

Examining Perceived Barriers to Physical Activity for Middle-Aged and Older Adults Using
an Ecological Framework

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Thesis submitted to the Faculty of Graduate and Postdoctoral Studies

In partial fulfillment of the requirements

For the degree of Master of Arts of the School of Human Kinetics

School of Human Kinetics

Faculty of Health Sciences

University of Ottawa

Acknowledgements

Surreal is the only word that can describe what it feels like to be writing this section of my thesis. Completing these final stages of writing has been very rewarding, and I am lucky to have the chance to thank the people in my life whose support has made this possible.

Thank you to my thesis supervisor, Dr. Bradley Young. I decided to pursue graduate studies in Ottawa because I was struck by your enthusiasm and passion for research. Thank you for your support and advice. You often went above and beyond the expectations for a supervisor to ensure my experience was the best it could be, I am very lucky to have been one of your students. No matter my mood beforehand, I left every meeting with you feeling confident, inspired and as my lab-mates can attest to, with a big smile on my face.

I would also like to thank my thesis committee members, Dr. Tanya Forneris and Dr. Tracey O'Sullivan. I sincerely appreciate your valuable ideas, guidance and encouragement.

Thank you to Val, your hard work and energy inspired me. Thank you for your insights and assistance with data collection and analysis. I really enjoyed working with you and I wish you the best of luck in the future.

I must thank my superb lab-mates for the many, many laughs. I will fondly look back on our time spent in class, the lab, breakfast dates and the occasional coffee break. You have made this experience unforgettable.

To Sarah, I am not exactly sure how I would have handled the many ups and downs of graduate school without you, I could not ask for a better friend or roommate! Stefanie and Cora, thank you for always giving me something to look forward to, I am very fortunate to have friends like you! To Paul, thank you for putting a big smile on my face every day. Your encouragement and understanding have meant so much to me and I am so happy to be sharing this with you! Thank you to Aunt Karen for your interest in my thesis, I appreciate everything you did to help.

Finally, I would also like to thank my parents, Kevin and Donna, and my brother, Steve. However, thank you does not even begin to describe how grateful I am for your support, encouragement and your confidence in me. I could not have done this without you and I love you all very much!

Abstract

This investigation, comprising two studies, examined the number of barriers to physical activity (Study 1) and barrier strength (Study 2) reported by middle-aged and older adults using a social ecological framework (McLeroy et al., 1988). Researchers were interested in assessing age group (45-54; 55-64; 65-74 yrs) by physical activity group (active, less active) effects for barrier responses using analyses of variance. In Study 1, 180 participants completed a physical activity level survey (Godin & Shephard, 1985) and answered open-ended questions about barriers. Results indicated that 45-54 yr-olds reported more barriers overall, and more intrapersonal barriers than older groups. Less active 45-54 yr-olds reported more organizational-interpersonal barriers than the other groups. Descriptive analyses of coded themes demonstrated that common intrapersonal barrier sub-themes cited by younger adults related to family commitments, while sub-themes reported by middle-aged and older adults related to having a health problem or an injury. In the organizational-interpersonal category, the most common barrier sub-theme related to the workplace. In Study 2, 116 participants completed a survey assessing weekly physical activity and barrier strength for items pertaining to ecological categories and barrier sub-factors. Results showed that less active adults reported each of intrapersonal, interpersonal, and physical environment barriers more strongly than active adults, irrespective of age; the intrapersonal category was relatively the most constraining for our participants. In terms of barrier sub-factors, results showed that significantly higher barrier strength scores are most often associated with physical activity level (i.e., less active), and only occasionally associated with age group. The overall investigation can provide valuable information for improving physical activity interventions for middle-aged and older adults.

Keywords: Social ecological theory, middle-aged and older adults, barriers, physical activity

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PERCEIVED BARRIERS TO PHYSICAL ACTIVITY

Introduction

Physical activity has become widely accepted as a mechanism to maintain health and prevent chronic disease (Chodzko-Jaiko et al., 2009; Vogel, Brechat, Lepretre, Berthel, & Lonsdorfer, 2009). Participating in physical activity or exercise can help reduce the risk of developing diabetes, obesity, osteoporosis and cardiovascular disease and can also assist in the treatment and management of these conditions (Chodzko-Jaiko et al.; Goggin & Morrow, 2001; Vogel et al.). In addition, physical activity has been suggested as a treatment and management technique for people battling depression and anxiety (Chodzko-Jaiko et al.; Goggin & Morrow). Even though the positive reasons to engage in physical activity have been well documented, current data suggest almost 50% of middle aged (35-55) and older adults (55+) are inactive (Statistics Canada, 2006). Data pertaining to younger populations (e.g., 20-34) suggests more favourable physical activity levels, as only 44% of this age group was considered inactive (Statistics Canada, 2006). Therefore, middle-aged and older adults tend to be the most inactive proportion of the population, and these adults may be missing the important health benefits physical activity and exercise can provide. Given the low levels of physical activity participation among the adult population and the potential for health benefits, it is important to understand the factors that influence the decision to engage or not engage in physical activity. If the reasons for the low participation rates among adults were better understood, interventions and public health messages to improve activity levels could be designed more effectively (Booth, Bauman, Owen, & Gore, 1997).

Previous research related to insufficient physical activity levels in aging populations often refers to factors that impede participation as barriers to physical activity, and assumes that identifying and eliminating these barriers will increase participation (Booth, Bauman & Owen,

2002). To date, there have been a number of studies examining perceived barriers to physical activity (e.g., Booth et al., 1997; Booth et al., 2002; Booth, Owen, Bauman, Clavisi, & Leslie, 2000; Hardy & Grogan, 2009; O'Neill & Reid, 1991). However, one of the limitations of this research is that many studies have not used a theoretical framework. Booth and colleagues (2000) explain that using a theoretical framework can better frame how we understand the complexity of physical activity behaviours. Furthermore, much of the research has focused on barriers at the level of the individual, such as attitude, motivation or self-efficacy. While the individual influences are important, physical activity is also influenced by the context in which the behaviour may or may not occur (Sallis & Owen, 1999). Context includes social and physical environmental factors, which have sometimes been overlooked in previous studies (Giles-Corti & Donovan, 2002).

Ecological models may be particularly valuable to the study of barriers to physical activity, because although they consider the individual, they emphasize the role of the environment and the interaction of these influences (Sallis & Owen, 1999). One ecological model that has been proposed is the social ecological model, which specifies five types or levels of influences on behaviour: intrapersonal, interpersonal, policy, community, and institutional or organizational (for simplicity, the institutional or organizational level will be referred to as 'organizational' in the remainder of the document) (McLeroy, Bibeau, Steckler, & Glanz, 1988). Intrapersonal determinants include characteristics of the individual, such as their attitude and self-efficacy for the behaviour. Interpersonal influences include a person's social environment, for example social support or modelling. A third level of influence is policy, which includes laws that promote or discourage active lifestyles, such as decreased funding for physical education in schools. Community influences include the availability of parks or recreational programs. Finally, organizational factors are characteristics of organizations such as schools, the workplace

or retirement homes; an institutional barrier would include a lack of physical activity opportunities in this type of organization. In addition to these five factors, the influence of the physical environment is commonly included in studies using an ecological approach (e.g., Giles-Corti & Donovan, 2002). The physical environment specifies the characteristics of the constructed/built environment that affect participation in physical activity, such as geographic accessibility and availability of facilities (Sallis & Owen, 1999).

The effectiveness of social ecological models has been demonstrated in previous health research, particularly in efforts to decrease smoking rates (Sallis, Owen & Fischer, 2008). Interventions targeting multiple levels of influence have been credited for the decline in this problematic behaviour (Sallis et al.). Similarly, physical inactivity is a major health concern, and interventions should be designed to address multiple levels of influence on behaviour. Thus, the need for a study examining influences on physical activity at multiple levels for the most inactive segment of our population becomes apparent.

The overall purpose of the current investigation was to examine differences in the number of reported barriers as a function of different barrier types as well as the strength of perceived barriers to physical activity for adults, using a version of the social ecological model that also considers barriers attributed to the physical environment. In addition to examining multiple levels of influence, another factor that is important to consider in the context of barriers is an adult's current physical activity level. An adult who incorporates physical activity into their lifestyle regularly is likely to report different barriers than an adult who is sedentary; measuring activity level along with perceived barriers can provide valuable information about which types of factors influence the behaviour of inactive adults compared to active adults (Booth et al., 2000; Booth et al., 2002; Lees, Clark, Nigg, & Newman, 2005). Consumers of this research will benefit from understanding the differences between adults who are less active and those who are

already active, because designing an intervention to target inactive adults would incorporate different strategies than one designed to reach out to adults who are already involved.

Furthermore, much of the information about adults' perceived barriers to physical activity has been gathered without examining possible age differences (e.g., all adults in a singular sample were aged 55 and over; Cardenas, Henderson & Wilson., 2009; O'Neill & Reid, 1991; Smith & Storandt, 1997, or all adults in a singular sample were aged 60 and over; Lees et al., 2005). Fewer studies have considered how barriers may change as a function of age; it has been suggested that examining barriers and how they change across age groups can provide a more in-depth understanding of how interventions can be structured and utilized most effectively (Booth et al., 2002; Booth et al., 1997). Thus, the second purpose of this study was to determine how age and current activity level may change an adult's perceptions of barriers to physical activity.

In summary, this study used an ecological framework to consider perceived barriers to physical activity for middle aged and older adults (ages 45-74). It specifically examined differences in the number of barriers as a function of barrier types and differences in the strength of barriers reported by adults who were active and less active, and across different age cohorts. This approach may provide information about the most salient barriers experienced by middle aged and older adults in the context of physical activity, and how these barriers may change according to life stage. With an ecological perspective, the factors influencing differentially active lifestyles might be better understood, and interventions to increase participation in this important health behaviour could be more effectively designed (Sallis & Owen, 1999).

Review of Literature

The following chapter will provide an overview of the social ecological model in the broadest sense, with a primary focus on the version discussed by McLeroy and colleagues (1988). It will further discuss how this model has been applied to study perceived barriers to physical activity for older adults. Specifically, previous research pertaining to influences for physical activity at the individual level, the social environment and the physical environment will be reviewed. Furthermore, previous research suggests that older adults' perceived barriers may change over time as age increases, or as adults are exposed to physical activity opportunities (Booth et al., 2002). Thus, the proposed study will consider how age and current activity level influence reported barriers to physical activity and the following review of literature will discuss previous research that has specifically included these variables. Finally, the purposes, hypotheses and significance of the proposed investigation are outlined.

Social Ecological Model: An Overview

Physical activity is a complex behaviour involving the individual as well as a variety of external factors. For example, the environmental context, the social interactions and the geographic location can all contribute to an individual's physical activity experience (Sallis et al., 2006). Thus, a framework that considers multiple levels of influence will be advantageous for studying physical activity. Social ecological models have been developed to examine health behaviours and emphasize the following principles: behaviour has multiple levels of influence, these influences interact with each other, and the most successful interventions to change behaviour act simultaneously at different levels (Sallis, Owen & Fischer, 2008). Ecological perspectives on behaviour have been developed relatively recently and are gaining support, especially in their application to health (Sallis et al., 2008). The most successful interventions focus not just on the individual (e.g., attitude, motivation) or the environment (e.g., providing

facilities) but several levels simultaneously. Previous research (e.g., Burton, Oldenburg, Sallis & Turrell, 2007; Sallis & Owen, 1999) explains that intervening at one level is often not sufficient when behaviour has a variety of determinants; for example, a positive attitude toward physical activity may not be enough to change a person's behaviour if a facility is inaccessible to that individual. Thus, studies examining the factors influencing physical activity participation should incorporate multiple levels of influence.

McLeroy and colleagues' (1998) specify the following five levels of influence on behaviour in their social ecological model: intrapersonal, interpersonal, policy, community and organizational factors. Intrapersonal factors include characteristics such as an individual's attitude, motivation, skills and knowledge. Interpersonal influences include an individual's social network, such as family, friends and coworkers. Policy is thought to affect behaviour through laws or regulations that serve to promote or limit an individual's choices, such as prohibiting rollerblading on sidewalks or introducing a fee to register a bicycle. Community influences may include relationships among organizations within a community, such as a lack of networking among community organizations that limits promotion of physical activity. Finally, organizational factors include characteristics of organizations (schools, workplaces, facilities) that may influence an individual's behaviour, such as a fitness centre within a workplace, or a lack of after school physical activity programs. Although not specified by McLeroy and colleagues (1998), a sixth level of influence often included in studies using an ecological framework is the physical environment; this would include, for example, availability and geographical access to recreational opportunities (Giles-Corti & Donovan, 2002).

Overall, ecological models are used to examine the impact of multiple influences on behaviour. The advantage to using such models is their ability to inform interventions designed to impact a variety of determinants of behaviour (Sallis et al., 2008). By adopting an ecological

approach, the importance of the interaction between environmental factors and individual characteristics in forming behaviour is highlighted, and the sole emphasis on individual responsibility for behaviour choices is minimized (McLeroy et al., 1988). This study will use the ecological framework proposed by McLeroy and colleagues along with the addition of the physical environment. Specifically, participants in the present study will have the opportunity to generate information about personally perceived barriers that will be categorized according to these six levels of influence. Such an approach has never been used to examine barriers to physical activity for adults and has the potential to provide a valuable outlook on factors that facilitate or inhibit this behaviour.

Applying the Social Ecological Model to Physical Activity in Older Adults

Until recently, the literature considering barriers and influences for physical activity in the middle-aged and older adult population has emphasized individual factors (Giles-Corti & Donovan, 2002). The studies that have adopted an ecological approach have provided support for its usefulness in this area of research (e.g., Cardenas et al., 2009; Giles-Corti & Donovan, 2002). However, the majority of these studies involving adults have not considered or afforded the possibility to consider all levels of influence of the social ecological model in the broadest sense.

One study has attempted to use a broad social ecological model to examine barriers to physical activity for high school students and those transitioning to first year of university (Gyruksik, Spink, Bray, Chad, & Kwan, 2006). The authors had students actively generate responses to an open-ended question about perceived barriers to physical activity. These responses were classified according to the levels of influence specified by the social ecological model. The methodology ensured that students reported the most important barriers they were facing; the authors contended that a general list of barriers would likely not have captured the experiences of students in this unique transition period. The same methodology will be applied in

the proposed study, as middle-aged and older adults also experience distinct transitions such as retirement, becoming grandparents, 'empty nest syndrome,' and the physical challenges associated with aging. Importantly, borrowing this methodology affords the possibility that data pertaining to all facets of the social ecological model will be generated.

The social ecological model has been useful in the past to gain an in-depth perspective of barriers experienced by students, and the following study will be the first to use this model and methodology with an adult population. The subsequent section of the literature review will outline the levels of influence that have received the majority of empirical support in the physical activity domain, with an emphasis on studies that involved middle-aged and older adults.

Intrapersonal factors. The intrapersonal or individual level of influence has received the most attention in previous research studying physical activity determinants (Giles-Corti & Donovan, 2002). Although many researchers who support ecological approaches criticize the emphasis that has been placed on the individual, these factors are consistently important influences for physical activity and should not be discounted. The following discussion will present previous research considering individual factors such as attitude, self-efficacy, individual demographic characteristics, knowledge about the benefits of exercise, lack of time and lack of motivation.

In a study looking at the relative influence of the individual, the social and the physical environment, individual factors were most strongly associated with adequate physical activity for a large sample of Australians aged 18 to 59 (Giles-Corti & Donovan, 2002). The individual factors included in this study were related to the concept of attitude, including perceived behavioural control, behavioural skills and intentions. Results showed perceived behavioural control, behavioural skills and intentions were significantly related to participation in physical activity (Giles-Corti & Donovan). Booth and colleagues (2000) found similar results when

examining individual influences for physical activity in adults aged 60 and over ($n = 449$). A strong positive attitude toward the health benefits of physical activity was significantly related to participation. Therefore, a positive attitude, and related concepts such as strong behavioural intentions and control seem to be associated with physical activity participation and adherence for adults (Booth et al.; Giles-Corti & Donovan).

Another individual level factor strongly associated with physical activity in middle-aged and older adults is self-efficacy. In a physical activity context, high self-efficacy refers to a high degree of confidence in being able to execute a specific activity at a specific time (Sallis & Owen, 1999). Adults who have high self-efficacy are more likely to be active and remain active in the face of barriers (Rhodes et al., 1999). Self-efficacy is known to predict changes in physical activity participation. McAuley et al. (2007) studied self-efficacy in a randomized controlled trial with 174 older adults. Results showed self-efficacy was predictive of physical activity participation at 2 years and 5 years after the intervention. Further, Booth and colleagues (2000) examined multiple variables in relation to physical activity and found self-efficacy to have a strong association. The relationship was sufficiently strong to necessitate a separate analysis excluding self-efficacy, to ensure the effects of other variables were not masked. Ayotte, Margrett and Hicks-Partick (2010) examined 116 married couples and their results showed that self-efficacy was directly related to physical activity, and indirectly related through outcome expectancies, barriers and self-regulatory behaviours. Overall, self-efficacy is considered one of the strongest determinants of physical activity in middle-aged and older adults.

A number of other individual influences for physical activity, in addition to those related to attitude and self-efficacy have been examined in recent studies. In a review of literature pertaining to individual factors associated with physical activity for older adults, Rhodes and colleagues (1999) further identified age, education and income as characteristics that are related

to physical activity level. To briefly explain these findings, adults tend to become increasingly inactive as they reach the later stages of life (i.e., with increasing age). Adults with more education and higher average incomes tend to be more likely than those with less education and fewer financial resources to achieve sufficient activity levels (Rhodes et al.). These types of demographic characteristics are important as they indicate the qualities of a more active adult.

Another individual level factor that seems to be important to physical activity participation is knowledge about the importance of, and/or outcome expectations for exercise, and about the recommended intensity to achieve health benefits. Ayotte et al., (2010) found that positive outcome expectancies were related physical activity behaviour through self-regulatory behaviour in their sample of 116 married couples. O'Neill and Reid (1991) provided a questionnaire to participants aged 60 and over which identified perceived barriers to physical activity. The authors used four categories to classify responses; knowledge about the benefits of exercise was one of these categories, and contained 61.5 % of responses. Findings indicated that older adults thought they already participated in an adequate amount of physical activity, illustrating that knowledge of sufficient exercise is a barrier for this population (O'Neill & Reid). This same finding has been reported by adults in Australia (Booth et al., 2000; 2002); it seems the perception of already attaining a sufficient amount of physical activity is a significant barrier for older adults, since evidence tells us that middle-aged and older adults are among the most inactive demographic in most Western societies (Goggin & Morrow, 1999).

In addition to feeling already sufficiently active, another barrier frequently reported by adults is lack of time. In a sample of Australian adults aged 60 to 64, lack of time was cited as the main barrier to participation in physical activity (Booth et al., 2002). In a similar study, lack of time was the main barrier reported by Australian adults aged 40 to 59 (Booth et al., 1997). Further, having no time was also reported in a qualitative approach to studying barriers,

particularly among older adults aged 65 and over who considered themselves to be active (Lees et al., 2005). These adults felt they did not have enough time to increase their participation. In sum, lack of time is a barrier reported frequently by people of all ages and has even been referred to as the “all time winner” for barriers to physical activity (Sallis & Owen, 1999, p. 119).

Another factor related to the individual that seems to prevent adults from participating in physical activity is lack of motivation (Booth et al., 1997). Difficulty getting started, or lack of motivation was reported frequently by Australian adults aged 40-59; lack of time was the only barrier reported more often (Booth et al., 2000). In a similar study, no motivation was reported as a barrier by Australian adults aged 60 to 64 (6.3 %), 65-69 (10 %) and 70+ (5.1 %), with percentages in parentheses representing the portion of the age cohort mentioning this as a barrier (Booth et al., 2002). Finally, feeling too old has commonly been reported by older adults. In a study looking at older adults aged 60 and over, 20% of participants reported feeling ‘too old’ as a barrier (Booth et al., 1997). In another study, adults aged 65-69 and 70+ reported feeling ‘too old’ to participate in physical activity, and this barrier was reported more frequently as participants’ ages increased (Booth et al., 2002).

In sum, intrapersonal level barriers have been studied in the greatest depth compared to the other levels of influence specified in the social ecological model. The intrapersonal factors that seem to be associated most often with middle-aged and older adults include attitude, self-efficacy, lack of knowledge about the benefits and recommended amounts of physical activity, lack of time and motivation, and feeling too old. These barriers have consistently been examined and have been significantly associated with physical activity in adults and thus each will be addressed as potential intrapersonal barriers in the current investigation.

Interpersonal factors. Interpersonal factors, or those relating to the social environment, also have been shown to be important influences for physical activity participation. The social

environment encompasses a wide variety of factors that have rarely been captured in one study; most researchers tend to concentrate on a few important items pertaining to the social environment. The following discussion will outline the interpersonal factors that have been examined in relation to physical activity for older adults.

Giles-Corti and Donovan (2002) examined the relative influence of individual, physical environment and social environment factors, and found social factors to be significantly associated with achieving sufficient amounts of physical activity. Specifically, they found that Australian participants aged 18 to 59 who exercised with significant others and were members of a sport or recreational club were more likely to achieve recommended amounts of physical activity. Participating with significant others has repeatedly been shown to be important. For example, Strath, Isaacs, and Greenwald (2007) used a qualitative approach to examine indicators for physical activity in adults aged 55 and over, and found 62 % of their sample reported they would be more physically active if the people surrounding them were active as well.

In addition to participating with others, receiving support from significant others seems to be important. Adults who perceive higher levels of support from family and friends tend to be more physically active, and have a greater chance of meeting recommended physical activity levels than those who do not (Orsega-Smith, Payne, Mowen, Ho, & Godbey, 2007). Similarly, Booth et al. (2000) found social support was significantly higher in older adults classified as sufficiently active compared to inactive. In this same study, the authors examined social reinforcement, and social modelling. Active adults experienced significantly more modelling (observing others in their environment who are also active), and received more encouragement to participate (reinforcement for being active) than inactive adults. In another recent study, Cerin, Leslie, Sugiyama & Owen (2010) distributed a survey to a large sample (n = 2194) of Australian adults, and found that receiving social support from friends and family was associated with

perceiving barriers to physical activity to a lesser degree. In addition to receiving social support directly, social support has been suggested to be facilitative of physical activity through encouragement, having someone to participate with, providing transportation, and so on (Shaw, Liang, Krause, Gallant & McKeever, 2010). Conversely, a lack of social support tends to exhibit the opposite relationship to physical activity participation. For example, Cardenas et al. (2009) examined social influences in a sample of seniors athletes aged 55 and over, but focused on lack of company and discouragement from friends. These two factors had the most constraining effect on physical activity participation for older sporting adults. Having no one to participate with has also been a barrier reported by older exercising adults in Australia (Booth et al., 1997; 2002).

