questionnaire (or neither component) if you wish.

This research is being conducted by Andy Kaczynski, a PhD Candidate in the Department of Recreation and Leisure Studies under the supervision of Dr. Mark Havitz. There are no known or anticipated risks associated with your participation in this study. You may decline answering any sections of the questionnaire that you do not wish to complete and you can withdraw from the study at any time. In order to calculate some measures of distance (e.g., from your home to a park), we will need to associate your address with the information you provide. However, we will remove your address from our paper and electronic data files once the distance information has been input. Further, your name does not appear anywhere with the data and all of the information you provide will be kept confidential and will be grouped with responses from other participants. The data collected through this project will be kept in a secure location in our department at the University of Waterloo. This study has been reviewed and has received ethics clearance through the Office of Research Ethics at the University of Waterloo. However, the final decision about participation is yours. If you ever have any comments or concerns resulting from your participation in this study, you may contact Dr. Susan Sykes in the Office of Research Ethics at 519-888-4567, ext. 36005.

We anticipate being in your neighbourhood in the evenings during the week of August 14th-18th. We hope you will strongly consider participating in this exciting project. In the meantime, if you would like any further information about the study, please do not hesitate to get in touch with us. We look forward to meeting with you soon.

Sincerely,

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Appendix B: Door to Door Recruitment Script

Physical Activity in the Community Study – Door-to-Door Participant Recruitment Script

Hi. My name is _____ and I'm part of a research team from the University of Waterloo. We're in your neighbourhood this evening asking people to take part in a study about physical activity and community health. Do you remember getting a letter like this in the mail last week?

Yes – Great, and did you have a chance to read it over?

Yes – Skip to Part A

No – Okay, that's alright. Well, basically, what it said is that we've randomly selected approximately 1 out of every 20 households in your neighbourhood to participate and you're the lucky one! Can I just take a few minutes to tell you about the study and you can decide if you'd like to take part?

Yes – skip to Part A

No – thank and leave

No – Okay, that's no problem. Well, basically, we've randomly selected approximately 1 out of every 20 households in your neighbourhood to participate and you're the lucky one! Can I take a few minutes to tell you about the study and you can decide if you'd like to take part?

Yes – skip to Part A

No – thank and leave

Part A (got/read the letter)

Great. So the overall purpose of the study is to better understand how the design of communities affects the opportunities that people have to build physical activity into their daily lives.

As far as participants go, we're looking for all of the adults who live in the households that were selected. Each person who participates in the study will receive $5 as a small thank you for their time and effort, and one person per neighbourhood will also win a $50 gift certificate for a restaurant of his or her choice.

To participate, there's two components to the study and each adult who takes part gets two booklets. The yellow one (*show it and flip through it*) is a questionnaire that you can fill out at any point over the next week. It takes approximately 30 minutes to complete and asks you questions about different factors that might affect a person's physical activity participation. The

green booklet is a log book where you're asked to record all of your episodes of physical activity for the course of a 7-day period.

Once we collect all of this information, it will be used to better understand the physical activity patterns of Waterloo residents and to help staff at the City to better design communities to be healthier and more active. In addition, for each participant, can provide personalized feedback on your physical activity participation over the course of the study.

So I imagine some of that you already knew from the letter. It's fairly simple to participate in the study and we'd really like you to take part. Does this sound like something you'd be willing to do?

Yes – skip to Part B

No – press a bit and then thank and leave

Part B - Once they have agreed to participate:

So there's two main parts to the study. The first is a questionnaire in the yellow booklet. It just basically asks you a variety of questions about yourself and your neighbourhood and some other things related to physical activity. It's fairly self-explanatory, so just read over the instructions (*show inside of front cover)* and then fill it out at any point before we come back to pick up your package.

The second part of the study is a physical activity log booklet in which we'd like you to record all of your episodes of physical activity for a period of seven full days. The booklet starts off with a couple pages of instructions (*show the pages*) that will help you when recording your activities. You should read through them at the start of the week and then refer back to them as necessary when filling out your log booklet. The next pages in the booklet show a map of your neighbourhood which shows streets, parks, and trails, and the map may be helpful when recording where you did your activities. The next four pages are sample log pages that show a variety of different activity episodes. So there's one about jogging, one about gardening, one for work-related physical activity, and so forth. Then, the remainder of the booklet, about another 25 pages or so, contains blank log pages.

For each episode of physical activity that you do for 10 minutes or more, we'd like you to fill out a new page. And for this study, physical activity includes any activity in which you expend energy. So you simply record the activity – walking around the mall, gardening, dancing, whatever – and how long you did it for. But when recording the duration, you need to subtract out anytime that you stopped being active. Then we also need to know how hard you were working. So was it mild, moderate, or strenuous, and definitions of each of those categories are provided in the instructions at the front (*flip back and point*). We're also particularly interested in where you did the activity – the location – so we've left you a lot of space to describe that in detail (*point to box*). Wherever possible, provide an address or a detailed description of the streets or parks or other places you went. And then there are just a few other questions about your point of origin, method of transport, if applicable, and who you were participating with. We

also want you to tell us the purpose of that physical activity, whether it was for recreation, transportation, household, or job-related, and definitions of each of those categories are provided at the front (*flip back and point*).