In sum, interpersonal factors have been shown to be important influences on the physical activity participation of middle-aged and older adults. These factors range from social support, participating with others, and lack of social support and constraints/discouragement from others. Based on these findings, the social environment is an important level of influence for physical activity in the adult population.

Physical environment. Until recently, the role of the physical environment was rarely included in studies identifying influences for physical activity (Giles-Corti & Donovan, 2002). However, evidence indicates that a physical environment supportive of physical activity is associated with increased participation. Further, it has been suggested that environmental variables may be particularly important influences with older adults, because issues such as mobility and personal independence can be further influenced by the design of an environment (Cunningham & Yvonne, 2004). Generally, the physical environment has been more weakly associated with physical activity than the intrapersonal or interpersonal levels of influence. However, research for this level of influence is expanding because researchers (e.g., Giles-Corti

& Donovan, 2002) have noted it as worthy of investigation, especially for older adults.

Environmental influences that relate to the built or natural physical environment and also seem to have an association with physical activity include accessibility, opportunities, safety, and aesthetic appeal (Humpel, Owen & Leslie, 2002).

For the purposes of this review, access pertains to the built and geographical environment, and is defined as “spatial distribution of facilities adjusted for the desire and the ability of people to overcome spatial separation to access a facility or activity” (Giles-Corti & Donovan, 2002, p. 1795). Accessibility to facilities has commonly been associated with physical activity. Giles-Corti and Donovan found that more inaccessible recreational facilities were less likely to be used. On the other hand, access to footpaths, cycle paths, health clubs and swimming pools has been linked to increased physical activity participation (Humpel et al., 2002). Booth and colleagues (2002) studied adults (aged 60 and over) in Australia and found access to a recreation centre, a cycling path, a golf course, a park and a swimming pool were all significantly associated with achieving recommended physical activity levels. Cerin and colleagues (2010) found that easy access to facilities was important because it minimized the time needed to participate in physical activity. It is important to note that this finding suggests that environmental variables (e.g., accessibility) can interact with intrapersonal variables (e.g., time), which highlights the importance of considering multiple levels of influence for physical activity.

The availability of opportunities to participate in physical activity have been reviewed, and include the availability of programs or clubs in a geographic area, or geographical characteristics such as coastal locations (Humpel et al., 2002). Other researchers have considered factors such as land use; mixed land use tends to promote physical activity as it provides a “purpose to do something” (Strath et al., 2007, p. 419). Thus, if adults have places (e.g., shops,

services, and places for daily errands) to go within walking distance of their residence, they may be more likely to use an active form of transportation to do so. This idea was also supported by Shigematsu et al., (2009) in a study looking at 1623 adults aged 20 – 97 years. The correlation between proximity to facilities and walking for transportation increased if the environment was considered supportive of walking, and this trend was particularly pronounced for the older groups of adults in their study. Similarly, the notion of proximity has also been suggested to be important; most often, people who reside closer to a destination of interest are thought to have increased opportunities for physical activity (Giles-Corti & Donovan, 2002). However, proximity seems to matter less when the attractiveness of the facility increases (Giles-Corti & Donovan).

Safety is another environmental factor that is related to access and opportunity. An environment perceived to be unsafe limits opportunities for participation. Safety has been assessed by asking about perceptions of environmental characteristics, such as conditions of sidewalks, presence of street lights, crime rates, or stray dogs (Cunningham & Yvonne, 2004). Adults' perceptions of the safety of their neighbourhood have been found to influence physical activity that occurs within this context (Cunningham & Yvonne; Strath et al., 2007).

Finally, aesthetic appeal of an environment has been shown to be associated with increased physical activity (Humpel et al., 2002). In a qualitative analysis with adults aged 55 and over, properly maintained sidewalks and properly maintained walkways were mentioned as supports for physical activity (Strath et al., 2007). Further, enjoyable scenery and overall aesthetic appeal of an environment were significantly associated with physical activity for older adults (Cunningham & Yvonne, 2004).

Overall, the literature suggests that the physical environment plays an important secondary role in comparison to individual factors when studying physical activity influences,

and should not be ignored (Giles-Corti & Donovan, 2002). Giles-Corti and Donovan used a logistic regression analyses to present odds ratios for various characteristics/variables relating to the individual, social environment and physical environment, and their association with exercising at recommended levels. Their results suggested that a higher determinant score for each variable was more strongly associated with exercise than a lower score, and that having a high score on individual characteristics determined exercise more than the social or physical environment scores. Therefore, the association of the physical environment did not appear to be as influential as individual characteristics, but was an important variable to be included. As Sallis and Owen (1999) explain, making facilities available is not enough to guarantee adoption of physical activity, but the environment in which an individual lives must be supportive of accessibility in order for this adoption to occur. Therefore, the physical environment is an important level of influence to consider, and overlooking it would fail to provide a complete picture of this complex behaviour.

Importance of Considering a Lifespan Perspective

An ecological perspective is projected to be useful for designing interventions that act at multiple levels of behavioural influence. However, the relative importance of each level is likely dynamic and may change as a person's environment (physical and social) changes. Thus, it is important to keep in mind that an intervention tailored to alleviate barriers to physical activity at one phase in an adult's life may not be continually effective. Studies that examine the possible fluctuations in barriers as people progress through adulthood are important to address this. This study will examine barriers and how they may change according to adults in three age cohorts (45-54, 55-64, 65-74 yrs).

Few studies have used the social ecological model to examine barriers for middle-aged and older adults, and no study was found that used this model while considering how perceived

barriers may change when cross-sectionally examining successive age cohorts. However, one study used an ecological approach to examine barriers for high school students making the transition to university (Gyurcsik et al., 2006). The authors examined students in grade seven through first year university and looked for changes in the types and number of barriers reported to gain an understanding of this critical transition period. Results of this study indicated that frequencies of barriers reported in each ecological category differed significantly by grade level, supporting the use of this ecological approach to study the most salient barrier types between groups. This same approach could be applied to older adults also experiencing unique transition periods such as ‘empty nest syndrome’, retirement, and becoming grandparents. By examining how barriers change with age, interventions could be more effectively tailored to adults by taking into account the transitional stages they are facing (Gyurcsik et al., 2006).

Although not using an ecological model per se, a small number of cross-sectional studies have examined barriers across different age cohorts of adults (Booth et al., 1997; 2002). Booth et al. (2002) had participants aged 60-64, 65-69 and 70+ rank barriers according to a list provided by the investigators and results were reported according to the most common barriers perceived by each age group. Although they failed to use multivariate analyses, a few important trends emerged from this study. Firstly, adults in each age category felt they were already active to a sufficient degree, especially adults aged 65-69 (63% reported this barrier compared to 38% of the youngest age cohort). Secondly, the percentage of adults reporting they were ‘too old’ to exercise increased as age increased. Finally, the youngest cohort of adults was more likely to report lack of time as a barrier than adults in the upper cohorts. Their study contributed the important observation that older adults are not homogenous, and illustrated the need to take lifespan factors into account.

The current study examined three age cohorts (45-54, 55-64, 65-74 yrs) to consider how various age stages may change reported barriers to physical activity. The majority of previous research examined adults aged 55 and over. Therefore, this study attempted to gather information about barriers experienced by adults prior to age 55 to fill this gap. Further, the inclusion of the oldest cohort (65-74 yrs) provided cross-sectional information about how barriers may change as adults' progress towards later stages of life.

Importance of Considering Activity Level

Logically, an adult who participates in physical activity differs behaviourally from an adult who does not. It is believed that the social ecological model can offer further explanation as to why these adults are active; for example, this research could tell us if an active adult typically experiences more or less barriers in their physical or social environment than an inactive adult. Previous research on barriers to physical activity has classified older adults as active or inactive, as it is hypothesized that an adult who incorporates sufficient activity into their lifestyle will report different barriers or differentially stronger barriers than a sedentary adult. For example, one study used components of McLeroy et al.'s (1988) social ecological model to examine barriers to physical activity for older adults (55+) and also categorized their participants as active or inactive (Cardenas et al., 2009). The more active adults reported fewer intrapersonal barriers and greater perceptions of benefits from physical activity, compared to the inactive. Furthermore, Booth et al. (2000) used insufficiently active versus sufficiently active physical activity levels as categories for their outcome variable in their study with a sample of older Australians (60+ yrs) while attempting to determine influences for being active.

Considering activity level will provide information about the individual, social and physical environmental differences for active adults compared to less active. This could help consumers of research understand how to target interventions toward the inactive segment by

removing the salient barriers for this subgroup, or how to design programs that have a good chance at retaining participants by removing the major challenges faced by adults who are already active. Further, information gathered from this aspect of the study could be used to inform interventions designed to recruit older adults versus those designed to retain adults who are already active.

Summary of Literature Review

This review of literature has outlined the development and support for using social ecological models to study health related behaviours such as physical activity. It has further provided an overview of the three traditionally dominant levels of influence specified in McLeroy and colleagues' (1988) social ecological model. Particularly, the emphasis was placed on the intrapersonal and interpersonal levels described in this model, as results to date have shown that these tend to be dominant influences for physical activity in adults; findings related to community, policy and organizational influences have been less salient. In addition, the research pertaining to the influence of the physical environment was presented; although this was not one of the original factors included in McLeroy and colleagues' social ecological model, it has been used in previous studies with adults and has been purported to be specifically relevant with middle-aged and older adults (Giles-Corti & Donovan, 2002). Finally, age and activity level were discussed as important factors to consider alongside the social ecological determinants. The remainder of the chapter will build on the information presented in the literature review to explain the purposes, research questions, hypotheses and significance of this investigation.

Purposes and Research Questions

The overall purpose of the investigation was to use the social ecological model as a framework to identify and understand perceived barriers to physical activity reported by adults aged 45 to 74. Furthermore, it determined if the number of reported barriers differed as a

function of ecological barrier type and whether there were differences in reported barrier strength when considering activity level (active or less active) and age (45-54, 55-64, 65-74). A secondary purpose of this study was to determine if perceived barriers were similar when they were actively generated by adults compared to when these same adults rated barrier items in a questionnaire provided by investigators.

To achieve these purposes, the investigation occurred in two studies. Study 1 comprised an open-ended questionnaire providing participants with the opportunity to actively generate up to seven perceived barriers to physical activity. These actively generated barriers were classified according to all six levels of the social ecological model (i.e., intrapersonal, interpersonal, organizational, community, public policy, physical environment). In addition, participants were asked to complete the Godin Leisure Time Exercise Questionnaire (Godin & Shephard, 1985), a self-report measure of current activity level to help determine physical activity status (i.e., active, less active). In Study 1, the first purpose was to determine whether there were age group or physical activity status differences in the total number of barriers reported by participants, irrespective of barrier type. This analysis allowed us to understand if the total number of perceived barriers seemed to depend on age, physical activity status or an interaction between these two variables. The second purpose was to determine if the number of barriers differ according to age cohort, activity group, or an interaction between these variables, in each of the social ecological categories used to classify barrier types. The third purpose was to provide a description of specific barriers themes reported by adults within each of the ecological barrier categories, according to age cohort and physical activity status. Given these purposes, three overarching research questions guided Study 1. First, did the mean number of total barriers reported depend on age cohort, activity level or an interaction between age and activity level? Second, using a social ecological framework, did the number of barriers reported in each

ecological category by middle-aged and older adults appear to depend on age cohort, physical activity level or an interaction between age and activity level? Third, what were the specific barrier themes within each ecological barrier category most frequently reported by adults, and did there appear to be differences between age groups and activity groups with respect to these descriptive themes?

Study 2 involved a ‘top-down’ questionnaire developed by the researcher that provided participants with a list of barriers reflecting three particular levels in the social ecological model: intrapersonal, interpersonal and the physical environment. Study 2 had three purposes and corresponding research questions. First, it attempted to determine the relative strength of intrapersonal, interpersonal and physical environment barriers to physical activity perceived by adults, and determined if the relative importance of these categories differed as a function of age and activity level. It is important to note that for the purposes of this study, ‘barrier strength’ refers to the extent to which participants viewed a barrier as limiting. Second, it aimed to validate barrier items pertaining to each of the three levels of influence in the social ecological model that could subsequently be employed in our multivariate analyses. Since recent literature outlines the need for information regarding the reliability and validity of instruments attempting to measure intrapersonal, interpersonal and environmental factors for physical activity (Burton, Oldenburg, Sallis, & Turrell, 2007), we aimed to ensure the validity of all barrier categories submitted to subsequent multivariate analyses in our study. Third, Study 2 examined age cohort and activity level group differences in the strength of barriers pertaining to specific sub-categories of barriers within each of the broader intrapersonal, interpersonal and physical environment categories, to determine if a significant interaction between age group and activity level existed. Given these purposes, three overarching research questions directed Study 2. First, which broad ecological category of barriers was most salient for middle-aged and older adults, and were differences

evident in the strength of barriers reported across each barrier category as a function of age and activity level? Second, which valid and reliable barrier sub-factors emerged within the broader intrapersonal, interpersonal and physical environment categories that we examined in our questionnaire? Third, were there age group or activity group differences in the strength of barriers perceived by middle-aged and older adults with regards to emergent sub-factors *within* each ecological category?

Together, Study 1 and Study 2 allowed for an examination of the most important perceived barriers for older adults by age and by physical activity level, and possible interactions between age and activity levels. Additionally, it allowed for an exploratory comparison between methods (active generation vs. questionnaire) used to gather this information.

Hypotheses

In this section, hypotheses are presented as they relate to each study. In Study 1, participants were asked to actively generate responses about their perceived barriers, and were classified as active or inactive for the subsequent analyses. Participants also belonged to one of three age cohorts. It was hypothesized that the number of barriers cited by participants would differ significantly between the active adults and the less active adults, and a significant difference was also expected between age cohorts. Further, it was expected that the number of barriers reported and classified according to the six levels of the social ecological model would differ significantly between age cohorts, and between the active and less active participants. Due to an absence of prior research that has stratified physical activity status, employed multiple age cohorts, and submitted these cohorts to multivariate analyses within the same study, no hypotheses relating to the age by physical activity interaction are advanced at this point; these analyses may be considered exploratory in nature.

In Study 2, participants responded to questionnaire items on a Likert scale that pertained to barriers associated with the intrapersonal, interpersonal or physical environment levels of the social ecological model. It was expected that the rated responses in each ecological level (intrapersonal, interpersonal and physical environment), and responses for specific barrier sub-categories within each of these ecological levels, would differ significantly between the three age cohorts and two activity levels. Again, we examined for interactions between age and physical activity status, but no specific hypotheses were advanced due to the exploratory nature of these analyses.

Significance of the Study

This study has the potential to provide information that consumers of research could use to increase the number of middle-aged and older adults participating in physical activity, and to maximize adherence to programs and activities. More specifically, less active adults provided information about the factors that seem to be preventing them from adopting a physically active lifestyle, which could be utilized to best understand how to recruit these individuals into suitable programs, venues, or contexts that promote activity. Active adults provided information about the challenges they faced in maintaining their lifestyle, which could be useful for understanding how to maximize adherence by minimizing obstacles for continued participation. Overall, designing programs and interventions while taking into account the important barriers middle-aged and older adults are facing could ultimately improve health through physical activity (Goggin & Morrow, 2001).

Another important contribution of this study is the use of a theoretical framework, the social ecological model. This approach could provide useful information for designing interventions at multiple levels of influence, and also allowed for an estimation of the relative importance of each level. This was the first study to the researcher's knowledge to afford the

possibility of using data pertaining to all six levels of the social ecological model (including the physical environment) with middle-aged and older adults. Finally, this study added information about barriers faced by adults in different age cohorts, and whether these age-related barriers also depended on whether individuals were more or less active; results therefore could provide direction and knowledge for designing interventions that are effective across the lifespan.

Methodology

Participants

The following section will summarize the recruitment, roles and experiences of participants in the study. Participants were recruited from the Ottawa area using convenience sampling. To attempt to ensure that a wide range of activity levels was reported, a local community health centre, a local card playing group, a walking program, a local gym and a recreational masters athlete program were contacted. The goal was to recruit 150 participants to have 50 participants for each of the following age cohorts: 45-54, 55-64 and 65-74.

Prior to partaking, participants were provided an information letter, including a letter of consent (see Appendix B), which outlined the details of the study, their responsibilities and potential risks. After reading the letter of informed consent, participants were asked to complete Study 1. First, participants were asked to respond to an open-ended question about perceived barriers to physical activity, and also complete a self-administered questionnaire about their participation in physical activity. Next, they had the option to provide an email address if they were interested in completing Study 2. In Study 2, which took place at least two weeks after the first phase was completed, participants were asked to complete a questionnaire developed by the researcher about perceived barriers to physical activity.

Instruments

Three instruments were used to collect data in this investigation. The questionnaire used in Study 1 (see Appendix E) included two instruments; first, a self-administered questionnaire measured adults' current activity level and second, an open-ended questionnaire about perceived barriers to physical activity. The third instrument employed in Study 2 was an online questionnaire (see Appendix G) developed by the researcher by borrowing items from similar studies (e.g., Booth et al., 2000; Giles-Corti & Donovan, 2002; Humpel et al., 2002) and was

completed at least two weeks after the completion of Study 1, if participants choose to be a part of both studies.

In Study 1, the Godin Leisure Time Exercise Questionnaire (GLTEQ) (Godin & Shephard, 1985) was used to measure the current physical activity level of participants. This instrument was developed as a simple way to assess physical activity participation and is self-administered. Participants were asked to reflect on an average week and report the number of times they were involved in activities classified as mild, moderate or strenuous. A metabolic equivalent (MET) value was assigned to each category of activity. By totalling the amount of time participants spend at each intensity level, a value of total energy expenditure for the week was obtained. Reliability of this questionnaire has been demonstrated with adults aged 20 to 59 (Jacobs, Ainsworth, Hartman & Leon, 1993) and suitable validity has been established with adults aged 18 to 65 (Godin & Shephard, 1985; see Pereira et al., 1997 for a review of all reliability and validity measures relating to this instrument). All self-report measures are associated with a certain amount of error, but these types of tests have been shown to be useful for determining if a person's lifestyle is generally active or inactive, which is sufficient for the purposes of this study (Sallis & Owen, 1999). Furthermore, by determining whether a participant is active or inactive, the activity level variable was able to be dichotomized for the purposes of group assignment in the data analyses.

In addition to this measure of activity level, the questionnaire in Study 1 included open-ended questions that asked participants to describe perceived barriers to physical activity. The open-ended questionnaire consisted of three questions. The first two questions were designed to capture the 'degrees' of barriers that an adult may experience. For example, sedentary adults might experience barriers to any form of physical activity, while minimally active adults might instead experience barriers that prevent them from achieving a desired frequency or intensity of

physical activity. The first two questions asked were: 1) Do you think there have been any circumstances that may have prevented you from doing physical activity in the last six months? 2) Were you satisfied with the frequency and intensity of your physical activity participation in the last six months? Both of these questions required a 'yes' or 'no' response. Next, participants answered the following final question which pertained to the specific barriers they had experienced and represented the active generation question: "Please provide a list of the most important barriers to physical activity you have experienced. In this case a 'barrier' refers to anything that may have prevented you from participating in physical activity or achieving your desired frequency (e.g., how often per week you participate) or intensity (e.g., at a level suited to your physical ability) of participation."

This methodology has been used in a similar study on barriers to physical activity for a special population and was useful for gaining an ecological perspective on barriers to physical activity for high school students making the transition to university (Gyurcsik et al., 2006). It is valuable to have participants actively generate their responses to a question pertaining to barriers, because it ensures that responses are not limited to what can be captured by a questionnaire that has barriers provided. By asking participants to report barriers without providing a list, the risk of overlooking the most important perceived barriers is minimized. These adults are individually faced with different experiences and as a group, are likely to be experiencing unique transition stages such as retirement, becoming grandparents, or going through periods associated with 'empty nest syndrome.' Thus, a general list of barrier was deemed to be insufficient to fully understand these adults' unique experiences, just as a general list was considered inadequate for studying high school students transitioning to university (M. Kwan, personal communication, February 4, 2010).

Study 2 involved a questionnaire developed by the researcher. The questionnaire contained three categories of items reflecting each of the traditionally dominant levels in the social ecological model: interpersonal, intrapersonal and physical environment. The items in the questionnaire were borrowed and adapted from similar studies such that all items could be set to the same scale and suitable for the data analyses (see Appendix F). All items required a response using a 5-point Likert scale, with a value of 1 indicating the participant ‘strongly disagrees’ with the statement and a value of 5 indicating the participant ‘strongly agrees.’

The intrapersonal category was comprised of items adapted from Giles-Corti and Donovan (2002) (items 1 to 7 in Appendix F). Suitable reliability of these items was demonstrated in a pilot study (Giles-Corti & Donovan, 2002). Since Giles-Corti and Donovan initially used the theory of planned behaviour to inform their intrapersonal items which they then adapted to an ecological approach, the repertoire of intrapersonal items used for the study was supplemented with items from Booth et al. (2002) (item 8) and Booth and colleagues (2000) (items 9 to 15). These additional items had strong face validity, as they represented the most frequently studied and prominent barriers in the literature on barriers and adults. Altogether, the intrapersonal items measured a participant’s attitude toward trying to be active, attitude toward the process of trying, frequency of trying, subjective norms regarding physical activity, perceived behavioural control, behavioural skills, intentions, perceptions of having insufficient time or motivation, perceptions of being too old, perceptions of cost, and injury/fear of injury.

Next, the interpersonal category contained items adapted from Giles-Corti and Donovan (2002) (see items 16 to 18 in Appendix F) and was supplemented with items from the social support for exercise behaviours scale developed by Sallis, Grossman, Pinski, Patterson and Nader (1987) (items 19 to 22), and Booth et al. (2000) (item 23). Additionally, item 24 was chosen to reflect social norms, which has been identified as an important influence of the social

environment (McNeill, Kreuter, & Subramanian, 2006). The supplemental items were included to ensure the scale includes the most prominent interpersonal influences as suggested by the current literature beyond those used in an ecological approach by Giles-Corti and Donovan. With respect to items borrowed from Giles-Corti and Donovan, those researchers demonstrated satisfactory reliability for these items in a pilot study; moreover, satisfactory reliability and validity of items borrowed from the social support for exercise behaviour scale has been demonstrated in previous studies (Sallis et al., 1987). Altogether, the interpersonal items examine club membership, modelling, participation with others, social norms and social support as defined by Sallis et al.

Finally, the physical environment category was represented by items developed by the researcher based on the main themes discussed by Humpel et al. (2002) in their review of environmental factors linked with physical activity in older adults (see items 25 to 28 in Appendix F). Currently, few scales have been developed to examine the influence of the physical environment for physical activity and those that do tend to focus on walking and cycling in a neighbourhood setting, and are not suitable for a sample that is expected to report a wide range of incidental physical activity (e.g., walking to a store, using stairs at work) to more structured/programmed and destination-specific physical activity involvement (e.g., exercise class, seniors sport). Therefore, the items in this scale represented the environmental factors hypothesized to be associated with physical activity, ranging from spontaneous activity to increasingly planned and organized activity (such as seniors sport), and have face validity based on the existing literature. Altogether, the items representing the physical environment captured perceptions of safety, accessibility of natural and built facilities, opportunities to be physically active and proximity of natural and built facilities.

In its entirety, the questionnaire attempted to capture and combine a wide range of factors that have been studied and identified as important in previous research. The intrapersonal and interpersonal items were borrowed and slightly modified from previous studies such that they could be assessed on the same Likert scale and therefore submitted to factorial analyses. The physical environment items were developed based on important themes in the literature and these items were stated so that they could also be answered on the same scale and submitted to the same mixed factorial analyses along with intrapersonal and interpersonal items. All items in the survey for Study 2 were submitted to rigorous exploratory factor analyses to ensure the validity of ecological barriers and specific barrier sub-categories with respect to the current sample of middle-aged and older adults.

Procedures

This study required the involvement of a community health centre, a local card playing group, a walking program, a local gym and a recreational seniors athlete program in the Ottawa area; these organizations were approached by the researcher to explain the purposes and gain their consent and support for the study. Organizational representatives were asked to read and sign a letter of information, including a letter of consent (see Appendix A), prior to participant recruitment at each organization. The remaining procedures are outlined by describing the expected distribution and collection of the instruments in Study 1 and in Study 2.

In Study 1, the researcher went to visit the community centre, card group, walking program, gym and seniors athlete program in person. The entire questionnaire, including the open-ended questions and physical activity measure, was distributed to participants who express interest at that time, and these participants were asked to complete the questionnaires on-site. The questionnaire was returned to the researcher upon completion. If an adult was interested in participating but could not take the time to complete and return the questionnaire at that time,

they were provided with a return envelope and postage to mail the completed questionnaire. After each participant completed and returned the open-ended questionnaire and the physical activity measurement, they were asked whether they were interested in participating in Study 2. If they were, those who had electronic access were asked to provide an email address for invitation to the second phase of the study.

Study 2 utilized an online survey. Participants were sent a letter of invitation via email requesting their participation in Study 2, which contained a secure link to the survey (see Appendix C). Participants were recruited for Study 2 in one of three ways. First, following completion of Study 1, participants had the opportunity to provide their email address to be invited to participate in Study 2. In this case, a letter of information (Appendix C) was sent via email two weeks after completing Study 1, which contained a secure link to access the survey in Study 2. Second, participants had the opportunity to provide their email address to the researcher through their respective organization, and were informed that an invitation to complete the survey would be sent to their email address. Third, a letter of information containing a secure link to the survey was sent via regular mail, and interested participants were able to visit the link to complete the survey. Notably, if participants were recruited via the second or third option, participants would not have completed Study 1 and the online questionnaire included the GLTEQ to ensure physical activity status could be determined.

The electronic survey was completed and submitted online. A reminder email (see Appendix D) was sent to participants who had not responded one week after the original questionnaire was sent to maximize response rate. Given that the population of interest was older and not likely to be as technologically savvy as younger people, it was expected that encouraging electronic completion of the survey in Study 2 while also having a paper version available if needed would maximize the response rate. In order to accommodate participants who did not

have access to an email account, the barriers questionnaire pertaining to Study 2 was also developed on paper and mailed to select participants (i.e, those who returned a paper copy of the phase one survey) along with appropriate return envelopes and postage. They were instructed to wait approximately two weeks before completing the questionnaire and asked to record the date of completion before returning the survey.

Data Analyses

The following discussion will summarize the data analysis procedures for each of the three instruments. First, the questionnaire measuring physical activity, the GLTEQ, was used to estimate leisure time physical activity in metabolic equivalents (METS). If calculations resulted in a score of 24 METS or above, participants were considered active enough, according to public health guidelines, to achieve health benefits (G.Godin, personal communication, September 3, 2010). Thus, data analysis began by calculating scores for each participant on the GLTEQ and assigning them an ‘active’ or ‘less active’ physical activity status. Physical activity level was included as an independent variable in the subsequent data analyses.

Next, the open-ended questionnaire generated a list of up to seven perceived barriers provided by each participant. These barriers were coded and classified according to each level of influence specified by McLeroy et al.’s (1988) social ecological model (intrapersonal, interpersonal, community, organizational, policy, and the physical environment), similar to the method used by Gyurcsik et al. (2006). Specifically, two researchers independently coded and classified a percentage of the reported barriers into one of the six levels of influence and resolved disagreements about classification through discussion and consensus (reliability analyses were performed to ensure agreement between researchers with respect to the assignment of barrier codes).

In Study 1, data was subjected to four analyses. As in Gyurcsik et al. (2006), the dependent variable was reported barriers, and the independent variables were age and activity level. First, to determine if a statistically significant difference existed between the mean number of total barriers reported by active and inactive adults, an independent *t*-test was used. Secondly, a one way ANOVA was used to determine if a statistically significant difference existed between the mean numbers of total barriers reported by each age cohort. When sample size allowed, investigators used a multivariate analyses of variance (MANOVAs) to examine the main effects of age and physical activity and a possible interaction, using dependent measures pertaining to various barrier categories. Study 2 involved a questionnaire prepared by the researcher. The results were used to determine which level of influence was relatively most important for middle-aged and older adults and physical activity. Two statistical analyses were conducted. To determine if the mean rated barrier strength reported by participants was significantly different for barrier category and age, a two way ANOVA (3 age cohorts x 3 barrier categories) was conducted. In this analysis, barrier strength was the dependent variable, age cohort and barrier category were the independent variables. Secondly, to determine if the mean rated barrier strength reported by participants was significantly different for barrier category and activity level, a two way ANOVA (2 levels of activity x 3 barrier categories) was conducted. The variables in this analysis are the same as the previous mixed ANOVA, with the exception of activity level as an independent variable in place of age cohort. Lastly, investigators used multivariate analyses of variance (MANOVAs) to examine differences in relative barrier strength across dependent measures pertaining to the intrapersonal, interpersonal, and physical environment categories.

Design

The study was a cross sectional design. A cross-sectional design is subject to a number of possible threats to validity and reliability. Content validity, which describes the ability of the instrument to measure what it is intended to, was minimized in the open-ended questionnaire and the barriers questionnaire due to the review process and ensuring that all items are grounded in the literature. Face validity for each barrier item included in the questionnaire was ensured through the review of literature, and previous measurements of reliability and validity for the borrowed questionnaire items were discussed. The GLTEQ had already demonstrated reliability and validity in previous studies (Godin, Jobin, & Bouillon, 1986; Godin & Shephard, 1985), therefore this instrument did not present any additional threats to the proposed study. Factorial validity in Study 2 was ensured by submitting items pertaining to barrier categories to exploratory factor analyses. Furthermore, any items that were grouped according to barrier sub-categories were derived following exploratory factor analyses to ensure the internal validity of the sub-categories.

The possible threats to reliability will be discussed in terms of internal and external threats. Internal threats included test-retest reliability, internal consistency, testing threat and selection bias. Cronbach alphas were run for the items in each barrier category included in the questionnaire (intrapersonal, interpersonal and physical environment) to determine internal consistency, prior to submitting the scores for each category to the analyses. Items found to be unreliable were removed. Testing threat was present in this study, because participants expressed interest in participating prior to the beginning of the study. Therefore, they may have been apt to increase their physical activity participation level during the interval between their responses for the survey in Study 1 and Study 2. This was not controlled for. Selection bias was also present, due to the non-random nature of the sample. Participants agreed to participate based on their

expressed interest, so there was no way to determine if this population was representative of the general population and may have reflected self-selected motivational bias. Finally, strategies to control for external validity included the collection of demographic variables, such as sex, education, and income. To respect external validity, results were interpreted and discussed with respect to the target population and care was taken to ensure results were not over-generalized.

Presentation of the Journal Articles

The following articles entitled *Examining Types of Barriers to Physical Activity Reported by Middle-aged and Older Adults using a Social Ecological Framework* and *Differences in Perceived Strength of Barriers to Physical Activity in Middle-aged and Older Adults according to Age and Physical Activity Status: A Social Ecological Perspective* presented in this chapter have been prepared for submission to an academic journal.

Examining Types of Barriers to Physical Activity Reported by Middle-aged and Older Adults
using a Social Ecological Framework

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Abstract

Identifying obstacles, or barriers to physical activity related not only to the individual but also to the environment in which physical activity occurs has been an important strategy for understanding how participation could be improved (Giles-Corti & Donovan, 2002). This study examined barriers to physical activity reported by middle-aged and older adults, using a social ecological model (McLeroy et al., 1988; Gyurcsik et al., 2006). 180 participants completed a survey that assessed physical activity level (Godin & Shephard, 1985) and contained open-ended questions about barriers. To assess age group (45-54; 55-64; 65-74 yrs) and activity group (active, less active) differences in the number of barriers reported by participants, a 2 X 3 between-groups ANOVA was conducted. Results indicated a main effect of age, $F(2,171) = 9.14, p < 0.001$, with younger adults reporting more barriers than middle-aged and older adults, and also an interaction between age and physical activity level, $F(2, 171) = 6.83, p = 0.001$, as the younger, less active group reported more barriers than all other groups in the analysis. A MANOVA further assessed group differences in the number of barriers according to intrapersonal, organizational-interpersonal and physical environment categories. Younger adults reported significantly more intrapersonal barriers than older adults, $F(2,173) = 5.00, p = 0.008$, and the number of organizational-interpersonal barriers depended on an interaction between age and physical activity level, $F(6,344) = 2.43, p = 0.026$, whereby the number of barriers became particularly more pronounced for the younger, less active group. Following qualitative coding of barriers, common themes in the intrapersonal category were related to having an injury, a health problem and family commitments, while in the organizational-interpersonal category, the common theme barriers related to the workplace.

Keywords: barriers, physical activity, middle-aged and older adults, social ecological model, open-ended questions

Examining Types of Barriers to Physical Activity Reported by Middle-aged and Older Adults using a Social Ecological Framework

The benefits of regular physical activity have been well documented and include reductions in the risk for heart disease, diabetes, osteoporosis and improvements in mental health (Chodzko-Jaiko et al., 2009; Goggin & Morrow, 2001; Vogel, Brechat, Lepretre, Berthel, & Lonsdorfer, 2009). These health problems are particularly important for an older population, as they are at high risk for developing such conditions. Despite the knowledge that regular physical activity can help reduce one's risk for developing these health problems, physical activity levels are low, especially among our middle-aged and older adult population (Craig, Russell, Cameron & Bauman, 2004; Statistics Canada, 2006). Thus, research aiming to understand the reasons for these unfavourable trends in physical activity levels among adults is needed.

Previous research in this area often refers to factors that impede participation in physical activity as barriers, and is conducted under the assumption that identifying and eliminating such barriers may help improve physical activity level trends (Booth, Bauman, & Owen, 2002). Thus, many studies have been conducted to identify perceived barriers to physical activity reported by adults (e.g., Booth et al., 2002; Booth, Owen, Bauman, Clavisi, & Leslie, 2000; Cerin, Leslie, Sugiyama, & Owen, 2010; Hardy & Grogan, 2009; O'Neill & Reid, 1991). Previous research in this area has focused primarily on barriers at the level of the individual, such as those related to attitude or motivation (Sallis & Owen, 1999). While these types of barriers have proven to be important, it has been suggested that other types of influences, such as those related to a person's social or physical surroundings, may have been overlooked (Giles-Corti & Donovan, 2002). With this in mind, researchers have suggested that using a social ecological framework to study physical activity provides important advantages over studying the individual alone (Sallis, Owen, & Fischer, 2008). Social ecological theory includes the individual, but highlights influences such

as the social and physical environment. These influences are important to consider for physical activity because they make up the context in which the actual behaviour occurs (Sallis & Owen, 1999).

While there have been a number of specific models developed using a broader social ecological framework (e.g., Bauer et al., 2003; Sallis et al., 2006), one model in particular was chosen to guide this study because of its specific definitions of multiple levels of influence on behaviour (McLeroy, Bibeau, Steckler, & Glanz, 1988). McLeroy et al.'s model specifies five types of influences on behaviour: intrapersonal, interpersonal, policy, community, and institutional/organizational (for simplicity, this particular level will be referred to as 'organizational' in the remainder of the document). Intrapersonal determinants include individual characteristics like a positive or negative attitude toward physical activity, or level or type of motivation to participate. Interpersonal influences are part of a person's social environment, for example having a person to participate with or receiving social support. A third level of influence is policy, which would include a policy at any government level that promotes or discourages active lifestyles, such as decreased funding for physical education in schools. Community influences include the availability of recreational programs provided within the community, or promotion of physical activity within the community. Finally, institutional/organizational factors are characteristics of organizations such as schools, the workplace or retirement homes; an organizational barrier would include a lack of physical activity opportunity in this type of organization. An additional level that will be included in this study is the physical environment. This level has shown to be important for physical activity in previous research (e.g., Giles-Corti & Donovan, 2002). The physical environment specifies the characteristics of the constructed/built environment that affect participation in physical activity, such as geographic accessibility and availability of facilities and the natural physical

environment, such as terrain, climate or weather (Sallis & Owen, 1999). Given its relevance in previous research, we have chosen to include the physical environment as a level of influence in our study.

In addition to examining the nature of barriers towards physical activity as they relate to levels of influence in the ecological model, the study will further consider how barriers vary as a function of an adult's current physical activity level and age. Physical activity level is an important variable to consider because of its implications for consumers of this research. An adult who is already interested and has opportunities to be active is likely to experience different barriers than a more sedentary adult (Booth et al., 2000; 2002). Research that documents such differences is important because it helps to design interventions to circumvent barriers that can be tailored toward different goals in respective populations, for example, the goal of improving retention rates of already active adults, or improving enrolment rates of inactive adults. With respect to age, much of the information in previous research on adults is based on inclusion criteria pertaining to one group of adults (e.g., all adults in a singular sample aged 60 or over, Lees, Clark, Nigg, & Newman, 2005; e.g., all adults in a singular sample aged 55 or older; Cardenas, Henderson, & Wilson, 2009; O'Neill & Reid, 1991). While this research has been important, it is advantageous to recognize that barriers are likely to change over the lifespan (Shaw, Liang, Krause, Gallant, & McKeever, 2010), and thus successive cross-sections of age in the same study are essential to make inferences about such changes. For example, barriers experienced by an adult at age 50 are unlikely to be the same as an adult at age 75. Important life changes take place as adults progress through middle and older age (e.g., perceptions of free time due to possible retirement or kids moving out, financial considerations, new opportunities provided by built or natural facilities), and their experiences with physical activity are likely to change as well. In addition to examining physical activity status and age as separate variables, it

is also important to consider how these two variables may interact. Previous studies have included these variables separately in the same study, which suggests their mutually important influence for physical activity (Booth et al., 2000) yet no study has formally examined an interaction between these two variables. The current study fills a void in the literature pertaining to middle-aged and older adults because it is one of the first to examine barriers by physical activity status and consecutive age cohorts in the same study, using rigorous multivariate statistics and an ecological model.

While there have been many studies looking at barriers to physical activity, there have been methodological limitations. The majority of previous quantitative research has used questionnaires containing barrier items provided to the participant by the researchers, and participants have been asked to respond to each item. Using this methodology, participants are unable to generate their own responses about barriers they experience; they must respond to each item provided in the questionnaire, whether or not they perceive it as relevant (Gyurcsik et al., 2009). These types of generic barrier lists contain commonly reported barriers, but may not provide information about barriers specific to the population of interest (Gyurcsik et al., 2006). One methodology that has been recommended for examining barriers in a specific population is open-ended elicitation, where participants are able to provide their own responses and describe barriers that are personally relevant (Gyurcsik et al., 2009). This approach has not been used previously for middle-aged and older adults, and our study methodology will address this limitation by using open-ended questions.

Overall, this study aimed to use a social ecological framework to identify and understand barriers to physical activity reported by middle-aged and older adults, and to determine if there were differences in types of barriers across three age cohorts (45-54; 55-64; 65-74 yrs) and between two activity groups (active, less active). Using social ecological categories to classify

barrier types, the study had three specific purposes. First, we attempted to determine whether there were age group or activity group differences in the total number of barriers reported by participants, irrespective of barrier type. The second purpose was to determine if the types of barriers differed according to age cohort, activity group, or an interaction between these variables, using social ecological categories to classify barrier types. The third purpose was to understand and provide a description of specific barriers reported by adults within each ecological barrier category, according to age cohort and physical activity status. Given these purposes, three overarching research questions guided our study. First, did the mean number of total barriers reported depend on age cohort, activity level or an interaction between age and activity level? Second, were the main effects or interactions between age and physical activity level for number of barriers a function of certain social ecological barrier categories? Third, what were the specific barriers within each barrier category most frequently reported by adults, and does there appear to be trends across age groups and activity groups with respect to main themes of open-ended barrier responses?

Methods

Procedures and Design

After obtaining approval for this cross-sectional study from the University of Ottawa's Office of Research Ethics and Integrity, participants were recruited at nine various community organizations and social events tailored toward middle-aged and older adults in Ontario (e.g., Canada 55+ Games, mall walking group, older adults recreational hockey league, Lions Club, bingo organization). A representative at each organization was contacted and asked to read and sign a letter of permission before participants were invited to take part in the study. After obtaining organizational permission, participants were then required to read a letter of information and provide informed consent prior to partaking in the study. Surveys were

distributed to, completed and returned by participants on-site at their respective organization. Participants were informed via the letter of information of the requirement to be between the ages of 45 and 74 to complete the survey.

Participants

A total of 180 participants (55% female, 45% male) completed the survey. Participants were divided into three age cohorts for the purposes of the statistical analyses, 45-54 (n=43), 55-64 (n=67) and 65-74 (n=70). We aimed to recruit a sample that would report a broad spectrum of physical activity levels, from very active to sedentary. Overall, 32% were participants in a structured, athletic event or league (e.g., participants at Canada 55+ Games, members of adult hockey league), 7% of participants were members of an adult walking club, 20% were volunteers at a community sporting event and were not necessarily involved in physical activity, 25% were recruited from somewhat structured community events not related to physical activity (e.g., bingo), and 16% were recruited from non-structured organizations within the community that were not related to physical activity (e.g., teachers, nurses).

Measures and Instruments

The questionnaire comprised two instruments. Firstly, participants completed the Godin Leisure Time Exercise Questionnaire (Godin & Shepherd, 1985) to measure leisure time physical activity during a typical seven day period. Secondly, participants completed a questionnaire containing open-ended questions about perceived barriers to physical activity.

Godin Leisure Time Exercise Questionnaire (GLTEQ). The GLTEQ is a self-report measure of physical activity that asks respondents to report the amount and types (mild, moderate or strenuous) of physical activity they regularly participated in during a typical seven day period. Responses from moderate and strenuous types are multiplied by metabolic equivalents, and summed to arrive at a single metabolic equivalents (METS) score. A score of 24

METS or above is recommended as the point at which a person should be considered active enough to meet recommended public health guidelines (G.Godin, personal communication, September 3, 2010). Therefore, participants with a score of 24 METS or above were considered 'active' while participants below 24 METS were considered 'less active' for the purposes of between group analyses. Suitable reliability and validity for this questionnaire has been demonstrated in previous studies (Godin, Jobin & Bouillon, 1986; Godin & Shephard, 1985; Jacobs, Ainsworth, Hartman, & Leon, 1993).

Open-ended barrier questionnaire. The second survey assessed perceived barriers to physical activity and was modeled after Gyruścik and colleagues (2006). Open-ended questions were used to elicit responses about barriers experienced by participants. Prior to responding to the open-ended questions, participants answered two priming questions: 1) "Have there been any circumstances that may have made it difficult for you, interfered with, or prevented you from participating in physical activity, exercise or sport in the past six months?" and 2) "Have you been satisfied with the frequency and intensity of your physical activity, exercise or sport participation in the last six months?" Next, participants were provided with a definition of the term 'barrier' to ensure all participants understood and shared a common interpretation, as suggested by previous research (Gyruścik et al., 2009). Barriers were defined for participants as *'anything that may have prevented you from participating in physical activity or achieving your desired frequency and intensity of participation; it is something that gets in the way, or makes it a hassle to do physical activity.'* With this definition in mind, participants were then asked to provide a description of barriers they experience. Instructions encouraged participants to begin with the barrier most significant for them and describe each barrier using one or two full sentences. Participants could provide up to seven responses in a series of open-ended boxes.

Responses to the open-ended barrier questions were initially coded and classified by the primary investigator and a research assistant according to each level of the social ecological model. Coding definitions were adapted from Gyurcsik and colleagues (2006) and used to code each barrier response. Intrapersonal barriers were defined as an individual characteristic that may prevent physical activity (e.g., injury, interest, motivation, time, health, fear, ability). Interpersonal barriers were defined as formal and informal social networks and support systems related to the decision to do physical activity that may prevent physical activity (e.g., lack of opportunity in a social environment). Organizational barriers were defined as characteristics inherent in a social institution containing organizational characteristics that may prevent physical activity, including aspects of the venue (e.g., availability of physical activity within a workplace). Community barriers were defined as formal and informal networks and relationships between organizations and social institutions that may prevent physical activity (e.g., absence or weakness in such networking). Public policy barriers were defined as any municipal, provincial or national laws or policies that may prevent physical activity. Lastly, physical environment barriers were defined as characteristics of the physical environment (built, or a feature of the natural landscape) that is not a social institution or related to the context of an organization, that may prevent physical activity (e.g., distance, weather, accessibility, safety).