Finally, at the end of the week, we'd like you to answer the question on the back (*show it*) as to whether this was a typical week for you in terms of your level of physical activity. And we're hoping that it will be a typical week for most people, so just go about your normal activities as you would whether this study was happening or not.

That's about it for the log booklet. If you read over the instructions carefully on the first couple pages, you shouldn't have too much trouble.

Closing comments:

And as I mentioned earlier, we'd like to have all of the adults in each household take part. How many people over the age of 18 are there in your house that would participate?

Okay, great. Well, here's _ packages then. I or another member of the research team will be back in your neighbourhood in about 10 days to pick up both booklets, so just put them back in this envelope when you're done. And we'd like to get everybody's in your area at the same time, so for this street, we plan to be back next _____, which is August ___ (*refer to pick up date column on sheet and fill out reminder card*). Here's a handy reminder card that you can put on your fridge or somewhere convenient and we'll see you then.

Thanks (*smile!*). Have a good evening.

Appendix C: Data Collection Route Recording Sheet

Physical Activity in the Community Study

Route: Beechwood 3

Initial Contact
NH = not home
R = refused to participate
A = accepted
I = inaccessible/non-existent

Second Contact
NH = not home
R = refused to participate
A = accepted

Pick Up
NH = not home
IC = incomplete or not done at all
R = retrieved/returned (and note # - e.g., R-2)

	Initial Contact		Number Given Out	Second Contact		Pick Up		$5 Compensation Each Received		
Address	**Date**	**Result**		**Date**	**Result**	**Date**	**Result**	**Name(s) Printed**	**Signature(s)**	**Total $**
272 BEECHLAWN DR										
286 BEECHLAWN DR										
300 BEECHLAWN DR										
336 BEECHLAWN DR										
338 BRIDLE PATH CRT										
383 STILLMEADOW CIR										
395 STILLMEADOW CIR										
418 STILLMEADOW CIR										
436 STILLMEADOW CIR										
447 STILLMEADOW CIR										
459 STILLMEADOW CIR										
398 CLAIRBROOK CR										
408 CLAIRBROOK CR										

275 FARADAY CRT										
285 FARADAY CRT										
301 FARADAY CRT										
320 FARADAY CRT										
277 CRAIGLEITH DR										
292 CRAIGLEITH DR										
303 CRAIGLEITH DR										
320 CRAIGLEITH DR										
333 CRAIGLEITH DR										
355 CRAIGLEITH DR										
366 CRAIGLEITH DR										
391 CRAIGLEITH DR										
408 CRAIGLEITH DR 4										
414 CRAIGLEITH DR 2										
20 COMBERMERE CR										
34 COMBERMERE CR										
47 COMBERMERE CR										

311 TATLOCK DR										
322 TATLOCK DR										
226 TATLOCK CRT										
244 TATLOCK CRT										

Appendix D: Physical Activity in the Community Questionnaire

Physical Activity in the Community

Questionnaire Booklet

Physical Activity in the Community

THANK YOU for agreeing to participate in this study. You are one of a small number of households who have been randomly selected out of all the households in your area. Therefore, we appreciate you completing this survey and the green physical activity log booklet in order to ensure we have information from a representative sample of people in your neighbourhood.

This survey asks numerous questions about issues related to physical activity. When completing the survey, **please think of physical activity as any activity that requires you to expend energy, including activities done for transportation, recreation, exercise, on the job, or around the house**. Some questions may give more specific descriptions of physical activity to think about when completing that section, but this is the definition you should generally follow.

Please complete this survey before the scheduled date when the study team member will be back to pick up your materials. However, you do not need to fill it all out in a single sitting.

If you ever have any questions about this survey or the green physical activity log booklet, feel free to contact Andy Kaczynski at (519) 888-4567 x32612 or atkaczyn@ahsmail.uwaterloo.ca.

Section A: Perceptions of Your Neighbourhood Environment

To begin, we would like to find out more about the way you perceive or think about your neighbourhood. Please answer the following questions about your neighbourhood and yourself.

A1. Types of residences in your neighbourhood

For each question, please circle the answer that best applies to you and your neighbourhood.

		None	A few	Some	Most	All
1.	How common are detached single-family residences in your immediate neighbourhood?	1	2	3	4	5
2.	How common are townhouses or row houses of 1-3 stories in your immediate neighbourhood?	1	2	3	4	5
3.	How common are apartments or condos 1-3 stories in your immediate neighbourhood?	1	2	3	4	5
4.	How common are apartments or condos 4-6 stories in your immediate neighbourhood?	1	2	3	4	5
5.	How common are apartments or condos 7-12 stories in your immediate neighbourhood?	1	2	3	4	5
6.	How common are apartments or condos more than 13 stories in your immediate neighbourhood?	1	2	3	4	5

A2. Access to services

For each statement, please circle the answer that best applies to you and your neighbourhood. Both "local" and "within walking distance" mean within a 10-15 minute walk from your home.