Using these coding definitions, two researchers independently coded 30 % of all returned surveys. Each researcher was responsible for reporting the total number of barriers reported by each participant and then assigning each barrier a code based on the definitions presented above. First, a Pearson correlation was used to determine inter-rater reliability with respect to the total number of barriers (collapsed across all categories) reported on a within-participant basis. This test was important because codings for some barrier responses were not mutually exclusive, they could fit into more than one level of the model and thus could be assigned two codes. A Pearson

correlation ($r = .99, p = .01$) confirmed that independent coders interpreted the total number of barriers reported by participants similarly. Cohen's Kappa was used to determine agreement between coders with respect to the assignment of barrier responses to various social ecological categories. Cohen's $\kappa = .96, p < .001$, indicated an excellent level of agreement, thereby allowing all remaining responses to be coded by the primary investigator.

Preliminary Analyses

Preliminary descriptive statistics were first conducted to inspect the mean number of barriers reported and the physical activity levels for the entire sample. Irrespective of barrier category, the mean number of barriers reported by each participant was 1.41 ($SD = 1.37$). With respect to physical activity level, the mean score on the GLTEQ for the entire sample was 36.41 METS ($SD = 25.13$). The younger adults (45-54 yrs) had a mean score of 38.71 METS ($SD = 31.15$), the middle-aged adults' (55-64 yrs) mean score was 34.22 METS ($SD = 20.53$) and the older adults' (65-74 yrs) mean score was 37.05 METS ($SD = 25.34$). These scores suggest that our oldest group of adults was slightly more active than our middle-aged group, and almost as active as the younger group, although a one way analysis of variance (ANOVA) confirmed that there was no significant difference between age cohorts for activity level ($p = 0.64$). Therefore, our sample did not demonstrate the expected decrease in physical activity level with increasing age (Trost, Owen, Bauman, Sallis, & Brown, 2002).

Overview of Data Analyses

First, we used a 2 X 3 between groups ANOVA to determine how age groups and physical activity groups differed in terms of the total number of barriers reported, irrespective of barrier categories. Next, to determine if there were age group or activity group differences, and if there was a significant interaction between age and physical activity level, we used a multivariate analysis of variance (MANOVA) to explore differences in the mean number of barriers reported

in various social ecological barrier categories (i.e., intrapersonal, interpersonal, organization, community, policy, physical environment). We had planned to use these categories as six dependent variables in the MANOVA, however, no responses were provided by participants that could be coded into the ‘community’ or ‘policy’ categories. Therefore, they were not included as identifiable categories in subsequent multivariate analyses. Additionally, the interpersonal category had an insufficient number of responses to be included as a stand-alone dependent variable, so this category was combined with the organizational category. Given that the organizational and interpersonal categories are both related to an individual’s broad *social* environment, the collapsing of these two categories was appropriate. Thus, the barrier categories serving as dependent variables for the MANOVA were intrapersonal, organizational-interpersonal, and physical environment. Finally, we attempted to provide a description of the frequency of common barrier themes reported within each of the barrier categories according to age group and activity group, for those barrier categories that proved significant in the aforementioned MANOVA.

Results

Mean Differences for the Total Number of Barriers Collapsed across all Categories

Prior to analysis, distributions were inspected on a within-group basis, and 10 outliers were removed using the criteria of being two or more standard deviations above the mean. A 2 activity group (less active; active) x 3 age group (youngest adults aged 45-54 yrs; middle-aged 55-64 yrs; oldest adults aged 65-74 yrs) between groups ANOVA was conducted to determine if there was a significant interaction between age and activity level for the total number of barriers reported. The main effect of activity level was not significant ($p = 0.51$) while the main effect of age was significant, $F(2,171) = 9.14$, $p < 0.001$. Post hoc tests for the effect of age indicated that the youngest adults reported significantly more barriers ($M = 1.84$, $SD = 0.19$) than the middle

aged group ($M = 1.21$, $SD = 0.15$), $p = 0.009$, and the oldest group ($M = .95$, $SD = 0.15$), $p = 0.001$. Most importantly, there was a significant interaction $F(2, 171) = 6.83$, $p = 0.001$, suggesting that the mean total number of barriers reported may be affected by an interaction between age and amount of physical activity. Post hoc inspection of confidence intervals indicated that the youngest inactive adults reported significantly more barriers in total than all other groups in the analyses (see Figure 1).

Insert Figure 1

Analyses for Specific Barrier Categories

Table 1 displays the descriptive statistics for the number of barriers reported in each of the social ecological barrier categories eligible for the analyses, as a function of age and of activity group. Next, each barrier category was examined specifically to determine if a significant interaction between age and activity level existed among the barrier categories. A two-way (activity group by age group) MANOVA was conducted with the mean number of responses in the three barrier categories serving as dependent variables. Outliers were not removed for these analyses; given the nature of the data, removing outliers would have greatly diminished the depth of responses the researcher was able to include in the analyses. Intuitively, the reporting of numbers of barriers should be positively skewed and our data confirmed this. (Analyses were performed with all data intact, yet supplemental analyses using log transformed data were performed to provide additional reliability to our results. Using variables that were subjected to a \log_{10} transformation to remedy skewness on a within-age group basis (Yockey, 2008), MANOVA results revealed the same findings. Thus, only analyses performed using the original data are discussed herein).

Insert Table 1

The MANOVA results showed the main effect of activity level was not significant, $p = 0.85$, while the main effect for age was significant, $F(6,344) = 4.93$, $p < 0.001$, partial eta squared 0.07. Significant between-subject effects for age were found for the organizational/interpersonal barrier category, $F(2,173) = 10.22$, $p < 0.001$, partial eta squared 0.10, and for the intrapersonal barrier category, $F(2,173) = 5.00$, $p = 0.008$, partial eta squared 0.05. Posthoc pairwise comparisons showed that the youngest adults reported significantly more organizational/interpersonal barriers ($M = 0.47$, $SD = 0.17$) than the middle-aged adults ($M = 0.158$, $SD = 0.15$), $p = 0.002$, and the oldest adults ($M = 0.08$, $SD = 0.15$), $p < 0.001$. Pairwise comparisons also revealed that the youngest adults reported significantly more intrapersonal barriers ($M = 1.47$, $SD = 0.16$) than the oldest adults ($M = 0.823$, $SD = 0.125$), $p = 0.005$. In addition, a significant interaction between age cohort and activity level was revealed, $F(6,344) = 2.43$, $p = 0.026$, partial eta squared 0.04. Significant between-subject effects for the interaction of age and activity level were found at the organizational/interpersonal barrier category, $F(2,173) = 4.51$, $p = 0.012$, partial eta squared 0.05. Visual inspection suggested that the main effect of age is particularly pronounced when examining the younger, less active group (see Figure 2). Examination of 95% confidence intervals indicated that the less active youngest adults reported significantly more barriers, $M = 0.61$, $SD = 0.10$, 95% CI [.40,.82] in the organizational-interpersonal category than the active older group, $M = 0.13$, $SD = 0.13$, 95% CI [.01,.27], the less active middle-aged group, $M = 0.17$, $SD = 0.08$ 95% CI [-.12,.18] and the less active older group, $M = 0.13$, $SD = 0.08$, 95% CI [-.12,.18] (see Figure 2).

Insert Figure 2

Specific Types of Responses within Barrier Categories

Given the significant differences found in the intrapersonal category with regards to age and in the organizational-interpersonal categories with regards to age and the interaction of age and activity level, responses were further examined in a descriptive manner to inspect which types of intrapersonal and organizational-interpersonal responses were experienced most often. Responses that had been coded a total of four or more times across the whole sample were grouped based on common themes and are presented in Tables 2 and 3 as frequencies. Collapsed across the entire sample, 27% of all coded barriers were miscellaneous, in that they did not meet the minimum criteria of occurring four or more times in a coherent theme and could therefore be considered in an ‘other’ category. It is important to note that our inspection of frequencies does not relate to these miscellaneous barriers. The frequencies of intrapersonal responses are presented in Table 2 as a function of age, given the significant differences shown between age cohorts our prior MANOVA. In Table 2, percentages are also included and are representative of just the barrier responses *within* each age category, not including miscellaneous barriers. Similarly, the frequencies of organizational-interpersonal responses are presented in Table 3 as a function of age and physical activity level given the significant interaction shown in this category. Percentages are not included in this table, due to low frequency counts. It is important to note that these analyses are intended to be descriptive only, and should not be considered formal post hoc analyses for prior ANOVA results, due to the large number of miscellaneous barriers that could not be coded into sub-themes.

In the *intrapersonal category* (see table 2), the most frequent common themes reported in response to the open-ended barrier question across the whole sample indicated participants were experiencing a ‘health problem’ (defined as a more chronic health condition) such as ‘arthritis causes too much pain’ or ‘I have an irregular heart beat’, n = 59, or an ‘injury’ (defined as a more short term condition) such as ‘I have a bad back’ or ‘knee pain makes (physical activity) too painful’, n = 39. ‘Lack of time’, n = 38, as well as ‘family commitments’ such as ‘I have to drive the kids to their activities four nights a week’ or ‘I have too much to do taking care of my family’, n = 20, were common themes frequently reported by all age groups. Notably, both health problem and injury themes were reported with greater frequency among the middle-aged group and older age group. However, responses for the ‘family commitments’ barrier theme were more frequent amongst younger adults than the middle-aged or older adults. The other reported themes included ‘fatigue,’ n = 11, ‘other commitments are more important,’ n = 11, ‘lack of motivation,’ n = 9, and ‘care giving responsibilities get in the way,’ n = 5.

Insert Table 2

Across the entire sample, the most frequent common themes coded in the *organizational-interpersonal category* (see table 3) were related to barriers experienced in the workplace, n = 30, and were related to work schedule, for example ‘I work shift work and cannot join any classes or leagues,’ travel, for example ‘I travel too often to join any groups or gyms’ and the workplace facility, for example ‘I am inactive all day at work’ or ‘there is no place to do physical activity at work.’ The less active younger adults cited workplace related barriers often, while the active oldest group and the less active middle-aged and older groups did not. The other barrier

responses included ‘cost,’ $n = 4$, and ‘having no one to participate with,’ $n = 6$. It is important to note that this analysis is provided for descriptive purposes and relates to frequency counts. The MANOVA results are reflective of mean values and because of sample size imbalances within cells, frequency counts are not interpretable in the same manner.

Insert Table 3

Discussion

The study had three main objectives. First, to determine if the total number of barriers reported, irrespective of barrier category, seemed to depend on age cohort (45-54; 55-64; 65-74 yrs), physical activity status (active; less active), or an interaction between age and activity status. It was hypothesized that there would be significant differences in the total number of barriers reported between age groups and activity groups, as well as a significant interaction. Following analyses to classify types of barriers according to the social ecological model, we attempted to determine whether the number of reported barriers in each of the barrier classifications differed between age groups or physical activity groups. It was hypothesized that there would be significant differences in number of reported barriers depending on barrier classification type, as a function of age group and activity group. Third, we aimed to provide a description of specific themes reported within each barrier category according to age groups and activity groups. Results pertaining to each objective are discussed in the following sections.

Group Differences and Interactions for Total Number of Barriers Collapsed Across all Categories

With regards to analyses for the number of barriers irrespective of barrier type, results suggest that age may play a role in the total number of barriers reported. Specifically, our results indicate that the younger adults in our study (45 – 54) reported significantly more barriers than the middle-aged and the older adults. Although research looking at number of barriers reported by cross-sectional age cohorts is limited, previous research seems to support this finding. One study looked at a large sample ($n = 5\,167$) of Canadian adults aged 15-79 yrs, and surveyed participants about barriers to physical activity (Pan et al., 2009). In this survey, barrier items were anchored on a seven point Likert scale, and thus assessed the strength of barriers. However, their results showed that having a higher score for perceived barriers was more likely to be associated with lower physical activity levels in their younger age cohorts (15-24; 25-39; 40-64 yrs) compared to the older group (65-79 yrs). The authors concluded that the influence of perceived barriers was more important for younger people (Pan et al.). While the Pan et al. study did not assess the number of barriers reported by younger adults, it supports the idea that barriers seem to be more of an influence for younger adults. One explanation for this finding could be that younger adults (45 – 54) tend to be busy at this stage of life (i.e., working, taking care of children), whereas older adults may not necessarily be busy with such responsibilities (i.e., more likely to be retired, children no longer at home). Thus, older adults may have more free time and experience barriers to a lesser degree (Pan et al., 2009; Shaw, Liang, Krause, Gallant, & McKeever, 2010), or in our case, fewer barriers.

Moreover, our results suggest that in addition to the effect of age, the total number of barriers reported also seems to depend on an interaction between age and physical activity level. In particular, the youngest, inactive adults reported more barriers than the younger, more active

adults, and the middle-aged and older adults, both active and less active. To our knowledge, this is the first study to use an ANOVA analysis to examine interaction effects of age cohort and physical activity level for barriers to physical activity using an adult population. Previous research tends to include physical activity status and age in the same study (e.g., Booth et al., 2002; Pan et al., 2009), but has not examined the possible interaction of these variables. The interaction between these variables is of importance to consumers of research, to focus intervention efforts on characteristics of different sub-groups. Our results suggest that in particular, it is the inactive group of adults within the younger population that may be experiencing particular difficulties with barriers, and intervention efforts could be tailored to this group.

Group Differences and Interactions for the Number of Barriers among Different Social Ecological Categories

When we examined the number of barriers reported using each social ecological classification, results suggested that the number of barriers reported within categories depends on age. This effect was particularly evident for the intrapersonal category and the organizational-interpersonal category. Specifically, in the intrapersonal category the younger adults reported more barriers than the oldest group of adults. Intrapersonal barriers were those related to individual characteristics, for example, lack of interest, perceived lack of time, lack of motivation or dislike for physical activity. This finding is consistent with previous research using consecutive age cohorts to determine differences in reported barriers based on age. Booth, Bauman, Owen, & Gore (1997) distributed a survey containing items related to physical activity preferences, sources of assistance and perceived barriers to a large, randomly selected sample of insufficiently active Australian adults aged 18 to 78 ($n = 2,298$). Their findings indicated that younger adults (18-39 yrs) reported the intrapersonal barriers of lack of time, lack of motivation

and childcare responsibilities more often than middle aged (40-59 yrs) and older (60+ yrs) adults. Although this study included adults who were younger than the youngest adults in our study (45-54 yrs), the trend whereby certain intrapersonal barriers were reported more frequently at younger adult stages and decreased in frequency at later life stages, is also evident in the current sample.

Our results also indicated that the younger adults reported more barriers classified as organizational-interpersonal barriers than the middle-aged and older adults. Organizational-interpersonal barriers were most often related to the workplace, for example, 'shift work makes it too hard to find activities' or 'travel too often with work,' or 'no opportunity to be active at work.' Less often, they reflected characteristics of a person's social environment, such as 'having no one to participate with.' Thus, it seems that younger adults in the present study are experiencing these types of barriers more often than the middle-age and older adults. This finding has been supported in previous research. Cardenas and colleagues (2009) used a survey to look at the experiences of participants in the North Carolina Seniors Games. The adults in this study (n = 440) were asked about perceived benefits and constraints (barriers) to physical activity. Notably, their questionnaire was anchored on a Likert scale, whereas our study used open-ended questions. The younger group of adults in the Cardenas et al. Study (55 - 64 yrs) reported more community related and social related constraints than the older group of adults (65+ yrs). The community related constraints were to some extent similar to barriers we classified as 'organizational.' For example, their barrier 'lack of equipment' would have been classified in the present study as a characteristic of a particular organization (e.g., fitness centre) not having adequate equipment. Also, some of the items comprising Cardenas et al.'s social related constraints, such as 'lack of company', were similar to barriers that were categorized as 'interpersonal' in our study. Overall, our finding that younger adults tended to report more

organizational-interpersonal barriers is similar to findings reported by Cardenas et al., despite the use of different survey methodologies.

In addition to the effect of age alone, our results indicated that the number of barriers reported within the organizational-interpersonal category appeared to depend on an interaction between age and physical activity level. Specifically, the main effect of age becomes particularly pronounced when we inspect the less active groups. One explanation for this finding could be that our younger adults (45-54 yrs) were likely to still be working, and thus were more likely to report barriers related to the workplace, especially the less active group. On the other hand, our middle-aged group (55-64 yrs) and older group (65-74 yrs) were more likely to be at an age typical of retirement and may not experience barriers involving a workplace. Consequently, aspects of the workplace may serve as important barriers for younger adults. It may be that working creates a time burden, or the workplaces of these younger, less active adults do not offer or promote opportunities to be active in that organization. Another explanation of these results could be that experiences within the workplace evolve as adults' progress from the younger age group to the middle and older age group, and their experiences during the younger stage serve as barriers. For example, adults in the 45 – 54 age group may be gaining experience in their career, striving for promotion, or even changing careers, which causes elevated stress related to their professional life, whereas middle-aged (55 – 64) adults may feel more settled in their career and in their workplace as they approach retirement.

Another possible explanation for this interaction effect could be related to social norms. It may be that younger adults feel as though they *should* be exercising, because of recent efforts to promote physical activity among adults. The older adults may not feel the same pressure to exercise because physical activity was not promoted or encouraged in the same manner during their younger adulthood, and they may feel like physical activity guidelines do not apply to them

because of their age. As a result, younger, less active adults may generate more barriers in our open-ended task because they have had to find a way to answer to these social pressures in the past and have answers readily available, whereas our older group may not be as well prepared in thinking about reasons not to exercise because they do not feel as though the expectations to exercise apply to them.

With respect to the social environment's role in the interaction effect for organizational-interpersonal barriers, our results suggest that younger, less active adults may benefit from efforts to alleviate barriers such as 'having no one to participate with.' It is possible that these types of barriers interact with each other. For example, our younger less active group may be experiencing difficulties because of barriers that relate to their workplace and their social environment, such as a lack of opportunity to be active with co-workers because of inadequate opportunities provided at the workplace. Future research could examine the possibility of creating opportunities for younger, less active adults in the workplace to be active with other co-workers, a strategy which encompasses both the organizational and interpersonal types of barriers.

Describing Barrier Themes within Categories

In addition to the multivariate analyses, our study methodology afforded us the opportunity to describe specific barrier themes our participants reported experiencing within categories. We were particularly interested in describing the various themes in the intrapersonal and organizational-interpersonal categories, as these categories showed significant differences between age groups as well as significant interaction effects. By looking at the responses within these categories we can understand group differences in the types of barriers reported not only at the broad level of each category, but more specifically by seeing common themes *within* each category.

Overall, responses in the intrapersonal category were most often related to one of three themes. First, adults reported having an injury, for example ‘back injury’ or ‘sore joints,’ that prevented involvement in physical activity. Second, participants often reported having a health problem, for example, ‘pain from arthritis’ or ‘heart condition,’ that prevented involvement in physical activity. Thirdly, the barrier ‘lack of time’ was also cited frequently, and this finding was consistent across all age groups. However, we were particularly interested in inspecting how the frequency of these themes were a function of age group, because of the significant main effect of age shown in the MANOVA. Results showed that when looking at responses as a function of age, injury and health problems were commonly experienced by the middle-aged group and the older groups, not the younger group. On the contrary, the most common barrier cited by the younger age group, which was not commonly experienced as an intrapersonal barrier for the two elder groups, was related to the theme of family commitments. For example, participants reported a ‘lack of time due to family commitments,’ that they were ‘too busy driving the kids to their activities,’ or that they ‘have a parent who is in a seniors home and need to visit 3 to 4 days per week’, leaving no time for one’s own physical activity. Overall, our results suggested that intrapersonal types of barriers tended to revolve around injuries and health problems for adults aged 55-64 and 65-74, while adults aged 45-54 seem to experience barriers related to family commitments most often. Similar trends have been found in previous research (e.g., Booth et al., 1997). Booth and colleagues used a survey containing a list of barriers provided by the researchers. Participants were required to rate items according to the frequency in which they encountered each barrier provided. They found that having an injury was reported by only 20% of their younger age cohort (18-39 yrs) and 40% of their older age cohort (60+ yrs). Similarly, they found that 27% of the oldest group reported having poor health as a barrier, while only 10% of the two younger age cohorts (18-39; 40-59 yrs) reported this barrier. Further, 33%

of their younger age cohort reported 'children' as barrier, which is similar to our theme of 'family commitments,' while only 20% of their older group reported this barrier. Overall, our findings in the intrapersonal category are similar to Booth et al. (1997) and this parallel is particularly important because the same trends emerge despite the use of two different survey methodologies.

Next, in the organizational-interpersonal category, three common themes were reported most frequently across all participants. The most common barriers in this category were related to a workplace theme. Barriers such as 'I travel too much with work,' 'shift work prevents me from joining activities' were common, which reflect difficulties with work schedules. There were also barriers such as 'no facilities at work,' and 'nowhere to shower at work,' which reflect characteristics of the workplace that may be making it difficult for one to plan to do physical activity. Trends indicated that the younger adults and middle-aged adults reported these types of barriers most often, which is expected because the older age group is more likely to be retired and therefore less likely to experience barriers related to the workplace. With regards to activity groups, it seems that both active and inactive younger adults tend to describe the same common workplace-related barriers with similar frequency. The other barriers in the organizational-interpersonal category were related to the themes of 'cost' and 'having no one to participate with.' These barriers, such as 'membership to fitness club is too expensive,' 'costs too much to join league' and 'I don't know anyone who will go with me' were reported only by active adults. Thus, in our sample it seems as though these barriers were acknowledged as things making it difficult to participate, but may not be actually preventing involvement for our sample. Previous research has suggested that cost is particularly problematic for younger adults compared to older adults (Booth et al., 1997; 2002). In our study, cost did not seem to be more frequently reported by the younger adults; however it was still acknowledged as a common barrier. Giles-Corti and

Donovan (2002) studied aspects of the social environment, including the influence of ‘participating with others’ and using odds ratios, they determined that having one person to participate with resulted in being 75% more likely to participate in physical activity compared to having no one, and having two people resulted in being more than two times more likely to participate in physical activity compared to having no one. Our study supports this finding, since participants acknowledged that having no one to participate with was something that was making it more difficult for them to participate.

Overall, the most common barriers reported within the intrapersonal category included injury, health problems, family commitments and lack of time. In the organizational-interpersonal category the most common responses were related to the workplace, and the other responses included cost and having no one to participate with. These findings offer a deeper understanding of group differences found in the statistical analyses, and also provide support for previous research that has shown similar results using a different methodology.