		Strongly Disagree			Strongly Agree
1.	Stores are within easy walking distance of my home.	1	2	3	4
2.	Parking is difficult in local shopping areas.	1	2	3	4
3.	There are many places to go within easy walking distance of my home.	1	2	3	4
4.	It is easy to walk to a transit stop (bus, train) from my home.	1	2	3	4
5.	The streets in my neighbourhood are hilly, making my neighbourhood difficult to walk in.	1	2	3	4
6.	There are major barriers to walking in my local area that make it hard to get from place to place (e.g., freeways, railway lines, rivers).	1	2	3	4

A3. Streets, Scenery, and Safety in Your Neighbourhood

For each statement, please circle the answer that best applies to you and your neighbourhood.

		Strongly Disagree			Strongly Agree
1.	The streets in my neighbourhood do not have many cul-de-sacs (dead-end streets).	1	2	3	4
2.	The distance between intersections in my neighbourhood is usually short (e.g. 100 metres or less; the length of a football field or less).	1	2	3	4
3.	There are many alternative routes for getting from place to place in my neighbourhood.	1	2	3	4
4.	There are sidewalks on most of the streets in my neighbourhood.	1	2	3	4
5.	Sidewalks are separated from the road/traffic in my neighbourhood by parked cars.	1	2	3	4
6.	There is a grass/dirt strip that separates the streets from the sidewalks in my neighbourhood	1	2	3	4
7.	There are trees along the streets in my neighbourhood.	1	2	3	4
8.	There are many interesting things to look at while walking in my neighbourhood.	1	2	3	4
9.	There are many attractive natural sights in my neighbourhood (such as landscaping, views).	1	2	3	4
10.	There are attractive buildings/homes in my neighbourhood.	1	2	3	4
11.	The speed of traffic on most nearby streets is usually slow (50 km/h or less).	1	2	3	4
12.	Most drivers exceed the posted speed limits while driving in my neighbourhood.	1	2	3	4
13.	My neighbourhood streets are well-lit at night.	1	2	3	4
14.	Walkers and bikers on the streets in my neighbourhood can easily be seen by people in their homes.	1	2	3	4
15.	There are crosswalks and pedestrian signals to help walkers cross busy streets in my neighbourhood.	1	2	3	4
16.	There is a high crime rate in my neighbourhood.	1	2	3	4
17.	The crime rate in my neighbourhood makes it unsafe to go on walks during the day.	1	2	3	4
18.	The crime rate in my neighbourhood makes it unsafe to go on walks at night.	1	2	3	4

A4. Convenience of facilities

For each of these places where you can exercise, please indicate if it is **on a frequently traveled route** (e.g., to and from work or school) or **within a 5-minute drive or 10-minute walk** from your work or home.

		Yes	No	Don't know
1.	aerobics studio	___	___	___
2.	basketball court	___	___	___
3.	beach, lake, river, or creek	___	___	___
4.	bike lane or trails	___	___	___
5.	golf course	___	___	___
6.	health spa/exercise gym	___	___	___
7.	martial arts studio	___	___	___
8.	playing field (soccer, etc.)	___	___	___
9.	public park	___	___	___
10	public recreation centre	___	___	___
11.	racquetball/squash court	___	___	___
12.	running track	___	___	___
13.	ice arena	___	___	___
14.	sporting goods store	___	___	___
15.	swimming pool	___	___	___
16.	walking/hiking trails	___	___	___
17.	tennis courts	___	___	___
18.	dance studio	___	___	___
19.	Other _____	___	___	___

20.	My neighbourhood has several free or low cost recreation facilities, such as parks, walking trails, bike paths, recreation centres, playgrounds, public swimming pools, etc.	**Strongly Disagree** 1	2	3		**Strongly Agree** 4

A5. Neighbourhood Connectedness

The following questions ask about the relationships among the people that live in your neighbourhood. Please indicate to what extent you agree with each statement.

		Strongly Disagree				**Strongly Agree**
1.	People around my neighbourhood are willing to help their neighbours.	1	2	3	4	5
2.	This is a close knit neighbourhood.	1	2	3	4	5
3.	People in this neighbourhood can be trusted.	1	2	3	4	5
4.	People in this neighbourhood generally don't get along with each other.	1	2	3	4	5
5.	People in this neighbourhood do not share the same values.	1	2	3	4	5

A6. Stores, facilities, and other things in your neighbourhood.
If you **walked** to them, about how long would it take to get from your home to the nearest businesses or facilities listed below? Please put one check mark (☑) for each business or facility.

	Minutes →	**1-5**	**6-10**	**11-20**	**21-30**	**31+**	**Don't know**
Ex.	Gas station	___	☑	___	___	___	___
1.	convenience store	___	___	___	___	___	___
2.	supermarket/grocery store	___	___	___	___	___	___
3.	hardware store	___	___	___	___	___	___
4.	fruit/vegetable market	___	___	___	___	___	___
5.	laundromat/dry cleaners	___	___	___	___	___	___
6.	clothing store	___	___	___	___	___	___
7.	post office	___	___	___	___	___	___
8.	library	___	___	___	___	___	___
9.	elementary school	___	___	___	___	___	___
10.	other schools	___	___	___	___	___	___
11.	book store	___	___	___	___	___	___
12.	fast food restaurant	___	___	___	___	___	___
13.	coffee shop	___	___	___	___	___	___
14.	bank/credit union	___	___	___	___	___	___
15.	non-fast food restaurant	___	___	___	___	___	___
16.	video store	___	___	___	___	___	___
17.	pharmacy/drug store	___	___	___	___	___	___
18.	salon/barber shop	___	___	___	___	___	___
19.	your job or school	___	___	___	___	___	___
20.	bus or train stop	___	___	___	___	___	___
21.	park	___	___	___	___	___	___
22.	recreation facility	___	___	___	___	___	___
23.	gym or fitness facility	___	___	___	___	___	___

A7: Reasons for moving here. Please rate how important each of the following reasons was in your decision to move to your neighbourhood.

		Not at all important				**Very important**
1.	Affordability/value	1	2	3	4	5
2.	Closeness to open space (e.g., parks)	1	2	3	4	5
3.	Closeness to job or school	1	2	3	4	5
4.	Closeness to public transportation	1	2	3	4	5
5.	Desire for nearby shops and services	1	2	3	4	5
6.	Ease of walking	1	2	3	4	5
7.	Sense of community	1	2	3	4	5
8.	Safety from crime	1	2	3	4	5
9.	Quality of schools	1	2	3	4	5
10	Closeness to recreational facilities	1	2	3	4	5
11.	Access to highways	1	2	3	4	5

Section B: Readiness to Engage in Physical Activity

Different people are at different stages of starting to be physically active. Regular physical activity is defined as 5 or more days per week for a total of at least 30 minutes. Please indicate which **one** statement best describes the stage you are at.

- ❑ I currently do not engage in physical activity regularly, and I do not intend to start doing so in the next 6 months.
- ❑ I currently do not engage in physical activity regularly, but I am thinking about starting to do so in the next 6 months.
- ❑ I currently participate in some physical activity, but not regularly.
- ❑ I currently participate in physical activity regularly, but I have only begun doing so in the last 6 months.
- ❑ I currently participate in physical activity regularly, and have being doing so for longer than 6 months.

Section C: Support for Physical Activity

This section asks about several common supporting behaviours from others that might help people to be physically active. For each question, please indicate how often – using the 1 (never) to 7 (very often) scale shown below – your family and friends have performed that behaviour in the past 3 months. Please think about "family" as the members of your household and "friends" as friends, acquaintances, and co-workers.

Never **Very often**
1 2 3 5 5 6 7

In the past 3 months, my family and friends ….	**Family (1-7)**	**Friends (1-7)**
Example: Have given me a ride to the gym to exercise.	5	2
1. Have been physically active with me.	__	__
2. Offered to do something physically active with me.	__	__
3. Gave me helpful reminders to do something physically active.	__	__
4. Gave me encouragement to keep doing physically active things.	__	__
5. Changed their schedule so we could do something physically active together.	__	__
6. Discussed physical activities with me.	__	__
7. Planned physically active activities on recreational outings.	__	__
8. Helped plan activities around my physically active pursuits.	__	__
9. Asked me for ideas on how they can be more physically active.	__	__
10. Talked about how much they like being physically active.	__	__
11. Took over chores so I had more time to exercise.	__	__
12. Made positive comments about my physical appearance.	__	__

Section D: Self-Confidence for Physical Activity

This section addresses barriers people sometimes have to overcome in order to be physically active. Please rate how confident you are that you could do each of the following things.

How confident are you that you could …		**Not at all confident**						**Very confident**
1.	Be physically active when your family is demanding more time from you.	1	2	3	4	5	6	7
2.	Be physically active when you have household chores to attend to.	1	2	3	4	5	6	7
3.	Be physically active even when you have excessive demands at work.	1	2	3	4	5	6	7
4.	Be physically active when social obligations are very time consuming.	1	2	3	4	5	6	7
5.	Get up early, even on weekends, to participate in physical activity	1	2	3	4	5	6	7
6.	Be physically active after a long, tiring day at work	1	2	3	4	5	6	7
7.	Participate in physical activity even though you are feeling depressed	1	2	3	4	5	6	7
8.	Get up earlier to participate in physical activity	1	2	3	4	5	6	7
9.	Set aside time for a physical activity program for at least 30 minutes three times per week	1	2	3	4	5	6	7
10.	Continue to participate in physical activity with others even though they seem too fast or too slow for you	1	2	3	4	5	6	7
11.	Be physically active when undergoing a stressful life change (e.g., divorce, death in the family, moving)	1	2	3	4	5	6	7

Section E: Reasons for Participating in Physical Activity

Listed below are some reasons that you might give for participating in physical activities. Please read each statement and indicate how true that reason is for you.