Limitations and Future Directions

Our study was the first to use open-ended questions to study barriers quantitatively in an adult population and provides interesting and unique results. Open-ended questions are particularly advantageous for studying barriers in a specific population, because of the assurance that all responses are relevant to participants and the responses generated pertain to the population of interest which may be different from generic barriers that would be afforded with a researcher-provided list. While using open-ended questions is a methodology that has been advocated by previous researchers (Gyruscik et al., 2006; 2009), there are still associated limitations.

This methodology does not allow us to infer the frequency with which the barrier is experienced by individual people, or the extent to which the barrier is limiting for the individual.

To further explain this, our results suggested that the younger adults experienced the most barriers in total; however, our younger adults were also the most active of the groups, according to mean scores in the GLTEQ. Thus, it is possible that our younger adults are acknowledging the most barriers, but these barriers may not actually be preventing their participation. An important addition to this methodology would have been to assess not only the barrier, but also the number of times the barrier is experienced (e.g., frequency per week) and the extent the barrier limits their participation (e.g., rated on a Likert scale) (Gyruscik et al., 2009). This approach would allow researchers to understand the types of barriers that are experienced, the barriers that are causing the most difficulty, and also could provide the possibility to examine coping mechanisms for barriers that are not shown to be very limiting (Gyruscik et al.).

Next, our open-ended question methodology afforded us the opportunity to use each of the six categories in the social ecological model. However, since we were not in control of the responses that were generated, we were unable to include the public policy or community levels of influence in our analyses because no responses were able to be coded in these categories. Therefore, although the methodology did not exclude these categories, participants were not identifying these types of barriers. It is possible that participants are unaware of public policy related barriers and community related barriers that may affect their physical activity experience, and thus they are not identified using open-ended questions. Perhaps individuals do not report these barriers via open-ended questions because these types of barriers act at a broad level; the effect of these barriers is not as obvious to a person because they are not experiencing them in a direct manner. Future research could consider studying these types of influences using qualitative research, such as focus groups. Focus groups have been used in the past to study barriers, and have generated important information about barriers specific to the population of interest (Lees et al., 2005). This would allow participants to think about policy and community

influences and discuss them with respect to their awareness of such influences and their opinion as to whether they are personally relevant.

Third, our methodology required barriers to be categorized into one level of the model. However, recent discussions of social ecological theory highlight the importance of interactions between types of influences for physical activity (Sallis et al., 2006). For example, the barrier of lack of time (intrapersonal barrier) could be related to distance of facilities (environmental barrier) in an interactive fashion, or being busy with caregiving responsibilities (interpersonal barrier) might interact with not making physical activity a priority (intrapersonal barrier). Therefore, it would be advantageous to use a methodology in future research that allows to the possibility for barriers to be considered interactive between categories, rather than viewing them as exclusive to one category, such as the use of focus groups.

In this study, gender differences were not examined. However, previous research has shown that this is an important consideration because physical activity participation levels, health issues and social factors affecting physical activity differ for men and women (Shaw et al., 2010), and future research using this methodology could consider gender as an additional between-group independent variable.

Finally, our survey provided participants with a definition of 'barrier' which served as the basis for their open-ended responses. Providing a specific definition ensures participants respond to open-ended questions with a common interpretation of the term. This has been used in previous research (Gyruscik et al., 2006), however one addition to the methodology that may have been helpful is the use of screening questions as inclusionary/exclusionary criteria for our sample. In our study, participants were required to answer two questions prior to reading the barrier definition. We used these questions as 'priming' questions, however, they could have also been used to determine the extent to which an individual was experiencing barriers. For example,

if a participant answered 'yes' to the first question about experiencing difficulties being physically active, and 'no' to the question about being satisfied with the amount of physical activity they were currently participating in, it would provide the researchers with a better understanding of difficulty they were having being physically active and would allow researchers to group participants based on having similar experiences.

Conclusion

This study examined the types of barriers to physical activity reported by middle-aged and older adults, using a social ecological model to classify barrier types. Results indicated that the younger adults reported more barriers in total than the middle-aged and older groups, and specifically, the younger, less active adults reported more barriers than all other adults. With respect to differences in types of barriers, our results suggested that younger adults report more intrapersonal barriers than the middle-aged and older adults, and younger, less active adults report more organizational-interpersonal barriers than the middle-aged less active group, and both active and less active older adults. Finally, specific barrier types were described for the intrapersonal and organizational-interpersonal reported barriers. Intrapersonal barriers reported by younger adults related to family commitments, while barriers reported by middle-aged and older adults related to injury and having a health problem. Organizational-interpersonal barriers reported across the whole sample tended to relate to the workplace.

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Table 1

Descriptive Statistics for Barrier Categories used in Multivariate Analyses

<u>Barrier Category</u>	<u>Age Cohort</u>									<u>Activity Level</u>					
	<u>45-54</u>			<u>55-64</u>			<u>65-74</u>			<u>Active</u>			<u>Less Active</u>		
	<u>M</u>	<u>SD</u>	<u>R</u>	<u>M</u>	<u>SD</u>	<u>R</u>	<u>M</u>	<u>SD</u>	<u>R</u>	<u>M</u>	<u>SD</u>	<u>R</u>	<u>M</u>	<u>SD</u>	<u>R</u>
Intrapersonal	1.42	1.30	5	1.04	1.03	5	.84	.86	3	1.07	1.04	5	1.02	1.05	5
Interpersonal	-			-			.03	.16	1	.02	.14	1	-		
Organizational	.44	.50	1	.16	.50	3	.09	.37	2	.22	.53	3	.16	.36	1
Physical Environment	.19	.54	3	.12	.40	2	.13	.40	2	.14	.41	2	.15	.46	3

Note. R = range

Table 2

Frequencies and Percentages of Barrier Responses coded in Intrapersonal Category as a function of age

<u>Barrier Response</u>	<u>Age 45-54</u>	<u>Age 55-64</u>	<u>Age 65-74</u>
Family commitments take up too much time	14 (24.5%)	4 (5%)	2(4%)
Health problem prevents or limits participation	7 (12%)	35 (45%)	17 (30%)
Injury prevents/ limits participation	5 (9%)	16 (20%)	18 (31%)
Lack of time	14 (24.5%)	12 (15%)	12 (21%)
Fatigue	7 (12%)	4 (5%)	0
Lack of motivation	2 (3%)	4 (5%)	3 (5%)
Other commitments are more important	5 (9%)	1 (2%)	5 (9%)
Care giving responsibilities get in the way	3 (5%)	2 (3%)	0

Note. Frequency counts are presented for barriers reported a minimum of four times across the entire sample and do not include miscellaneous barriers.

Table 3

Frequencies of Barrier Responses coded in Organizational-Interpersonal Category as a function of age and physical activity level

<u>Barrier Response</u>	<u>Active Adults</u>			<u>Inactive Adults</u>		
	<u>45-54</u>	<u>55-64</u>	<u>65-74</u>	<u>45-54</u>	<u>55-64</u>	<u>65-74</u>
Cost	0	3	1	0	0	0
Workplace related barriers	8	8	1	10	2	1
No one to participate with	1	3	2	0	0	0

Note. Frequency counts are presented for barriers reported a minimum of four times across the entire sample and do not include miscellaneous responses.

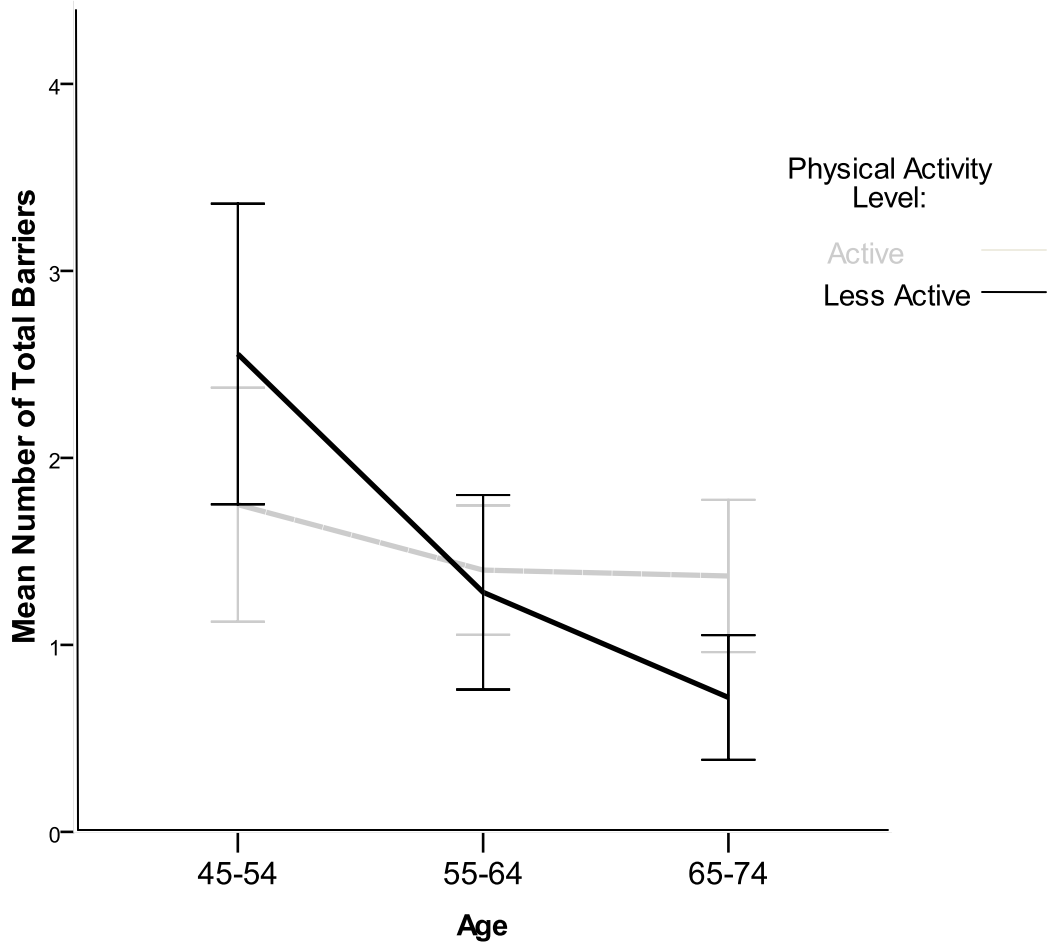


Figure 1. Interaction effect of age cohort and physical activity level for the total number of barriers reported by participants. Error bars represent 95% confidence intervals.

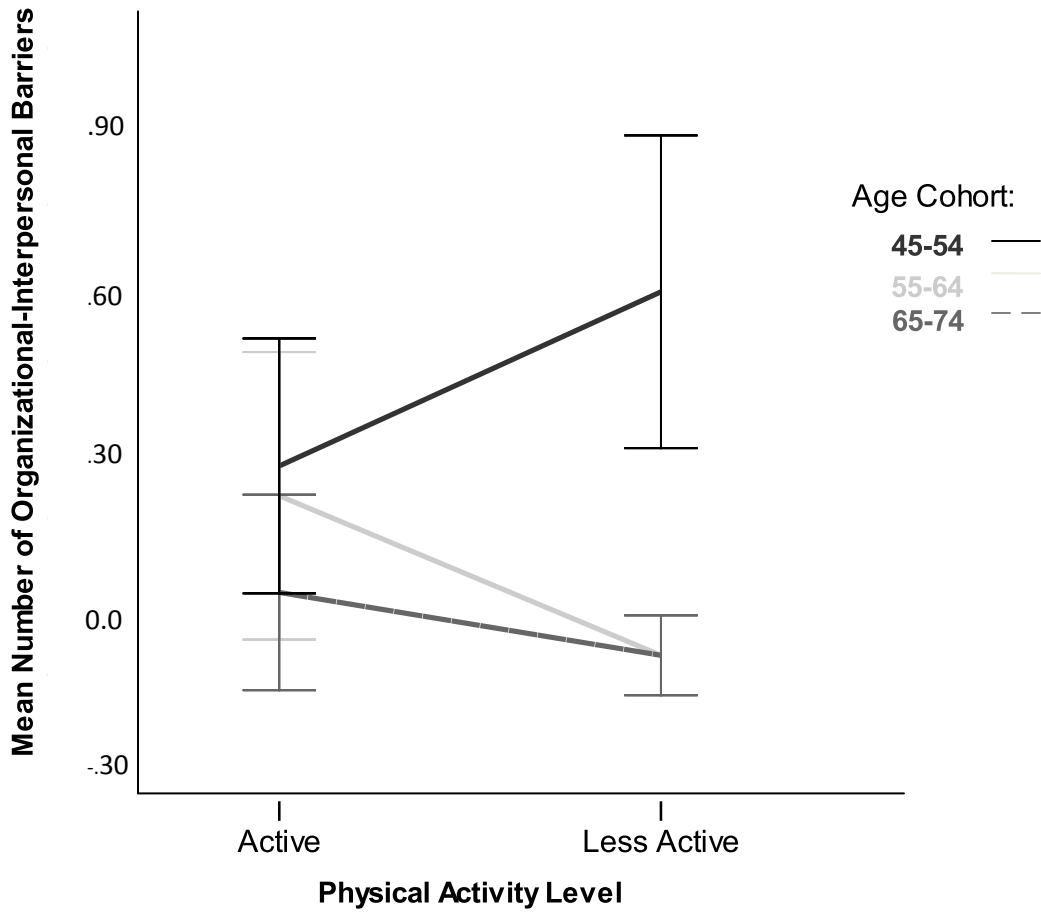


Figure 2. Interaction of age and physical activity level for the mean number of organizational-interpersonal barriers. Error bars represent 95% confidence intervals.

Differences in Perceived Strength of Barriers to Physical Activity in Middle-aged and Older
Adults According to Age and Physical Activity Status: A Social Ecological Perspective

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Abstract

Identifying barriers to physical activity using a social ecological framework has been suggested as a valuable approach because multiple levels of influence including, but not limited to the individual can be considered (Sallis et al., 2006). This study used a social ecological framework (Giles-Corti & Donovan, 2002) to examine barriers to physical activity in adults in three broad ecological categories: intrapersonal, interpersonal and the physical environment. 116 participants (59% female, 41% male) completed surveys assessing weekly physical activity (Godin & Shephard, 1985) and reported strength of barriers (the extent to which a barrier was limiting for them) to physical activity. The survey included items pertaining to each ecological category, and analyses to identify valid and reliable sub-factors within each barrier category were also performed. A MANOVA revealed a significant main effect of physical activity level, $F(3, 56) = 11.22, p < .001$, where less active adults reported barriers more strongly than active adults in the intrapersonal, $F(1,64) = 29.5, p < .001$, interpersonal, $p < .001$, and physical environment categories, $p = 0.03$. In terms of variables representing barrier sub-factors, separate between-groups ANOVAs examined age group (45-54; 55-64; 65-74 yrs) and activity group (active; less active) differences. Less active adults reported stronger perceptions of barriers related to 'self-efficacy and motivation,' 'attitude toward physical activity,' 'spouse,' 'family members,' 'neighbourhood characteristics,' and 'opportunities near home' (all $ps < .02$). The oldest age group reported stronger barriers related to 'co-workers' compared to the middle-aged group, and the youngest age group reported a greater influence of barriers related to 'opportunities near work' compared to the oldest group (both $ps < .04$). In the current sample differences in barrier strength across and within ecological categories appear to depend on physical activity status more often than on age group status or interactions between physical activity and age.

Keywords: social ecological model, physical activity, barriers, adults

Differences in Perceived Strength of Barriers to Physical Activity in Middle-aged and Older Adults According to Age and Physical Activity Status: A Social Ecological Perspective

Physical activity has become widely accepted as a means to maintain health and lower the risk of chronic disease with advancing age (Chodzko-Jaiko et al., 2009; Vogel, Brechat, Lepretre, Bethel, Lonsdorfer, 2009). In addition, physical activity has been suggested as a treatment and management technique for older people battling depression and anxiety (Chodzko-Jaiko et al.; Goggin & Morrow, 2001). Even though the positive reasons to engage in physical activity have been well documented, current data suggests almost 50 percent of middle aged (35-55 yrs) and older adults (55+ yrs) are inactive (Statistics Canada, 2006). Data pertaining to younger populations (e.g., 20-34 yrs) suggests more favourable physical activity levels, as only 44 % of this age group was considered inactive (Statistics Canada). Therefore, middle-aged and older adults tend to be the most inactive proportions of the population, and these adults may be missing the important health benefits that physical activity and exercise can provide. Given the low levels of physical activity participation among the adult population and the potential for health benefits, it is important to understand the factors that influence the decision to engage or not engage in physical activity. If the reasons for the low participation rates among adults were better understood, interventions and public health messages to improve activity levels could be designed more effectively (Sallis et al., 2006).

Previous research related to insufficient physical activity levels in aging populations often refers to factors that impede participation as barriers, and assumes that identifying and eliminating these barriers will increase participation (Booth, Bauman & Owen, 2002). A number of studies examining perceived barriers to physical activity (e.g., Booth et al., 1997; 2002; Booth, Owen, Bauman, Clavisi, & Leslie, 2000; Hardy & Grogan, 2009; O'Neill & Reid, 1991)

have been important for advancing knowledge, however, much of the research has focused on barriers at the level of the individual, such as attitude, motivation or self-efficacy. These individual barriers are psychological in nature, and prevent or make it difficult for one to engage in physical activity (Gyrucsik, Spink, Bray, Chad, & Kwan, 2006; O'Neill & Reid). While the individual influences are important, physical activity is also influenced by the context in which the behaviour may or may not occur (Sallis & Owen, 1999). The context includes social and physical environmental factors, which have sometimes been overlooked in previous studies (Giles-Corti & Donovan, 2002).

Social ecological models may be particularly valuable to the study of barriers to physical activity; the individual is considered, but these models emphasize the environment and the person-environment interaction (Bauer et al., 2003). Individual, or intrapersonal, determinants include characteristics of the individual, such as their attitude and self-efficacy for the behaviour. Interpersonal influences include a person's social environment, for example social support or modelling (Giles-Corti & Donovan, 2002). A third level of influence is the physical environment, which specifies the characteristics of the constructed/built environment that affect participation in physical activity, such as geographic accessibility and availability of facilities (Sallis & Owen, 1999). It is important to consider the collective influence of these levels because they all contribute to the context for physical activity, as specified by social ecological models (Stokols, 1996).

The effectiveness of social ecological models has been demonstrated in previous health research, particularly in efforts to decrease smoking rates (Sallis, Owen, & Fischer, 2008). Interventions targeting multiple levels of influence have been credited with the decline in this problematic behaviour (Sallis et al., 2008). Similarly, physical inactivity is a major health concern, and interventions should be designed based on research that has examined multiple

levels of influence on behaviour. Thus, the need for a study examining influences of physical activity at multiple levels for the most inactive segment of our population becomes apparent.

This study will address this need by examining perceived barriers to physical activity for middle-aged and older adults considering intrapersonal, interpersonal and environmental influences as suggested by social ecological theory (Giles-Corti & Donovan, 2002; Stokols, 1996).

In addition to examining the nature of barriers towards physical activity as they relate to levels of influence in the ecological model, the study will further consider how barriers vary as a function of an adult's current physical activity level and age. Research has shown that an adult who incorporates physical activity into their lifestyle regularly is likely to report different barriers than an adult who is more sedentary (Booth et al., 2000; 2002; Lees, Clark, Nigg, & Newman, 2005). Therefore, consumers of this research will benefit from understanding barrier differences between adults who are less active and those who are already active. From this research, interventions to target inactive adults would incorporate different strategies than one designed to reach out to adults who are already involved. With respect to age, much of the information about adults' perceived barriers to physical activity has been gathered from singular samples of adults, for example samples where all adults are aged 55 and over (Cardenas, Henderson & Wilson, 2009; O'Neill & Reid, 1991; Smith & Storandt, 1997) or samples where all adults are aged 60 and over (Lees et al., 2005). Fewer studies have considered how barriers may change as a function of age. It is important to understand if barriers are reported similarly or of differing strength between less active and more active adults, and whether these differences are the same or different as adults progress through consecutive life stages (Shaw, Liang, Krause, Gallant, & McKeever., 2010). It has been suggested that examining barriers and how they change across age groups can provide more in depth understanding of how interventions can be structured and utilized most effectively (Booth et al., 1997; 2002). Cross-sectional research using

consecutive age cohorts in the same study would be an effective way to determine whether certain barriers are reported at different strengths by adults at different life stages. In addition to examining activity level and age as separate variables, it is also important to examine the possibility of an interaction effect between these two variables. From an applied perspective, information about age and activity level interactions could help tailor intervention efforts among adults more effectively.

Overall, this study used a social ecological approach to examine middle aged and older adults' perceived barriers to physical activity, and examined possible differences in the strength of barriers reported across various barrier categories by adults who are active and less active, and across three age cohorts: 45-54, 55-64, 65-74. These age cohorts allow us to examine potential differences in the strength of different types of barriers for adults at different life stages, beginning with middle-aged adults and extending to older adults. More specifically, this study had three main purposes. First, it attempted to determine the relative strength of intrapersonal, interpersonal and physical environment barriers to physical activity perceived by adults, and to determine if the relative importance of these categories changes as a function of age and activity level. 'Barrier strength' refers to the extent to which a barrier statement is acknowledged as limiting for participants. Second, it aimed to validate barrier items pertaining to each of the three levels of influence in the social ecological model that could subsequently be employed in multivariate analyses. Since recent literature outlines the need for information regarding the reliability and validity of instruments attempting to measure intrapersonal, interpersonal and environmental factors for physical activity (Burton, Oldenburg, Sallis, & Turrell, 2007), we attempted to examine the validity of all barrier categories submitted to further multivariate analyses in our study. Third, it examined potential age cohort and activity level group differences in the strength of barriers pertaining to specific themes or sub-categories of barriers within each

of the broader intrapersonal, interpersonal and physical environment categories and to determine if a significant interaction between age group and activity level exists. The emerging valid and reliable themes within each of the broad categories are referred to as barrier ‘sub-factors’ in the remainder of the study. Given these purposes, three overarching research questions directed the study. First, which broad ecological category of barriers would be most salient for middle-aged and older adults, and would there be differences in the strength of barriers reported across each category as a function of age and activity level? We hypothesized that the intrapersonal barrier category would show the strongest influence relative to the other categories (Giles-Corti & Donovan, 2002), and there would be significant differences in barrier strength between age groups and activity groups. Second, are there valid and reliable sub-factors that emerge within the broader intrapersonal, interpersonal and physical environment categories examined using our questionnaire? We posited that there would be emergent sub-factors within the broader categories. Third, would there be age group or activity group differences in the strength of barriers perceived by middle-aged and older adults with regards to possible emergent sub-factors *within* each ecological category? We hypothesized that there would be significant differences in barrier strength within ecological categories between age and activity groups. Due to a lack of previous research using multivariate analyses to examine an interaction between age and physical activity, no hypothesis was developed for this part of the study and it can be considered exploratory.