	I participate in physical activities because:	Strongly Disagree				Strongly Agree
1.	It makes me happy.	1	2	3	4	5
2.	I like activities that are physically challenging.	1	2	3	4	5
3.	I like the excitement of participation.	1	2	3	4	5
4.	I want to improve my cardiovascular fitness.	1	2	3	4	5
5.	I want to be attractive to others.	1	2	3	4	5
6.	I find these activities stimulating.	1	2	3	4	5
7.	I want to define my muscles so I look better.	1	2	3	4	5
8.	I want to get better at these activities.	1	2	3	4	5
9.	I want to improve my appearance.	1	2	3	4	5
10.	I want to lose or maintain my weight so I look better.	1	2	3	4	5
11.	I will feel physically unattractive if I do not participate.	1	2	3	4	5
12	I want to improve my existing skills.	1	2	3	4	5
13.	I want to improve my body shape.	1	2	3	4	5
14.	I like to be with others who are interested in physical activities.	1	2	3	4	5
15.	I think they are interesting.	1	2	3	4	5
16.	I want to meet new people.	1	2	3	4	5
17.	I want to maintain my physical strength to live a healthy life.	1	2	3	4	5
18.	It is fun.	1	2	3	4	5
19.	I enjoy spending time with others doing these activities.	1	2	3	4	5
20.	I like to do these activities.	1	2	3	4	5
21.	I want to maintain my physical health and well-being.	1	2	3	4	5
22.	I want to have more energy.	1	2	3	4	5
23.	My friends want me to.	1	2	3	4	5
24..	I want to be physically fit.	1	2	3	4	5
25.	I like participating in activities that challenge me physically.	1	2	3	4	5
26.	I enjoy these activities.	1	2	3	4	5
27.	I want to keep up my current skill level.	1	2	3	4	5
28	I want to be with my friends.	1	2	3	4	5
29.	I want to obtain new skills.	1	2	3	4	5
30.	I like the challenge.	1	2	3	4	5

Section F: Social-Psychological Involvement with Physical Activity

The following statements refer to how you usually feel about physical activity. Some of the statements may seem repetitive but it is important to answer all of them. Think of these statements in general terms. It is not necessary to recall any specific incident of physical activity when completing this section.

		Strongly Disagree				**Strongly Agree**
1.	Physical activity is one of the most enjoyable things I do.	1	2	3	4	5
2.	Physical activity occupies a central role in my life.	1	2	3	4	5
3.	I enjoy discussing physical activity with my friends/family.	1	2	3	4	5
4.	When I participate in physical activity, I can really be myself.	1	2	3	4	5
5.	You can tell a lot about a person by seeing them participating in physical activity.	1	2	3	4	5
6.	Physical activity is very important to me.	1	2	3	4	5
7.	I find a lot of my life is organized around physical activity.	1	2	3	4	5
8.	Most of my friends/family are physically active.	1	2	3	4	5
9.	I identify with the people and image associated with physical activity.	1	2	3	4	5
10.	That I participate in physical activity says a lot about who I am.	1	2	3	4	5
11.	Physical activity is one of the most satisfying things I do.	1	2	3	4	5
12.	To change my preference from physical activity to more sedentary activity options would require major rethinking.	1	2	3	4	5
13.	My participation in physical activity provides me with an opportunity to be with friends/family.	1	2	3	4	5
14.	When I'm participating in physical activity, I don't have to be concerned with the way I look.	1	2	3	4	5
15.	When I participate in physical activity, others see me the way I want them to see me.	1	2	3	4	5

Section G: Pros and Cons of Physical Activity

This section lists several factors people might take into account when deciding whether to engage in physical activity or to continue doing so. By circling a number from 1 to 5 for each question, please indicate how important each of the following factors is in your decision as to whether or not to be physically active.

		Strongly disagree				**Strongly agree**
1.	I am too tired to do my daily work after participating in physical activity.	1	2	3	4	5
2.	I find it difficult to find a physical activity that I enjoy that is not affected by bad weather.	1	2	3	4	5
3.	I feel uncomfortable when I participate in physical activity because I get out of breath and my heart beats very fast.	1	2	3	4	5
4.	I would like my body better if I participated in physical activity regularly.	1	2	3	4	5
5.	Regular physical activity takes too much of my time.	1	2	3	4	5
6.	I have less time for my family and friends if I participate in physical activity regularly.	1	2	3	4	5
7.	At the end of the day, I am too exhausted to participate in physical activity.	1	2	3	4	5
8.	I have more energy for my family and friends if I participate in physical activity regularly.	1	2	3	4	5
9.	Regular physical activity helps me relieve tension.	1	2	3	4	5
10.	I feel more confident if I participate in physical activity regularly.	1	2	3	4	5
11.	I sleep more soundly if I participate in physical activity regularly.	1	2	3	4	5
12.	I feel good about myself if I keep my commitment to participate in physical activity regularly.	1	2	3	4	5
13.	It is easier for me to perform routine physical tasks if I participate in physical activity regularly.	1	2	3	4	5
14.	I feel less stressed if I participate in physical activity regularly.	1	2	3	4	5
15.	I feel more comfortable with my body if I participate in physical activity regularly.	1	2	3	4	5
16.	Regular physical activity helps me have a more positive outlook on life.	1	2	3	4	5

Section H: Time Spent Sitting

These questions are about the time you spend sitting while at work, at home, while doing school work, travelling, and during leisure time. This may include, among other things, time spent sitting at a desk, visiting friends, watching television, reading, or in a vehicle. Please give your best estimate for each question.

1. During the last 7 days, how much time did you usually spend sitting on a weekday?

   ____ hours and/or ____ minutes per day

2. During the last 7 days, how much time did you usually spend sitting on a weekend day?

   ____ hours and/or ____ minutes per day

Section I: Physical Activity

We wish to know a bit more about the intensity of your physical activity behaviour. Please answer the following questions and then refer to the green log booklet and instructions for more information about reporting your physical activity as it occurs.

1. Considering a 7-day period (a week), how many times on the average do you do the following kinds of exercise for more than 15 minutes during your free time?

   a) STRENUOUS physical activity (heart beats rapidly) ____ times per week
   e.g., running, jogging, vigorous swimming

   b) MODERATE physical activity (not exhausting) ____ times per week
   e.g,, fast walking, tennis, easy bicycling

   c) MILD physical activity (minimal effort) ____ times per week
   e.g., easy walking, golf, bowling

2. Considering a 7-day period (a week), during your leisure-time, how often do you engage in any regular physical activity long enough to work up a sweat (heart beats rapidly)?

   ❑ Often ❑ Sometimes ❑ Never

Also, please remember to record all of your physical activity episodes in the accompanying green booklet so that we can learn more about the ways that people in Waterloo are active!

Section J: Household Information

Finally, we wish to know about a bit more about you and the members of your household so that we can compare the people in this study to the rest of the population in Waterloo and Ontario. We realize that some of this information is fairly personal but would appreciate you answering all the questions so that we have complete data from everyone in the study. Remember that your name appears nowhere on the questionnaire and all of the data will be grouped such that individual households will never be associated with specific responses.

1. First, please describe the members of your household by completing all the information in each row:

	Male	Female	Age	Height	Weight
a) Yourself	❑	❑	____	___ feet ___ inches	_____ lbs or ___ kg
b) Person 2	❑	❑	____	___ feet ___ inches	_____ lbs or ___ kg
c) Person 3	❑	❑	____	___ feet ___ inches	_____ lbs or ___ kg
d) Person 4	❑	❑	____	___ feet ___ inches	_____ lbs or ___ kg
e) Person 5	❑	❑	____	___ feet ___ inches	_____ lbs or ___ kg
f) Person 6	❑	❑	____	___ feet ___ inches	_____ lbs or ___ kg

2. What is your current marital status?

❑ Single, never married
❑ Married
❑ Not married, but living in a marriage-like relationship
❑ Divorced
❑ Separated
❑ Widowed

3. What is the *highest* level of education you have *completed*?

❑ Attended some high school
❑ Graduated from high school
❑ Attended some university or college
❑ Graduated from college
❑ Completed a professional degree (e.g., teacher's college)
❑ Graduated from university
❑ Completed a master's degree (or equivalent)
❑ Completed a PhD, M.D., J.D. (or equivalent)
❑ Other _____

4. What is your current work status? (check only <u>one</u> option that indicates your primary role)

❑ Employed full-time
❑ Employed part-time
❑ Homemaker
❑ Retired
❑ Unemployed
❑ Part-time student
❑ Full-time student
❑ On disability or other leave from work
❑ Other _____

5. How many total motor vehicles are owned by the members of your household (that are driven at least once per week)? Please exclude recreational vehicles like RVs, ATVs, etc.

_____ vehicles

6. Do you personally own a membership to a public or private gym/exercise facility?

❑ No ❑ Yes

7. Do you have any exercise equipment in your home?

❑ No ❑ Yes – Please describe _____

8. Do you currently suffer from any temporary injuries? (e.g., broken leg)

❑ No ❑ Yes – Please describe _____

9. Do you currently suffer from any of the following health concerns?

❑ Heart problems (heart disease, heart attack, high blood pressure, etc.)
❑ Cancer
❑ Diabetes
❑ Osteoporosis
❑ Asthma/allergies
❑ Depression or other mental health concern
❑ Disability – Please describe _____
❑ Other health concern – Please describe _____

10. Do you currently smoke cigarettes?

❑ No ❑ Yes – Approximately how many cigarettes on an average day? ___ /day

11. How would you rate your physical fitness compared to people your age?
(please circle a number from 1-7)

Very poor						**Very good**
1	2	3	4	5	6	7

12. How would you rate your overall health compared to people your age?
(please circle a number from 1-7)

Very poor						**Very good**
1	2	3	4	5	6	7

Thank you for taking the time to complete this survey.

Please keep it in a safe place in the envelope provided until a member of the study team comes to pick it up (along with the physical activity log) on the pre-arranged date.

If you have any questions, please feel free to contact:

Andy Kaczynski
Department of Recreation and Leisure Studies
Faculty of Applied Health Sciences
University of Waterloo
Waterloo, Ontario N2L 3G1
(519) 888-4567 x32612
atkaczyn@ahsmail.uwaterloo.ca
http://ahs.uwaterloo.ca/~atkaczyn

REMEMBER

- **Please fill out the green physical activity log book on a continuous basis for a seven-day period. Thank you again for your participation!**

- **Please turn to the back cover of this booklet for information on receiving a copy of the results of this study.**

Would you like to receive a copy of the results of this study?

❑ No thank you

❑ Yes – Please provide your address in the space below and tear this page out of your survey booklet. Then give it to the member of the research team who picks up your booklets. He or she will store it in a separate location to preserve your anonymity.