Methods

Procedures and Design

After obtaining approval for this cross-sectional study from the University of Ottawa’s Office of Research Ethics and Integrity, participants were recruited at nine community organizations and social events tailored toward middle-aged and older adults in Ontario (e.g.,

Canada 55+ Games, mall walking group, older adults recreational hockey league, Lions Club, bingo organization). A representative from each organization was contacted and asked to read and sign a letter of permission before participants were invited to take part in the study. After obtaining organizational permission, participants were contacted in one of two ways. Firstly, interested participants provided their email address to the researcher which was then used to send a secure link to an online survey. Secondly, a link to the survey was created and letters containing this link were sent via postal mail, after obtaining permission from the organization to utilize mailing addresses. After reading this letter, interested participants could access the online survey using the link provided. Participants who accessed the survey were required to read a letter of information and indicate informed consent before beginning. Participants were informed via the letter of information of the requirement to be between the ages of 45 and 74 to complete the questionnaire.

Participants

In total, 116 participants completed the online questionnaire (58% female, 42% male). Participants were divided into the following three age cohorts for the purposes of the statistical analyses: younger cohort aged 45-54 (n=24), middle-aged 55-64 (n=55), older age cohort aged 65-74 (n=37) yrs. Overall, the goal of participant recruitment was to obtain a sample that would span a range of physical activity levels, from inactive to very active. Approximately 36% of the sample was recruited at a senior's athletic event, another 23% were considered masters athletes and members of a structured sporting community, and 41% of the sample was recruited from community organizations that were relatively unstructured and not necessarily related to physical activity (e.g., bingo, workplace).

Survey Instruments

The online questionnaire comprised two instruments. Firstly, participants completed the Godin Leisure Time Exercise Questionnaire (Godin & Shepherd, 1985) to measure leisure time physical activity during a typical seven day period. Secondly, participants completed a questionnaire assessing relative barrier strength of items reflecting themes from the three social ecological categories of barriers.

Godin Leisure Time Exercise Questionnaire (GLTEQ). Participants completed the GLTEQ, a self-report measure of physical activity. This questionnaire requires participants to consider a typical seven day period, and report the amount (number of times) and types (mild, moderate or strenuous) of physical activity they participate in. For the purposes of our study, a metabolic equivalents (METS) score was obtained for each participant by multiplying the amount of moderate and strenuous types by an assigned MET value, and then obtaining the sum for these two categories. A score of 24 METS or above is recommended as the point at which a person should be considered active enough to meet recommended public health guidelines (G.Godin, personal communication, September 3, 2010). Therefore, 24 METS was the value used to assign participants an 'active' (24 METS or above) or 'less active' (below 24 METS) physical activity status. Suitable reliability and validity for this questionnaire has been demonstrated in previous studies (Godin, Jobin & Bouillon, 1986; Godin & Shephard, 1985; Jacobs, Ainsworth, Hartman, & Leon, 1993).

Barrier strength questionnaire. This questionnaire contained 72 items in total and was divided according to three barrier categories which are traditionally the most dominant levels in the social ecological model: interpersonal, intrapersonal and physical environment. Barrier items belonged to one of these three categories. The items in the questionnaire were set to a common 5-point Likert scale (value of 1 being 'not at all true for me' and a value of 5 being 'very true for

me'), with lower scores reflecting participants' acknowledgment of greater barrier strength. (In some cases due to the wording of statements, items had to be reverse scored to ensure that low scores always reflected greater barrier strength.) Since all items were anchored on the same scale, the scores could be compared across categories in subsequent multivariate analyses, which is a methodological strength that has not been realized in prior studies using an ecological approach to study physical activity in middle-aged and older adults. Notably, one item in the questionnaire asked participants about their intention to exercise ('It is likely that I will be trying to do a regular exercise routine in the next two weeks'). This item was included because intention to exercise has been discussed as a way to differentiate real barriers from excuses or reasons (Brawley, Martin, & Gyurcsik, 1998). Identifying and measuring actual barriers is important for intervention efforts with people who desire to be more active but are experiencing these impediments (Brawley, et al.).

This questionnaire was compiled for the present study, yet all items were borrowed or adapted from previous research. With respect to the intrapersonal category, items were based on those used by Giles-Corti and Donovan (2002), and Booth et al., (2000, 2002) and related to attitudes toward physical activity, frequency of trying a physical activity program, perceived behavioural control, behavioural skills, intentions, and perceptions of time, cost and injury. In the interpersonal category, items were based on those used by Giles-Corti and Donovan (2002) and Sallis, Grossman, Pinski, Patterson, and Nader (1987), and measured subjective norms, modelling, participation with others, club membership and social support. Finally, the items in the physical environment category were based on the information provided by Humpel, Owen, and Leslie (2002) and considered perceptions of neighbourhood safety, accessibility of natural and built facilities, opportunities near home and near work to be physically active and proximity

of natural and built facilities. More details on the exact items retained for analyses in each category are provided following factor analyses in Tables 1, 2, and 3.

Preliminary Analyses

Preliminary descriptive statistics were first performed to inspect the physical activity levels of the sample. The overall mean score in METS on the GLTEQ was 40.4 ($SD = 19.8$). The mean score for the active group was 49.5 ($SD = 15.6$, range = 23.0 – 155.0) while the mean score for the less active group was 21.0 ($SD = 14.1$, range = 0.0 – 78.0). With respect to age group, the mean GLTEQ scores were 36.6 ($SD = 15.91$), 43.3 ($SD = 21.09$) and 38.8 ($SD = 20.17$) for the younger, middle-aged and older groups, respectively. A one way ANOVA showed no significant differences between age groups with respect to mean values in METS ($p = 0.456$), thus physical activity in our sample did not reflect the typical decrease in physical activity associated with increasing age (Troost, Owen, Bauman, Sallis, & Brown, 2002). The sample was also examined for overall intention to exercise. Overall, 96 participants answered the intention item with a score of 3 or higher and were considered to have moderate to high intention to exercise (analyses were conducted using only these participants with moderate to high intentions, and these results were congruent with the results using the full sample, thus, full sample results are discussed herein). Overall, the descriptive statistics indicate that on average, the sample was sufficiently active to achieve health benefits outlined by public health guidelines and also tends to have the intention to participate in exercise and physical activity. In preparation for subsequent analyses, outliers for scores on the GLTEQ were examined and removed if the value exceeded 2.5 standard deviations from the mean, on a within group basis.

Overview of Data Analyses

First, we used a multivariate analysis of variance (MANOVA) to determine how physical activity and age groups differed in terms of relative barrier strength across the three ecological categories. In order to obtain a composite variable for each of the intrapersonal, interpersonal and physical environment categories, three separate forced one factor solutions were conducted to determine the valid constituent items that should be retained; the composite variables served as dependent variables in the MANOVA, the between-group independent variables were age cohort and activity level. Second, we attempted to determine if there were reliable and valid sub-factors within each broad ecological category. Using the original items, three separate factor analyses were conducted within each of the broader ecological categories to reveal emergent sub-factors. Internal consistency for each sub-factor was examined using Cronbach's alpha. Lastly, to determine if there were activity group or age group differences in the strength of barriers reported for sub-factors within each broad ecological category, and to determine if there were significant interactions between age and activity level, we conducted a series of separate mixed ANOVAs. For each ANOVA, the first between-group independent variable was age group and the second between-group independent variable was activity level, and the dependent variable represented reported barrier strength on each sub-factor.

Results

Analyses for Relative Barrier Strength across Three Categories

We planned to use a MANOVA to determine group differences in the relative strength of each of the three barrier categories: intrapersonal, interpersonal, physical environment. In preparation for the MANOVA, a composite variable for each ecological category was first obtained by conducting three separate exploratory factor analyses with forced one factor solutions. Items with factor loadings below 0.40 were removed using an iterative approach, until

all remaining items had loadings of .40 or greater. For the *intrapersonal* category, 22 items were submitted to the factor analysis, 6 items were removed using an iterative approach with insufficient factor loadings, leaving 16 items with loadings of 0.40 or greater. The total variance explained by the final factor solution was 42 %. The internal consistency of these 16 items was assessed using Cronbach's alpha and was shown to be high, $\alpha = .90$. For the *interpersonal* category, 28 items were submitted to the factor analysis, 9 were removed with factor loadings below .40 using an iterative approach, leaving 19 items. The total variance explained by the final factor solution was 32 %. Internal consistency for these 19 items was assessed using Cronbach's alpha and was shown to be high, $\alpha = .87$. Lastly, there were 21 items in the *physical environment* category submitted to the factor analysis, 5 were removed using an iterative approach, leaving 16 items with factor loadings of .40 or greater. The total variance explained by the final factor solution was 45 %. Internal consistency for these 16 items was shown to be high, $\alpha = .90$. Next, a composite variable for each ecological category was calculated using the items with sufficient factor loadings and internal consistency. The composite variables for the intrapersonal, interpersonal and physical environment categories served as the dependent variables in the following MANOVA. The independent variables were activity group (active, less active) and age group (45-54; 55-64; 65-74 yrs).

Descriptive results obtained from the MANOVA showed grand marginal means which indicated that collapsed across the entire sample, participants judged interpersonal barriers, $M = 2.9$, 95% CIs [2.7, 3.1], as significantly more constraining than both intrapersonal, $M = 3.6$, 95% CIs [3.4, 3.8], and physical environment barriers, $M = 3.5$, 95% CIs [3.2, 3.7]. The MANOVA results showed the main effect of age group was not significant, $p = 0.50$, while the multivariate main effect for activity level was significant, $F(3, 56) = 11.22$, $p < .001$, partial eta squared = 0.37. A significant between-subject effect for activity level was found for the intrapersonal

category, $F(1,64) = 29.51, p < .001$, partial eta squared = .33. Posthoc pairwise comparisons showed that less active adults ($M = 3.05, SE = .17$) reported a significantly stronger perception of barriers to physical activity related to the intrapersonal category than active adults ($M = 4.16, SE = .11$), $p < .001$. Similarly, a significant between-subject effect for activity level was found for interpersonal $F(1,64) = 15.31, p < .001$, partial eta squared .20. Post hoc comparisons revealed that the less active adults ($M = 2.54, SE = .16$) reported a significantly stronger perception of interpersonal types of barriers than the more active adults ($M = 3.31, SE = .11$), $p < .001$. Finally, results also showed a significant between-subject effect for activity level with respect to the physical environment barrier category, $F(1,64) = 4.48, p = 0.03$, partial eta squared = .07. Specifically, the less active adults ($M = 3.26, SE = .19$) reported a significantly stronger perception of barriers related to the physical environment than the more active adults ($M = 3.75, SE = .13$), $p = .03$. Lastly, the MANOVA revealed no significant interactions between age group and activity group, $F(6, 114) = .75, p = .60$.

Within-Barrier Category Factor Analyses

Next, three separate exploratory factor analyses were conducted for each of the ecological categories included in the questionnaire: intrapersonal, interpersonal and physical environment. These analyses were necessary to examine the validity of this questionnaire and to determine which emergent sub-factors existed within each of these broad categories. Reliability analyses were then conducted for items loading on each emergent factor to ensure items comprising the composite variables had strong internal consistency. Together, the exploratory factor analyses and reliability analyses were necessary to derive reliable and valid composite scores representing barrier variables that could be used in subsequent multivariate analyses.

Intrapersonal factor analysis. An exploratory factor analysis was conducted on the 23 intrapersonal items included in the questionnaire. The Kaiser-Meyer-Olkin measure of sampling

adequacy was 0.71, above the recommended level of 0.60, and the Bartlett's test of sphericity was significant, $\chi^2(66) = 538.9, p < 0.05$. Communalities were all above 0.52, demonstrating that each item shares some common variance with other items. The principle component extraction method was used and an eigenvalue of 1 or greater was required for each factor. The initial solution produced six factors; using varimax rotation, an iterative process was used to remove items using two criteria; first, items with a primary loading of less than 0.5 were removed and second, items for which the difference between the primary loading and the cross loading was less than 0.2 were removed. In total, 11 items were removed. The final solution contained five factors and explained 75.1% of the total variance in intrapersonal items. All factors were labelled according to common themes among the items comprising each factor. Factor 1 was labelled 'Self-efficacy and Motivation' and had six items with factor loadings greater than .71 and cross-loadings lower than .34. Factor 2 was labelled 'Attitude Toward Physical Activity' and had three items with factor loadings greater than .66 and cross-loadings less than .28. The third factor, labelled 'Fear of or Current Injury' had two items with factor loadings greater than .76 and cross-loadings less than .39. Finally, the fourth and fifth factors contained one item each and were labelled 'Feeling Too Old,' factor loading .89, cross-loading less than .12, and 'Cost,' factor loading .95, cross-loading less than .08. The final factor loading matrix is presented in Table 1.

Insert Table 1

Internal consistency for all factors containing two or more items was assessed using Cronbach's alpha with a minimum value of .60 being considered acceptable, and .70 or above being considered good (Nunnally, 1978). Reliability for Self-efficacy and Motivation was initially calculated to be .66, but with the item 'I think I am already active enough' deleted the reliability

was .84. For Attitude toward Physical Activity, reliability was .81. The Cronbach alpha value for Fear of/Current Injury was .50, which was considered low, likely because only two items accounted for injury.

Interpersonal factor analysis. An exploratory factor analysis was conducted on the 28 items originally included in the questionnaire. The Kaiser-Meyer-Olkin measure of sampling adequacy was 0.67, above the recommended level of 0.60, and the Bartlett's test of sphericity was significant, $\chi^2(325) = 1033.3, p < 0.05$. Communalities were all above 0.45, demonstrating that each item shares some common variance with other items. The principle component extraction method was used and an eigen value of 1 or greater was required for each factor. The initial solution contained seven factors with eigen values greater than one. Using a varimax rotation, the previously described iterative process was used to remove items, resulting in 8 items being excluded. The final solution contained seven factors and accounted for 77.7% of the variance. Again, factors were labelled according to common themes among the original items. The first factor was labelled 'Subjective Norms' and contained six items with factor loadings above .68 and cross-loadings below .56. The second factor, 'Influence of Spouse for Physical Activity' contained three items with factor loadings above .70 and cross-loadings below .49. The third factor was labelled 'Influence of Co-workers for Physical Activity' and contained three items with loadings greater than .77 and cross-loadings less than .21. The fourth factor, 'Influence of Neighbours for Physical Activity' contained two factors with loadings greater than .83 and cross-loadings less than .14. The fifth factor was labelled 'Influence of Family Members for Physical Activity' and contained two items with factor loadings greater than .76 and cross-loadings less than .25. 'Constraints of Family Members' was the name given to the sixth factor, which contained two items with loadings greater than .87 and cross-loadings less than .11.

Lastly, the seventh factor was called ‘Social Norms’ and contained two items with loadings greater than .83 and cross-loadings less than .16. The final factor matrix is presented in Table 2.

Insert Table 2

The interpersonal factors were also examined for internal consistency using Cronbach’s alpha. All factors demonstrated strong internal consistency (see Table 2) except the sixth factor, ‘Constraints of Family Members,’ which had an alpha value of 0.57, which was lower than the specified acceptable value and results should be interpreted accordingly.

Physical environment factor analysis. An exploratory factor analysis was conducted on the 21 items originally included in the questionnaire for this category. The Kaiser-Meyer-Olkin measure of sampling adequacy was 0.81, above the recommended level of 0.6, and the Bartlett’s test of sphericity was significant, $\chi^2(210) = 1269.68, p < 0.05$. The communalities were all above 0.53. The principle component extraction method was used and an eigen value of 1 or greater was required for each factor. The initial solution using a varimax rotation was satisfactory in having factor loadings greater than 0.5 and no cases in which the difference between the primary factor loading and cross loading was less than 0.2. Therefore, no items needed to be removed. The final solution contained six factors with eigen values greater than one. Factors with eigen values greater than 1 were given a name according to common themes between the items comprising each factor. The first factor was named ‘Proximity and Accessibility of Facilities’, which contained seven items with loadings greater than .70 and cross-loadings less than .23. The second factor was labelled ‘Opportunities Near Work’, contained four items with loadings greater than .70 and cross-loadings less than .46. The third factor was labelled ‘Opportunities Near Home’ and contained three items with loadings greater than .73 and cross-loadings less

than .32. The fourth factor was labelled 'Neighbourhood Characteristics' and contained four items with factor loadings above .63 and cross-loadings lower than .24. The fifth factor was labelled 'Opportunities at Home' and contained two items with factor loadings greater than .78 and cross-loadings less than .20. Lastly, the sixth factor was labelled 'Safety' and contained one item loading at a value of .91, and cross-loadings less than .13. The final factor matrix is presented in Table 3.

Insert Table 3

All eligible factors demonstrated strong internal consistency (see Table 3), except the fifth factor, 'Opportunities at Home,' which had an alpha value of 0.52. This is lower than the specified acceptable value and results using this factor should be interpreted accordingly.

Analyses of Sub-factors within each of the Intrapersonal, Interpersonal and Physical Environment Categories

Composite scores were calculated for all sub-factors submitted to the previous factor analyses and reliability analyses. Descriptive statistics for these scores are presented in Table 4. These scores were all anchored on a 5-point Likert scale, with lower scores representing greater perceptions of barrier strength. Barrier factors were used as dependent variables in a series of separate 2 activity group (active; less active) by 3 (age groups - 45-54; 55-64; 65-74 yrs) mixed ANOVAs to determine if there was a significant interaction between physical activity group and age group on barrier strength for each of the sub-factors.

Insert Table 4

Intrapersonal sub-factors. Three mixed ANOVAs were conducted separately for each of the following dependent variables representing intrapersonal sub-factors: self-efficacy and motivation, attitudes toward physical activity, and fear of/current injury. Firstly, a significant main effect of activity level was found for self-efficacy and motivation, $F(1,113) = 24.14, p < 0.001$. Specifically, the less active group perceived barriers relating to self-efficacy and motivation more strongly ($M = 3.15, SE = .12$) than the active group ($M = 3.89, SE = .08$). There were no significant findings for an interaction effect or main effect for age. Secondly, a significant main effect of activity level was found for attitudes toward physical activity, $F(1,113) = 19.05, p < 0.001$. In particular, the less active adults ($M = 3.80, SE = .14$) reported a stronger perception of attitude-related barriers than the more active group ($M = 4.59, SE = .10$). Neither the interaction effect nor the main effect of age were significant. Lastly, no significant results were found for the analysis involving fear of/current injury, all $F_s(1,115) < 3.2$ all $p_s > 0.07$.

Interpersonal sub-factors. Seven mixed ANOVAs were run separately for each of the following dependent variables representing interpersonal sub-factors: subjective norms, influence of spouse, influence of co-workers, influence of neighbours, influence of family members, constraints of family members, and social norms. A significant main effect for activity level was found for influence of spouse for physical activity, $F(1, 111) = 17.59, p < 0.001$. In particular, the less active adults reported a significantly stronger perception of barriers involving one's spouse ($M = 2.36, SE = .22$) when compared to the more active group ($M = 3.53, SE = .16$). The analysis for the influence of family members on physical activity showed a significant main effect of activity level, $F(1,112) = 4.9, p = 0.02$. Specifically, the less active adults reported a stronger perception of family member-related barriers ($M = 2.73, SE = .24$) than the more active group ($M = 3.41, SE = .17$). With regards to the influence of co-workers for physical activity, a significant main effect for age was evident, $F(2, 81) = 2.53, p = 0.034$, where the

oldest adults reported a significantly stronger perception of work-related barriers ($M = 1.48$, $SE = .28$) than the middle-aged group ($M = 2.35$, $SE = .20$), $p = 0.04$. No other significant main effects or interactions were found.

Physical environment sub-factors. Separate 2 X 3 mixed ANOVAs were performed using the following physical environment sub-factors as dependent variables: neighbourhood characteristics, opportunities near home, opportunities at home, opportunities near work, proximity and accessibility of facilities, and safety. A significant main effect of activity level was found for neighbourhood characteristics, $F(1,114) = 12.2$, $p = .001$. Specifically, the less active adults reported a stronger perception ($M = 2.10$, $SE = .17$) of barriers relating to natural and built facilities within the neighbourhood when compared to the active group ($M = 2.85$, $SE = .12$). Similarly, with regards to opportunities near home, the less active group also reported a significantly stronger perception ($M = 3.26$, $SE = .20$) of barriers compared to the active group ($M = 4.09$, $SE = .14$), $F(1,109) = 11.0$, $p = 0.001$. There were no significant main effects of interactions in analyses pertaining to proximity and accessibility of facilities, or opportunities at home, all F s (2, 113) < 2.44, all p s > 0.092. To assess group differences for opportunities near work, a 2 activity group by 2 age group mixed ANOVA was used. (The oldest age group could not be included for this analysis due to a low cell size, likely because they had reached retirement and the workplace locale was not relevant). A significant main effect for age was shown, $F(1,62) = 19.9$, $p < .001$, where the youngest group reported a significantly stronger perception of barriers ($M = 2.64$, $SE = .22$) compared to the middle-aged group ($M = 3.96$, $SE = .18$), $p < 0.001$.

Discussion

The study had three main objectives. First, it aimed to assess the relative barrier strength of the broadest ecological categories using valid item inventories, and to specifically determine if

there were age group or activity group differences in relative barrier strength across intrapersonal, interpersonal and physical environment categories. Based on previous research (Giles-Corti & Donovan, 2002), it was hypothesized that the intrapersonal barrier category would be reported as the strongest influence relative to the other categories, and also that there would be significant differences in barrier strength between age groups as well as activity groups. Secondly, we aimed to assess the factorial validity and reliability of questionnaire items developed to measure intrapersonal, interpersonal and physical environmental barrier sub-factors perceived by middle-aged and older adults, to determine if there were emergent themes or sub-factors within each of these categories. The third objective was to assess activity group and age group differences in barrier strength *within* each of the three broader categories and to determine if an interaction effect between age group and activity level exists; specifically, differences in reported barrier strength for each emergent sub-factor within the intrapersonal, interpersonal and physical environment categories were assessed. It was hypothesized that there would be significant differences in barrier strength between age groups and activity groups within each category. Results pertaining to each objective of the study will be discussed in the following sections.

Relative Barrier Strength across Categories

With regards to the overall relative strength of the intrapersonal, interpersonal and physical environment categories collapsed across age and physical activity levels in the present sample, the mean values indicated that the interpersonal barriers were moderately constraining, whereas the physical environment barriers and the intrapersonal barriers were less than moderately constraining. Moreover, the interpersonal barriers were significantly more constraining than the other two categories. In addition to this comparison of mean values across the whole sample, comparisons were also made for relative barrier strength between activity

groups. Although all three categories proved significantly constraining on physical activity levels, results suggested in particular that there is a difference in the degree of influence that types of barriers have on active versus less active adults, across categories. Comparisons of the partial eta squared values revealed that barriers in the intrapersonal category had the strongest effect overall (partial eta squared = .33), and that the interpersonal category was stronger (partial eta squared = .20) than the physical environment category (partial eta squared = .07). Therefore, items relating to the intrapersonal category most strongly accounted for the differences in barrier strength between active and less active adults, with a medium effect size according to Cohen's (1988) guidelines; there was a medium effect size for the differences in physical activity groups attributed to barrier items from the interpersonal category, and items in the physical environment category accounted for differences between activity groups with a small effect size. These results are in line with the hypothesis that the intrapersonal category would have the strongest influence, relative to the other categories.

Although the current investigation is the first known study to align barrier strength measures on the same Likert-scale for multivariate analyses, and to use partial eta squared values to examine relative differences in effect size between these categories, our results still align with previous findings regarding relative strength of these ecological categories. For example, Giles-Corti and Donovan (2002) found that intrapersonal influences were the most likely to be associated with exercising as recommended compared to social and physical environment influences. They studied 1803 Australian adults aged 18-59, using a probability cluster sampling method. Using odds ratios, they examined the relative influence of intrapersonal, social and physical environment influences on the likelihood of exercising at a moderate intensity for 30 min or more on most days of the week. Having a high score in the intrapersonal category meant that participants were 8.14 times more likely to exercise as recommended than having a low

score. In contrast, having a high score in the social category meant that one would be 3.72 times more likely to exercise as recommended compared to a low score. Finally, having a high score in the physical environment indicated that one was .43 times more likely to exercise as recommended compared to a low score. That study concluded that intrapersonal and interpersonal influences were most influential for adults' physical activity, and the physical environment seems to have a relatively weak yet important influence for physical activity (Giles-Corti & Donovan); our results parallel these findings as well.

Results suggested that the less active group experiences barriers in each of the three categories to a greater extent than the more active group. This finding is consistent with the hypothesis that there would be differences between groups according to activity level. These results are also in line with previous research on intrapersonal and interpersonal influences for physical activity in which active vs. inactive adults were compared. In one study, Cardenas and colleagues (2009) examined 444 adults aged 55 and over who were participants in the North Carolina Seniors Games. Participants completed a survey containing items asking them about intrapersonal and interpersonal influences for participation in the games, as well as a self-report measure of physical activity. Their results showed active adults reported experiencing intrapersonal barriers such as lack of good health, fear of injury and lack of discipline to a lesser extent than the inactive adults (Cardenas et al.). There were no differences for the interpersonal category in their study, which included items related to discouragement from friends, lack of company, lack of time and lack of interest. Notably, in our study lack of interest and lack of time were classified as intrapersonal barriers, rather than interpersonal. Overall, Cardenas et al.'s results are consistent with our findings for the intrapersonal category. The majority of previous research examining activity group differences has not included the interpersonal or physical

environment influences; therefore future research should include these categories while examining activity group differences to determine the degree of support for our results.

Although the present results did not show a significant main effect for age, nor a significant interaction between age and activity level for the broadest categories of influence, social ecological theory suggests that these types of interactions are important. It is possible that the use of broad categories obscured underlying age group differences and particularly the hypothesized physical activity by age group interactions, thus we further explored barriers using more specifically defined sub-factors within each of the intrapersonal, interpersonal and physical environment categories. To examine these questions, we first had to validate and ensure the reliability of retained items for our current sample.

Validity and Reliability Assessment of Barrier Questionnaire

Following separate factor analyses conducted for each of the broad categories, our results revealed an inventory of reliable and valid sub-factors. In the intrapersonal category, the emergent factors were ‘self-efficacy and motivation’, ‘attitude toward physical activity’, ‘current/fear of injury’, ‘feeling too old’, and ‘cost’. In the interpersonal category, the emergent factors were named ‘subjective norms’, ‘influence of spouse’, ‘influence of co-workers’, ‘influence of neighbours’, ‘influence of family members’, ‘constraints of family members’, and ‘social norms’. Lastly, the sub-factors for the physical environment category were ‘facilities and clubs’, ‘opportunities at home’, ‘opportunities near work’, ‘opportunities near home’, ‘neighbourhood characteristics’ and ‘safety’.

Information regarding validity and reliability of similar scales reflecting intrapersonal, social and environmental influences for physical activity has been lacking in previous research, thus the information generated in this study attempts to address this limitation. However, there has been one other known study examining validity and reliability of a scale pertaining to similar

ecological influences for physical activity (Burton et al., 2007). Burton and colleagues investigated the factorial reliability and validity of the questionnaire they developed to measure individual, social and environmental influences for physical activity among adults aged 18-65. Using a factor analysis, they found 24 reliable and valid sub-factors pertaining to individual, social and environmental categories. Although the sample in their study was larger ($n = 5000$), included much younger adults than the present study, there were important similarities between the emergent factors in this study and in the current investigation. The congruencies between these two analyses highlight factors that have emerged despite the use of different instruments and samples. Thus, these factors can be considered re-emerging, independent influences for physical activity according to social ecological theory. First, Burton and colleagues labelled one factor 'opportunity' which reflected simply having opportunities to do physical activity. In our study, having opportunities emerged as an important environmental influence. More specifically, our results suggest that opportunities related to specific locations such as 'near work', 'near home' and 'at home' are important given that they emerged as separate factors. In a second similarity, under the broader dimension of 'neighbourhood situation', Burton et al. report two factors related to one's neighbourhood, named 'physical characteristics' and 'aesthetic characteristics.' Physical characteristics reflected items similar to those comprising the 'neighbourhood characteristic' factor in the present investigation, such as the proximity of places to go in and around the neighbourhood as well as its aesthetic appeal. Burton et al.'s aesthetic characteristics included safe conditions for walking, which was related to our 'safety' factor. Next, Burton and colleagues labelled one factor 'efficacy,' reflecting the pursuit of activity despite the presence of barriers or difficulties, which was similar to our factor 'self-efficacy and motivation.' Thus, self-efficacy emerged as a valid and reliable influence for physical activity in our sample of middle-aged and older adults, which supports previous research looking at self-

efficacy and physical activity (McAuley, 1993). Notably, in addition to reflecting self-efficacy our factor also reflected motivation whereas this was not explicitly included in Burton et al.'s analysis. Another similarity between these two factorial validity assessments is the factor labelled 'physical health' by Burton and colleagues, reflecting poor health limiting one's ability to participate in physical activity, which was captured by the factor 'current/ fear of injury' in the present study. This similarity highlights the idea that health problems may be preventing physical activity participation. In the current study, the items reflected injury but did reflect more chronic health issues, which may have been an important addition given Burton et al.'s physical health factor and should be included in future research. Finally, their factor analyses resulted in two factors pertaining to the social environment: positive support and discouragement. The 'positive support' factor reflected encouragement and participating with the individual. Our interpersonal factors related to one's spouse, family members (e.g., children, brothers, sisters), neighbours and co-workers reflect similar ideas; however, our results suggest that these types of social influences (encouragement and participating with the individual) are not necessarily broad influences but can be teased apart and validly assessed in relation to specific social agents. Lastly, Burton et al.'s 'discouragement' factor was somewhat similar to our 'constraints of family members' factor, since both reflected criticism for doing physical activity, however our factor specifically reflected significant others' anger towards the individual for their participation, while Burton's analysis reflected a more general act of criticism.

Overall, the factor analysis in the present study shows similarities to previous research and these re-emerging factors seem to be important influences pertaining to ecological sub-categories of influences for physical activity. There were a few differences that should be noted. Interestingly, there were no factors in Burton et al.'s (2007) analysis that related to broad social influences, such as subjective norms or social norms. These sub-factors did emerge as reliable

and valid in our factor analyses and may be of importance for our sample. In addition, our factors ‘cost’ and ‘feeling too old’ did not emerge as separate factors in Burton et al.’s analysis, but were included under a broad dimension of perceived barriers related to ‘low personal functioning.’ This discrepancy highlights the potential importance of the barriers ‘cost’ and ‘feeling too old’ for our sample since they were separate factors, suggesting that they should be considered as discriminant variables and not assumed within larger factors. On a final note, the intrapersonal, interpersonal and physical environment factors presented in the current study are the first to relate specifically to middle-aged and older adults, and more research with this population is needed to assess the degree of support for these findings.

Group Differences in Sub-Factors within Barrier Categories

Using the sub-factors within the intrapersonal, interpersonal and physical environment categories, we examined possible activity group and age group differences in barrier strength, as well as possible interaction effects between age and activity level. Results will be discussed as they pertain first to activity group differences for various sub-factors and, secondly, to age group differences in each sub-factor.

Results indicated that the less active group of adults reported a stronger influence of intrapersonal barriers related to ‘self-efficacy and motivation’ compared to the active group. This sub-factor reflected self-efficacy in terms of one’s ability to persist in physical activity despite obstacles such as bad weather or feeling too tired, and also reflected their motivation to participate in physical activity. Therefore, the less active adults seem to experience more difficulties persisting in activity in the face of obstacles (self-efficacy) and at the same time seem to be less motivated to do physical activity when compared to the active group. Additionally, the less active group reported a stronger influence of intrapersonal barriers related to ‘attitude toward physical activity’ compared to the active group. This factor reflected one’s assessment of how

they would feel about participating in physical activity (e.g., feeling good and/or satisfied when considering the idea of participating in an exercise routine) and our results suggest that compared to the active group, the inactive adults' attitude toward physical activity is not as favourable and is thus serving as a barrier to participation. These findings parallel previous research where a randomly selected sample of active Australian adults aged 60 and over had significantly higher scores for self-efficacy and a more favourable attitude toward physical activity compared to inactive adults (Booth et al., 2000).

With regards to the interpersonal sub-factors, the less active adults acknowledged having less supportive or facilitating influences from spouse and family members compared to the active group. These factors reflect the influence of these specific social agents (spouse and other family members) and in particular whether these people participate in physical activity themselves, or participate with the individual. Thus, our results suggested that the more active adults may have family members and spouses who are more active and participate in physical activity with our active participants more often than the less active adults; the absence of such support serves as an interpersonal barrier for the less active group. The results of the present study are consistent of previous findings which suggest that an individual will be more active if they have opportunities to exercise with others and if they receive a high level of social support (Shaw et al., 2010).

Results showed that the less active group reported stronger perceptions of physical environment barriers specifically pertaining to 'neighbourhood characteristics' compared to the more active group. This sub-factor reflected the proximity of places to be active near one's neighbourhood. For example, the proximity of natural and built facilities offering physical activity opportunities, the proximity of shops and services and the overall aesthetic appeal of the neighbourhood were captured in this sub-factor. Thus, active adults may reside in areas that have more places of interest closer to home, and these may afford a better chance to be active by

walking or biking for transport to such places, compared to the less active group, irrespective of age. In addition, facilities located close to home may reduce the impact of barriers such as lack of time and lack of motivation, because facilities are easy to access (Cerin, Leslie, Sugiyama & Owen, 2010). Similarly, the less active adults also reported a stronger barrier influence of ‘opportunities near home’ compared to the more active adults, which reflects opportunities to be physically active offered by natural and built facilities near home. Our results indicated that the less active adults do not have or perhaps are not aware of opportunities to be active close to home. Thus, our findings pertaining to these two physical environment sub-factors support previous research which found that adults are more likely to engage in physical activity when facilities are located close to their residence (Shigematsu et al., 2009).

Next, results examining differences between age groups will be discussed as they pertain to sub-factors within each barrier category. There was a significant difference between age groups for the interpersonal barrier related to the ‘influence of co-workers.’ Specifically, older adults experienced barriers related to their co-workers to a greater extent than the middle-aged group, specifically in terms of participating with co-workers and having co-workers who are active (modelling). At first glance, this result is surprising because of the assumption that the older group would be more likely to be retired, and thus less likely to be influenced by co-workers to any degree. However, Giles-Corti and Donovan (2002) included co-workers in their examination of the social environment, and suggested that participating in physical activity with significant others (including co-workers) increases the likelihood of being more active. Our results suggested that middle-aged adults are experiencing barriers related to their co-workers to a lesser degree than the older adults. Thus, it appears that the middle-aged adults may be able to participate with their co-workers whereas the older adults may not have co-workers to participate with, which serves as a barrier to participation. Furthermore, younger adults reported physical

environment barriers related to ‘opportunities near their work’ to a greater degree than the middle-aged group. This factor reflected opportunities provided by natural or built facilities to be physically active located near the workplace, and our results suggested that younger adults do not have or fail to realize such opportunities when compared to middle-aged adults. Previous research looking at factors that increase physical activity in the workplace suggests that intrapersonal factors such as self-efficacy are the most important (Kaewthummanukil & Brown, 2006). Our study adds to this literature by suggesting opportunities located close to work are important as well. Overall, results from the present study with regards to ‘opportunities near work,’ and previous research looking at proximity of facilities to one’s place of residence, suggest that age differences are likely to exist for middle-aged and older adults and should continue to be examined.

Absence of Age Effects and Age by Physical Activity Interactions

In the present investigation, a discussion of non-significant findings is warranted. Beginning with analyses across barrier categories, our results revealed no significant differences between age groups with regards to relative differences between the intrapersonal, interpersonal and physical environment categories. The lack of significant differences between age groups is surprising, as previous research has suggested that different age groups experience barriers in different ways (Cardenas et al., 2009; Gyurcsik et al., 2006). For example, Cardenas and colleagues found that their middle-aged (55-64 yrs) participants reported a significantly stronger influence of social related (interpersonal) barriers than their older group (65+ yrs). One reason for the discrepancy in these findings may be the different types of influences examined within each category. For example, in their study the ‘social influence’ category included discouragement from friends, lack of company and lack of time, whereas the interpersonal category in our study was more expansive, covering specific social agents (family members,

neighbours, co-workers, friends, etc.) and also subjective and social norms. Thus, even though both studies refer to social or interpersonal influences, the items comprising the categories in both studies appear to be quite different. In another study examining age group differences, Gyurcsik and colleagues found that types of ecological barriers experienced by their sample changed according to age cohort. However, this study assessed types of barriers and did not look at differences in reported barrier *strength*. More research looking for differences in age cohorts would be useful for determining if and how barrier strength may differ across age groups in adults.

On the whole, age effects were not evident in results pertaining to the broadest ecological categories or barrier sub-factors. Previous research looking for differences in barrier strength reported across age cohorts is limited. However, in one study, Booth and colleagues (1997) found significant differences in the frequency of barriers reported by their younger (18-39 yrs), middle-aged (40-59) and older groups (60+) with regards to perceptions of time, motivation and personal injury. Specifically, younger adults reported more barriers such as not having enough time nor having sufficient motivation compared to older adults, while older adults were more likely to report having an injury preventing them from participating compared to the younger adults. In the present sample, interestingly, no age effects were found for motivation (co-joined with self-efficacy) or current injury. One reason for this discrepancy may be that Booth et al. (1997) looked at frequency of barriers, whereas our study examined barrier strength. Perhaps the lack of significant differences found in our study could be attributed to this methodological discrepancy. In the present study, there were no age differences found with respect to the physical environment sub-factors relating to ‘facilities and clubs’, ‘opportunities at home’, ‘opportunities near home’, or ‘safety’. This is somewhat surprising, as previous research looking at age differences in environmental factors suggests that in particular, having destinations close

to home is an important correlate of physical activity in older adults compared to younger adults (Shigematsu et al., 2009). However, this study used walking as a measure of physical activity, while our study measured leisure-time physical activity, which may account for the difference in findings.

Interestingly, no significant age nor activity group differences were found pertaining to the analyses involving ‘current/ fear of injury’. Previous research focused on adults aged 60 and over suggests that adults frequently cite current injury or a health problem as a barrier to physical activity (Booth et al., 2002). However, there have been few studies examining differences between active and less active adults, so it may be that having an injury or fearing injury is an important barrier for adults, but does not differentiate active and less active people in our study. Alternatively, active and less active adults may both be experiencing this barrier, but the more active adults may have developed effective self-regulatory coping mechanisms to overcome this barrier (Gyruscik et al., 2009).

Lastly, none of our analyses at the broadest category levels or at sub-factor levels revealed significant interaction effects between age cohort and activity level. These variables have been included together in previous studies looking at barriers in adults, suggesting their mutual importance for studying physical activity (Troost et al., 2002). However, previous investigations have not submitted these variables to the appropriate statistical analyses (i.e., mixed ANOVAs or MANOVAs) to detect an interaction, using successive age groups in the same study. Our study methodology afforded this opportunity, yet results proved non-significant. For the present sample, at least, reported barrier strength depends most often on physical activity status and in certain select instances on age, but reported barrier strength does not appear to depend on both physical activity status and age together. It is possible that the activity level of our sample may have interfered with the possibility of detecting an interaction. As previously

mentioned, our sample did not demonstrate the linear decrease in activity levels we would expect with increasing age (Sallis & Owen, 1999; Trost et al.), as shown by the scores on the GLTEQ. Thus, our oldest group does not seem to be experiencing barrier strength differently than the younger group, as we might expect had there been decreasing activity level trends related to age. Our sample was recruited from various organizations within the community, which may be an important factor to consider. Perhaps these adults naturally enjoy activities within the community and also have the means (e.g., financial, transportation, social opportunity) to do so, and are more likely to find it easy to participate in physically active opportunities because of this predisposition. Overall, future research with a more representative sample may find an interaction effect between age and physical activity status, but for our moderately active sample it seems as though this was not a concern.

Limitations and Future Directions

The findings of this study are important and unique, but there are limitations that must be acknowledged. Based on methodological recommendations (Brawley et al., 1998), there are possibly limitations in terms of how we asked questions relating to barrier strength. Brawley et al. advocated that researchers ask about how frequently barriers are experienced and the degree that each barrier limits behaviour. This approach would further explain a barrier in terms of whether or not the barrier actually *prevents* participation. It may be that barriers cited often by participants are also barriers that these individuals have learned to cope with and thus can maintain their involvement in physical activity despite their acknowledgment of the barrier (Gyurcsik et al., 2009). Future research might ask participants to identify the barrier, but then also to indicate how frequently they experience this barrier (e.g., number of times in one week) and also the extent to which this barrier limits their participation (e.g., using a Likert-scale 1-5) (Gyurcsik et al., 2009). This approach would provide a well-rounded picture of the barrier for the

researcher, and would eliminate the possibility that barriers are cited by participants which are not actually limiting their behaviour. This idea may provide an explanation for the barriers cited in the present study by our relatively active sample; perhaps our more active adults are acknowledging barriers, but these barriers are not actually limiting their physical activity behaviour. If this proved to indeed be the case (i.e., if barriers were experienced frequently but the more active cohorts, but were not very limiting), future researchers could inquire about coping mechanisms. It has been suggested that understanding coping mechanisms and how people are able to overcome barriers is as important as understanding which barriers are experienced (Gyurscik et al). This approach may have proven valuable in the present study, and may have allowed us to determine if there were indeed differences according to age and activity level together, with regards to the extent to which barriers were limiting participation.

Another methodological aspect that may have proven valuable if it had been included in our study is the ability to consider interactions between ecological barrier categories. Although our study afforded the opportunity to examine an interaction between age and physical activity status, it did not allow for study of interactions between barrier categories. Recent discussions of social ecological theory highlight the importance of interactions between types of influences for physical activity (Sallis et al., 2006). For example, the barrier of lack of time (intrapersonal barrier) could be related to distance of facilities (environmental barrier) in an interactive fashion, or being busy with caregiving responsibilities (interpersonal barrier) might interact with not making physical activity a priority (intrapersonal barrier). Clearly, it is possible that barrier influences may not belong to just one ecological level of influence, but may interact between levels. It would be advantageous for future research to choose a methodology that affords this opportunity. For example, hierarchical regression analyses first using single barrier categories (e.g., intrapersonal, interpersonal), and then following with interactive barrier categories (e.g.,

intrapersonal x interpersonal) would determine if more variance in barrier strength over and above the individual categories could be explained by barrier interactions (Holmbeck, 2002). In addition to using quantitative methodologies to examine interactions between categories, qualitative methods such as interviews or focus groups would also provide this opportunity.

Another limitation of the current study is the sample size, which was insufficient for an analysis involving relative barrier strength of all sub-factors derived from the questionnaire as dependent variables in the same MANOVA. In order to conduct a MANOVA using all intrapersonal, interpersonal and physical environment factors as dependent variables and age and activity groups as independent variables, the sample size would need to be larger than the scope for which the current study allowed. However, this analysis would allow for examination of relative barrier strength for each factor and would be an important consideration for future research. Lastly, as indicated above, the relatively high activity level of our sample does limit the generalizability of our results past the current sample.

Conclusion

This study examined the relative barrier strength of three ecological categories of barriers: intrapersonal, interpersonal and the physical environment. Overall, results indicated that the intrapersonal category was relatively the most influential barrier category, but that interpersonal and to a lesser extent physical environment categories also proved to be significantly constraining for our participants. This study revealed reliable and valid sub-factors within each of these ecological categories that pertained specifically to middle-aged and older adults, and examined differences according to age cohort and physical activity status for each sub-factor. Results suggested that the strength of certain sub-factors within barrier categories may often depend on physical activity status. In particular, less active adults reported significantly stronger perceptions of barriers related to 'self-efficacy and motivation,' 'attitude

toward physical activity,' 'influence of spouse,' 'influence of family members,' 'neighbourhood characteristics,' and 'opportunities near home' compared to the active group. Results also demonstrated that the strength of certain sub-factors within barrier categories less often depends on age cohort, with the few significant results pertaining only to the 'influence of co-workers' where the oldest group reported a stronger perception compared to the middle-aged group, and 'opportunities near work' where the youngest age group reported a greater influence compared to the oldest group. Finally, we did not find that barrier strength in our current sample depended on the interaction between physical activity level and age.