Street Address: _____

Postal Code: _____

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Thank you again for your participation!

Appendix E: Physical Activity in the Community Log Booklet

Physical Activity Log Booklet Instructions

Thank you for taking the time to share your daily physical activities with us. Please carefully review both instructions pages and refer back to them as necessary when recording your physical activities throughout the course of the week. **Please be as accurate and honest as possible in completing the booklet pages**. What we can learn about Waterloo residents' physical activity patterns and the conclusions we can draw depend heavily on the quality of the data we receive from these log booklets.

Each episode of physical activity should be recorded on a separate page in the log book. If you require additional pages, feel free to photocopy a booklet page, create a readable, rough draft on a blank piece of paper, or visit the study website at http://ahs.uwaterloo.ca/~atkaczyn to print additional pages. You can also call or email the study director and we will be happy to drop off another booklet.

All episodes of physical activity that are greater than 10 consecutive minutes in length should be recorded in the log booklet. Physical activity includes any activity that requires you to expend energy. This means that we are not just interested in physical activity that you do for exercise, but also physical activity that occurs during the course of your daily life, including for transportation, recreation, at work, and around the house. If you are unsure as to whether an activity should be included in the log, record it to be on the safe side.

The physical activity log pages should be completed for a total of 7 consecutive days. In order to ensure comparable data across participants, we need to have a full 7 days of records for each person.

Please record your physical activities on the log pages at least once per day. One option is to keep this booklet with you and record activities as you do them. Another option is to record your day's physical activities (if any) before you go to sleep at night. The key is to make sure you record activities within a maximum of 12-15 hours after they were completed (i.e. on the same day) so that details about the episodes don't get mixed together.

The following sections provide instructions specific to each of the sections on the physical activity log page.

Activity

What type of physical activity were you doing? Please describe the **primary form of physical activity** that you were engaged in for that episode. If you were engaged in multiple activities, do not fill out two different pages for the same time period (just use the primary activity for that time period).

Duration

You only need to record episodes of physical activity that are **10 consecutive minutes or greater** in length. When reporting the duration, **please subtract out time that was spent not engaged in the activity**. For example, if you went for a walk for half an hour, but stopped to talk to a neighbour for 5 minutes, please record only 25 minutes of activity for that episode.

Intensity

Using the following definitions, please indicate **how hard you were participating for the majority of that episode** (to help you, think about whether the activity you were doing was similar to the examples):

Mild:	Minimal effort, no perspiration	e.g., easy walking, yoga, bowling
Moderate:	Not exhausting, light perspiration	e.g., brisk walking, easy swimming, recreational sports
Strenuous:	Heart beats rapidly, sweating	e.g., jogging, hard biking, competitive sports

Location

For our analyses, we need to be able to locate (by exact address) where people are engaging in physical activity, so **please be as specific as possible**. To assist you, the map on the following page indicates the names of several common physical activity locations in your area (e.g., parks, facilities, etc.). **If you went to a specific location** and know the name of the facility or park where you engaged in the activity, please record it in the location box for that episode. If more than one location exists in Kitchener-Waterloo for that facility name, please indicate something that would allow us to determine the exact address. Similarly, if you don't know the name of a facility or park, but you can describe the address or location, please record that information.

If you engaged in PA on your own property, please simply indicate "**at home**". **If your physical activity occurred on streets, trails, or parks** (e.g., during a walk or bike ride), please list the **major streets, trails, parks, etc**. We are especially interested in study participants' use of parks, trails, and recreation facilities for physical activity, so please be sure to record this information if applicable.

Point of Origin

Sometimes we depart to engage in physical activity from home, work, school, or other places. If you went somewhere (e.g., walking from home; working out at lunch break), please **indicate where you started from and give a specific location or address whenever possible**. If you were already at the location where the physical activity took place, simply put "already there".

Method of Transport

If the physical activity occurred at another location (e.g., park, gym), please describe how you got there (e.g., car, bus, bike, walk, etc.). If you didn't go anywhere to participate in the physical activity or if the physical activity *was* the method of transportation (e.g., walking to the store; biking home from work), please check the box labeled "n/a" (not applicable).

Co-Participants

Was anyone (including a pet) participating in the activity with you for the majority of the time you recorded for that episode? If not, simply put "none" in the co-participants box. If someone was participating with you for the majority of the time, please list spouse, children, friend, parent, co-worker, pet, etc.

Purpose

People often undertake physical activities for different reasons. Please review the definitions of each category of physical activity and **choose one of the following options for the purpose of each episode**. If you engaged in the activity for multiple reasons, please indicate the **primary purpose**.

Household:	Unpaid physical activity in and around your home (e.g., gardening, home maintenance).
Job-Related:	Physical activity that occurs during paid jobs, farming, volunteer work, course work, and any other unpaid work you did outside your home (remember that unpaid work around the home should be classified as household).
Transportation:	Physical activity that occurs when travelling from place to place, including to places like work, school, stores, movies, and so on.
Recreation:	Physical activity that was done for recreation, sport, exercise, or leisure.

Please do not hesitate to email (atkaczyn@ahsmail.uwaterloo.ca) or phone (888-4567 x32612) Andy Kaczynski if you ever have any questions about the log booklet or this study.

Map page – left half

Map page – right half

Physical Activity Episode Information
SAMPLE PAGES #1-4 (with handwritten examples)

Date: _____ **Start Time**: _____ a.m. or p.m. (circle one)

Activity:

Duration: ____ minutes

Intensity:
- ❑ Mild
- ❑ Moderate
- ❑ Strenuous

Location:

Point of Origin:

Method of Transport:

❑ Car ❑ Walk ❑ Bike ❑ Public Transit ❑ n/a ❑ Other _____

Co-Participants:

Primary Purpose:

❑ Recreation ❑ Transportation ❑ Household ❑ Job-Related

During this episode of physical activity …	**Very low**						**Very high**
1. The challenge of the activity for me was	1	2	3	4	5	6	7
2. My skills in and knowledge of the activity were	1	2	3	4	5	6	7

Please respond to the following two statements about this physical activity episode:	**Strongly disagree**						**Strongly agree**
1. That physical activity episode was pleasurable	1	2	3	4	5	6	7
2. I was really enjoying doing that	1	2	3	4	5	6	7

Physical Activity Episode Information
(26 blank pages like this followed)

Date: _____ **Start Time**: _____ a.m. or p.m. (circle one)

Activity:

Duration: ____ minutes

Intensity: ❑ Mild ❑ Moderate ❑ Strenuous

Location:

Point of Origin:

Method of Transport:

❑ Car ❑ Walk ❑ Bike ❑ Public Transit ❑ n/a ❑ Other _____

Co-Participants:

Primary Purpose:

❑ Recreation ❑ Transportation ❑ Household ❑ Job-Related

During this episode of physical activity …	**Very low**						**Very high**
1. The challenge of the activity for me was	1	2	3	4	5	6	7
2. My skills in and knowledge of the activity were	1	2	3	4	5	6	7

Please respond to the following two statements about this physical activity episode:	**Strongly disagree**						**Strongly agree**
1. That physical activity episode was pleasurable	1	2	3	4	5	6	7
2. I was really enjoying doing that	1	2	3	4	5	6	7

Thank you for taking the time to share your physical activity episodes with us.

Please keep this booklet in a safe place in the envelope provided until a member of the study team comes to pick it up (along with the yellow questionnaire booklet) on the pre-arranged date.

If you have any questions, please feel free to contact:

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(519) 888-4567 x32612
atkaczyn@ahsmail.uwaterloo.ca
http://ahs.uwaterloo.ca/~atkaczyn

REMEMBER

- Please fill out the yellow questionnaire.

- **Please turn to the back cover of this booklet for one last summary question about your physical activity this week.**

Please answer the following question at the end of the 7-day period for which you kept track of your physical activity episodes:

Overall, please indicate (from 1-5) how typical of a week this was in terms of your level of physical activity involvement?

Not at all Typical				Very Typical
1	2	3	4	5
↓	↓			

If you answered 1 or 2 on the above question, please tell us if you normally do more or less physical activity in a typical week:

❑ Usually do **MORE** ❑ Usually do **LESS**

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Appendix F: Accelerometer Instructions for Participants

Physical Activity in the Community Study – Accelerometer Instructions

Thank you for agreeing to participate in the accelerometer component of the study. Please read over the following instructions carefully.

What is an accelerometer?

An accelerometer is a motion sensor that is similar to a step-counter, but instead of measuring the number of steps, an accelerometer measures physical activity by recording how often and how quickly movements are made. Accelerometers are small, non-invasive devices that are worn on a belt around the waist and do not interfere with usual daily activities or function.

How do I use an accelerometer?

1. Make sure to put the accelerometer on **as soon as you wake up** so that all of your movement in the day is measured.
2. Wear the accelerometer around your waist near your **right hip** all day.
3. **Do not wear the accelerometer during water activities** (e.g., bath, shower, swimming, etc.) since it is not waterproof. Also, **do not wear it when you are sleeping**.

When should I wear the accelerometer?

The accelerometer will have been programmed to start recording data by the time you receive it. We would like to collect data for three full days. Therefore, please put on the accelerometer when you wake up on the day after you receive it and wear it continuously (except for sleeping, swimming, and showering) until midnight (or when you go to sleep in the evening) on the third day. For example, if you receive the accelerometer on Tuesday, please wear it for Wednesday, Thursday, and Friday.

What happens at the end of the study?

When you take the accelerometer off after the three days, please simply put it back in the envelope and store it in a safe place until a member of the research team returns to pick up all your study materials. **These monitors are very expensive. Please take extra care with them!**

If you have any questions or concerns, please contact one of the following people:

Andy Kaczynski
atkaczyn@ahsmail.uwaterloo.ca
(519) 888-4567 x2612

Mark Havitz
mhavitz@healthy.uwaterloo.ca
(519) 888-4567 x2612

Thank you for your participation in this study!

Please read and sign two copies of the statement below. One copy will be left with you and one retained for our records.

I, _____, acknowledge having received the accelerometer and agree to wear it as specified above and then to return it to the aforementioned researchers by August 25, 2006.

_____	_____	_____	_____
Signature of Study Participant	Address	Phone #	Date