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Table 1

Factor Loadings for Exploratory Factor Analysis with Varimax Rotation of Intrapersonal Items

	<u>Self- efficacy & Motivation</u>	<u>Attitude toward PA</u>	<u>Injury</u>	<u>Feeling too old</u>	<u>Cost</u>
Cronbach's Alpha	.84	.81	.50	-	-
Variance %	31.93	14.75	10.87	9.12	8.36
<u>Item</u>					
All things considered, I would feel satisfied if I were trying to do a regular exercise routine over the next two weeks		.90			
All things considered, I would feel good if I were trying to do a regular exercise routine over the next two weeks		.88			
Regardless of whether I succeed or fail, I have a pleasant feeling when I try to do a regular exercise routine		.66			
I planned particular days on which would do physical activity in the last month	.71				
I am motivated to participate in exercise or physical activity	.72				
I am likely to continue to exercise or participate in physical activity even when I am tired	.86				
I am likely to continue to exercise or participate in physical activity even when it is raining	.61				
I am likely to continue to participate in exercise or physical activity even when I feel pressed for time	.84				
Injury or poor health prevents me from being as involved in physical activity as I would like to be*			.83		
Fear of injury or personal safety prevents me from being as involved in physical activity as I would like to be *			.76		
I would be more involved in physical activity if it cost less*				.95	
I think I am too old to participate in exercise or physical activity*					.89

Note. * indicates the item was reverse scored; - indicates Cronbach's Alpha value was unable to be calculated.

Table 2

Factor Loadings for Exploratory Factor Analysis with Varimax Rotation of Interpersonal Items

	<u>Subjective Norms</u>	<u>Spouse</u>	<u>Co-workers</u>	<u>Neighbours</u>	<u>Social Norms</u>	<u>Family Members</u>	<u>Constraints of Family Members</u>
Cronbach's Alpha	.87	.78	.76	.71	.76	.67	.57
Variance %	25.46	11.87	10.74	9.32	8.11	5.90	5.01
<u>Item</u>							
My doctor is likely to think I should be doing a regular exercise routine in the next two weeks.	.75						
My friends are likely to think I should be doing a regular exercise routine in the next two weeks.	.80						
My spouse or partner is likely to think I should be doing a regular exercise routine during the next two weeks.	.66						
My family members are likely to think I should be doing a regular exercise routine during the next two weeks.	.87						
Most people who are important to me think I should perform physical activity regularly.	.82						
My family members have encouraged me to stick with/start participating in physical activity in the past month.	.62						
My spouse or partner participated in physical activity with me in the past month.		.74					
My spouse or partner has encouraged me to stick with/start participating in physical activity in the past month.		.89					

I have received emotional support from my spouse or partner in regards to my participation in physical activity in the past month.	.58
The people at work have participated in physical activity with me in the past month.	.80
In the last month the people at work participated in physical activity more than once per week in the past month.	.76
The people at work have encouraged me to stick with/start participating in physical activity in the past month	.80
The people in my neighbourhood participated in physical activity with me in the past month.	.85
The people in my neighbourhood have encouraged me to stick with/start participating in physical activity in the past month	.82
I find that people my age are expected to do physical activity.	.86
I am likely to do a regular exercise routine because it is expected of people my age.	.81
My family members have participated in physical activity with me in the past month.	.82
In the last month my family members participated in physical activity more than once per week in the past month.	.82
My spouse or partner has gotten angry at me for participating in physical activity in the past month.*	.90
My family members have gotten angry at me for participating in physical activity in the past month.*	.89

Note. * indicates the item was reverse scored

Table 3

Factor Loadings for Exploratory Factor Analysis with Varimax Rotation of Physical Environment Items

	<u>Proximity & Accessibility of Facilities</u>	<u>Opportunities Near Work</u>	<u>Opportunities Near Home</u>	<u>Neighbourh- ood Characteristic</u>	<u>Opportunities at Home</u>	<u>Safety</u>
Cronbach's Alpha	.93	.87	.87	.75	.52	-
Variance %	35.55	12.75	10.53	7.14	5.71	4.95
Item						
I find that there are built facilities (e.g., gyms, arenas, pools) that are welcoming, attractive and pleasant to attend for the purposes of being physically active.	.79					
Built recreational or sport facilities near the area I live provide opportunities to be physically active.	.83					
There are sport clubs, recreational clubs or physical activity groups near where I live.	.70					
It is easy for me to access sport clubs or physical activity groups.	.89					
It is easy to access sport clubs or physical activity groups that are of interest to me.	.88					
It is easy to access sport clubs, recreational clubs or physical activity groups that provide programs that are suitable to my physical ability.	.86					
It is easy to access built recreational or sport facilities near my place of work.	.88					
Natural facilities near the area I work provide opportunities to be physically active.		.85				
Built recreational or sport facilities near the area I work provide opportunities to be physically active.		.76				

It is easy to access natural facilities near my place of work.	.83	
It is easy to access built recreational or sport facilities near my place of work.	.70	
Footpaths and trails for physical activity are safe for being physically active in my neighbourhood.	.73	
Natural facilities near the area I live provide opportunities to be physically active.	.79	
It is easy for me to access sport clubs, recreational clubs or physical activity groups near my place of residence.	.86	
I do physical activity to get to parks or other natural places in my neighbourhood.	.75	
I do physical activity to get to recreational centres, gyms or fitness facilities in my neighbourhood.	.82	
I do physical activity to get to shops, services and places where I do everyday errands in my neighbourhood.	.72	
Attractive natural sights, pleasant landscaping and interesting things to look at make me physically active in my neighbourhood.	.63	
In my home, I have the opportunity to use my own exercise equipment.	.78	
I have the opportunity to be physically active on the groups of my place of residence.	.78	
I feel safe being physically active in my neighbourhood.		.94

Note. - indicates Cronbach's Alpha value was unable to be calculated.

Table 4

Descriptive Statistics for Emergent Sub-Factors in Each Barrier Category

Factor	# Items	<i>M</i>	<i>SD</i>	Skewness	Kurtosis
Intrapersonal					
Self-efficacy and Motivation	6	3.66	.75	-1.11	1.33
Attitude toward Physical Activity	3	4.32	.92	-1.76	2.90
Current/ Fear of Injury	2	4.11	1.07	-1.14	.72
Interpersonal					
Subjective Norms	6	3.61	1.22	-.70	-.59
Influence of Spouse	3	3.18	1.40	-.20	-1.31
Influence of Co-workers	3	2.21	1.19	.75	-.40
Influence of Neighbours	2	1.97	1.20	1.01	.15
Influence of Family Members	2	3.17	1.43	-.13	-1.32
Constraints of Family Members	2	4.79	.520	-2.73	6.8
Social Norms	2	2.98	1.21	-.01	-.87
Physical Environment					
Facilities and Clubs	7	3.82	1.18	-.99	-.10
Opportunities at Home	2	3.44	1.26	-.39	-.86
Opportunities near Home	3	3.84	1.22	-.93	-.16
Opportunities near Work	4	3.46	1.32	-.45	-.94
Neighbourhood Characteristics	4	2.62	1.07	.34	-.73

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Conclusion

The following section provides a conclusion for the complete investigation. First, summaries of Study 1 and Study 2 are provided, followed by a discussion of the similarities and differences between the methodology and results of both Study 1 and 2. Finally, future directions and practical implications for the investigation will be discussed.

Summary of Studies

The overall investigation used a social ecological framework to examine barriers to physical activity in middle-aged and older adults and comprised two separate studies. In both studies participants were stratified according to physical activity status (active or less active) and age (45-54; 55-64; 65-74). In Study 1, participants completed a questionnaire containing open-ended questions where they were asked to generate responses about perceived barriers to physical activity. Responses to these questions were coded and classified into one of six possible social ecological categories (Gyruścik et al., 2006; McLeroy et al., 1988). Analyses for Study 1 began with an examination of age group and activity group differences in the total number of barriers reported, irrespective of ecological category. Results indicated that younger adults reported more barriers in total than the middle-aged and oldest adults. Further, our results indicated that the total number of barriers reported depends on an interaction of age and physical activity status, where the total number of barriers reported by younger adults is particularly pronounced when looking at the less active group. Within specific barrier categories, results showed that younger adults reported more intrapersonal barriers than middle-aged and older adults. In addition, the number of barriers reported within the organizational-interpersonal category depended on age and physical activity status, where the younger, less active group reported the most of these types of barriers. Finally, the use of open-ended questions allowed us

to describe specific barrier sub-themes cited frequently within ecological categories.

Intrapersonal barriers typically revolved around injury and health problems for the middle-aged and older groups, while the younger group tended to report having barriers related to family commitments. Lack of time was a common barrier across all age groups. In the organizational-interpersonal category, a common sub-theme for barriers reported across all groups related to the workplace.

In Study 2, participants completed a questionnaire containing barrier items pertaining to the intrapersonal, interpersonal and physical environment ecological categories. Items were chosen from previous research relating to the three ecological categories and were adapted in certain cases such that all items were anchored on the same Likert scale, allowing for a relative comparison of barrier strength across categories. To this end, examination of effect sizes indicated that the intrapersonal category was relatively the most influential with a medium effect size. While the interpersonal and physical environment categories also proved to be significantly constraining, both had smaller effect sizes compared to the intrapersonal category. Next, three separate factor analyses were conducted to determine if valid and reliable sub-factors existed within each of the broader ecological categories. Further analyses determined if the reported strength of these barrier sub-factors depended on age group, physical activity status, or an interaction between the two. Results suggested that the strength of certain barrier sub-factors may often depend on physical activity status. In particular, less active adults reported significantly stronger perceptions of barriers related to ‘self-efficacy and motivation,’ ‘attitude toward physical activity,’ ‘influence of spouse,’ ‘influence of family members,’ ‘neighbourhood characteristics,’ and ‘opportunities near home’ compared to the active group. Results suggested far fewer occasions where the strength of certain barrier sub-factors depends on age cohort, with

significant results pertaining only to the ‘influence of co-workers’ where the oldest group reported a stronger perception compared to the middle-aged group, and ‘opportunities near work’ where the youngest age group reported a greater barrier influence compared to the oldest group.

In sum, this investigation used an ecological framework to examine the number of barriers pertaining to ecological categories (Study 1) and the strength of barriers across and within categories (Study 2). Both studies examined age group and activity group differences as well as potential interactions between age and activity level. While the aim of each study was similar, two different methodologies were used. As such, there are important similarities and differences worth mentioning.

Similarities and Differences between Studies

A discussion of similarities and differences between the studies is important may offer directions for future research. To begin, Study 1 and Study 2 were both designed to examine barriers to physical activity in middle-aged and older adults, using an ecological approach. Both studies allowed us to examine barriers related to the individual, as well as the social and physical environment. Previous research looking at barriers to physical activity in middle-aged and older adults has emphasized barriers at the individual level. With respect to the participants for each study, recruitment was conducted at similar types of organizations in the same geographic area. In fact, some participants overlapped between studies (although not enough to allow for separate analyses). Further, both studies aimed to recruit a sample that would report a wide range of physical activity levels, from inactive to quite active. Therefore, we can assume a certain amount of similarity between the samples for both studies, and that results from both studies pertain to moderately active samples overall.

With respect to the results for each study, it is difficult to make direct comparisons because of the differing methodologies (i.e., Study 1 looked at the *number* of barriers reported in ecological categories whereas Study 2 looked at barrier *strength*). However, in an exploratory manner, results can be compared and similarities found. In Study 1, a greater number of mean barriers were mentioned by participants in the intrapersonal category, and we could infer that more responses are reflective of a greater barrier influence. In Study 2, results showed that the intrapersonal category was the most constraining for participants and demonstrated the strongest effect size explaining differences between active and less active adults. Thus, both studies suggest that intrapersonal barriers are the most important for our participants.

The results of Studies 1 and 2 were also different. In Study 1, analyses examining differences between age and activity groups showed the majority of significant differences involved age. For example, results showed that younger adults reported more total barriers, more intrapersonal barriers, and more organizational-interpersonal barriers than the middle-aged and older adults. However, in Study 2 the majority of significant differences between groups involved physical activity status but not age status. Results showed that less active adults tended to report experiencing barriers to a stronger degree than the active adults for a number of factors. The discrepancy in these findings is an important outcome for the overall investigation. It suggests that findings about barriers to physical activity derived from a sample of middle-aged and older adults depend on *how* questions are asked, depending on the methodology used. Our studies used similar participants and shared somewhat common objectives, but revealed quite different results

The overarching difference between Study 1 and Study 2 is methodological. In Study 1, the barrier questions were open-ended, whereas in Study 2, participants were provided with a list of barrier items and responded to each item using a Likert scale. Open-ended questions have been advocated by previous researchers (Gyruksik et al., 2009), because participants generate their own responses about barriers they experience, ensuring that responses are relevant. In Study 2, participants were asked to respond to every item on the questionnaire. Thus, it is difficult to determine whether barriers are in fact relevant for participants, or if they are simply responding to each item in the questionnaire, as directed.

Evidently, the use of open-ended questions has methodological advantages compared to the researcher-provided list of items used in Study 2, but the latter methodology has unique advantages as well. By creating a list of items, the researcher has more control over the data that is generated compared to open-ended questions, which offers no guarantee to the researcher that data pertaining to all variables of interest will be collected. Furthermore, a list of barrier items can be examined for factorial validity and reliability using factor analyses, which is not a possibility when using open-ended questions.

Future Directions and Practical Implications of the Investigation

Future research could consider one study which incorporates these two methodologies using the same participants. This would provide more rigorous support for the idea that asking questions about barriers in different ways may elicit different results. For example, if the same participants completed both types of questionnaires, we could be certain that the types or strength of barriers that are revealed through the study should be the same regardless of methodology used, without the confound of different participant pools. In this case, if the results showed incongruent results, we could use that information to determine that the way questions

are asked is important to the results obtained. Furthermore, a study like this could help determine the situations in which each methodology could serve as most advantageous.

In addition, the results of each study may have important practical implications. The results of Study 1 showed that overall, younger adults tended to report more barriers than middle-aged and older adults. Further, younger adults reported more intrapersonal barriers (e.g., health problem, injury, to busy because of family commitments) than middle-aged and older adults. This information could be useful to consumers of research because it suggests that interventions may be particularly important for younger adults, and these interventions should emphasize strategies to remedy the intrapersonal barriers, while still considering social and environment barriers. Study 1 also suggested that organizational-interpersonal types (e.g., related to the workplace, having no one to participate with) of barriers depend on both physical activity status and age group. This highlights the importance of considering the interaction of these two variables when designing interventions. For example, the strategies that may be most effective for younger, less active adults may be different from younger, more active adults. Specifically, the current results suggest that interventions focusing on designing a workplace that promotes and encourages physical activity, and encouraging social interactions during physical activity may be particularly effective for younger, less active adults.

The results of Study 2 suggest that intrapersonal barriers seem to be the most constraining for participants compared to the interpersonal and physical environment barriers. But, the latter two barrier categories were also significantly constraining. Thus, our results suggest that interventions may be most effective if designed to target multiple levels of influence, rather than just the individual. Further, the results of Study 2 showed that barrier strength often depends on physical activity status, where less active adults seem to experience barriers to a greater extent

than more active adults. This information suggests that interventions may be most effective when designed to target sub-groups based on physical activity status.

In sum, this investigation used both open-ended questions and a researcher-provided list of items to examine barriers to physical activity. Both methodologies have advantages and disadvantages, and our investigation opens the door for future research that would perform a more formal comparison to ultimately determine when and where each methodology could serve as most effective. This investigation also offers unique results that may help consumers of research design intervention efforts more successfully, to improve physical activity levels among middle-aged and older adults.

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Appendix A

Organizational Representative Letter of Information and Consent

Dear (*insert name of contact person at community organization*),

I am contacting you in the hope that you will consider endorsing a research project and grant permission to recruit participants from your organization.

This study is a Master's level thesis project with the School of Human Kinetics at the University of Ottawa. The purpose of the research is to identify and understand perceived barriers to physical activity, exercise and sport in adults aged 45 to 74. The study will involve distribution of two questionnaires to adults who express interest in participating. In total, both questionnaires will take approximately 25 minutes to complete. In the first questionnaire, participants will be asked to report possible reasons for not participating or not increasing their participation in physical activity. They will also be asked about the amount of physical activity that they are currently involved in. Participants will complete this survey and return it to the researcher on-site. After the questionnaire is returned, participants will be asked to provide an email address if they are interested in completing the second survey in the study. If they are, the researcher will electronically mail this second survey to participants two weeks later for completion using a safe and secure online survey. This online survey contains security measures such as a firewall, advanced data encryption and user authentication to safeguard the data. Information provided by participants may be stored indefinitely with the on-line survey provider (surveymonkey.com), but only the investigators listed below will access or make use of the data.

In accordance with ethical procedures at the University of Ottawa, all the information that participants provide will remain confidential and all steps will be taken to ensure the anonymity of participants during the data analyses and reporting of results. Participation in the study is entirely voluntary. If at any time a participant wishes to withdraw from the study, he or she may do so freely without penalty of any kind. There is the possibility that certain questions about barriers may cause feelings of psychological or emotional discomfort. In this case, participants may contact the researchers below to request information for appropriate resources to help with such discomfort. If at any time there are ethical concerns involving the conduct of the study, the Protocol Officer for Ethics in Research may be contacted at the following email address, ethics@uottawa.ca, or phone number (613) 562-5800 x. 5387.

This study has the potential to identify important barriers perceived by adults in regards to physical activity participation. This information could be useful for designing programs and interventions to help middle-aged and older adults to become more physically active and to increase the number of adults engaging in physical activity. Given the potential health benefits of having a more active older population, I ask you to consider granting permission to recruit adults from your organization to participate in the study. I also ask you to grant permission for the researcher to maintain a booth on-site allowing for the distribution and collection of questionnaires. The location and functioning of such a booth would be subject to your preferences, respectful of the surrounding events, and would be entirely non-disruptive. Adults would have to approach the booth to express interest in participating in the study and the researcher would not solicit participants at other venues.

I ask for your consent as an organizational representative to permit this research by reading and signing the letter below and returning it to the investigator.

Stacie C. Carey
Master of Arts Candidate
School of Human Kinetics

Bradley Young, PhD.
Assistant Professor
School of Human Kinetics

To Whom It May Concern,

My name is _____, and I represent an organizational group called _____ . I have been contacted by Stacie Carey, a Research Assistant at the University of Ottawa working with Dr. Bradley Young on research relating to physical activity in middle-aged and older adults. I endorse this research and Stacie has my permission to distribute questionnaires to participants who are between 45 and 74 years of age and who are affiliated with my organization. I understand that this task requires about 25 minutes in total on two occasions to complete. I understand that all research procedures conform to ethical procedures at the University of Ottawa and that participation in the study is voluntary, and at any time it is possible for participants to withdraw freely from the study without penalty of any kind. I agree to provide access so that Stacie may maintain an on-site table/booth on my organization's premises, which will be subject to my preferences, respectful of surrounding events and participants, and entirely non-disruptive. I understand that all interested participants will have to approach the table to discuss the research, and that they will not be solicited in undesignated areas on-site. I will allow Stacie to distribute questionnaires to members of my organization and collect completed questionnaires from them from the designated booth/table on-site.

Signature: _____ Date: _____

Appendix B

Letter of Consent 1

Dear Participant,

We have received permission from your organization to ask you to consider taking part in a research study. This study is a Master's level thesis project in the School of Human Kinetics at the University of Ottawa looking at the types of factors that influence physical activity participation in adults. Upon completion of the study, you will have the opportunity to request a summary of the findings.

This study will require you to complete two questionnaires. The first questionnaire can be completed and returned to the researcher on-site. It asks you to report some of the barriers you may face in regards to physical activity and also asks about your current level of physical activity participation. Altogether, this first survey will take approximately 15 minutes to complete. At the end of this survey, you will be asked whether you are interested in participating in the second questionnaire which will occur two weeks later. You have the right to decline to participate in this second survey, without penalty of any kind.

If you would like to participate in the second survey, you will be asked to provide a valid electronic mailing address. This email address will be used for the sole purpose of electronically mailing a second online survey to you. Your email address will not be used for any other purpose, and will be stored safely by the primary researcher until the end of the investigation. At that time, your email contact will be destroyed. This second questionnaire can be completed online and takes about 10 minutes to complete. It asks about factors relating to your self, your friends and significant others, and your surrounding environment that may influence your participation in physical activity. This online survey is certified safe and secure. Security features include a firewall, advanced data encryption and user authentication to ensure the data is safeguarded. Data provided may be stored indefinitely with the on-line survey provider (surveymonkey.com), but only the investigators listed below will analyze and use your information.

In accordance with research ethics procedures at the University of Ottawa, all of the information that you provide will remain confidential. To ensure confidentiality, personal information will be coded and stored in a locked lab to which only the researchers listed below will have access. You will be assigned an identification number in order to maintain your anonymity throughout the course of data collection and analysis. When the final report is written, it will be done in such a way as to conceal the identity of all participants. Inferences will be based on information collected from group data and not upon individual cases. Collected data will be used for analyses in the present study and will be kept on file for a period of ten years, after which it will be destroyed.

You must be between the ages of 45 and 74 to participate in this study. Your participation in the study is entirely voluntary. Filling out the first questionnaire and returning it to the researcher would indicate that you freely consent to participate in this study. This means that you have been informed of the requirements of the research, understand that you have the opportunity to ask questions and discuss this study, and have been assured that your information will remain confidential. If at any time you no longer wish to continue as a participant, you may withdraw freely without penalty of any kind. If you wish to withdraw from the study after submitting the questionnaire, please indicate to the researcher either verbally or in writing your intention to withdraw. Your information will be removed from the study upon your request and destroyed. There is the possibility that certain questions about barriers may cause you to feel psychologically or emotionally uncomfortable. In this case, you may contact the researchers below to request information for appropriate resources to help with such discomfort.

Your participation would be extremely helpful and greatly appreciated. You can contact the researcher about any part of the study at any time using the information below. Information requests or concerns about the ethical conduct of the project can be addressed to the Protocol Officer for Ethics in Research at the following email address, ethics@uottawa.ca, or phone number, (613) 562-5841.

Stacie C. Carey
Master of Arts Candidate
School of Human Kinetics

Bradley Young, PhD.
Assistant Professor
School of Human Kinetics

Appendix C

Letter of Consent 2

Dear Participant,

Thank you for your interest in this research. After you completed the last phase of this research study, you indicated that you were interested in continuing your participation and provided your email address.

The following questionnaire will take approximately 10 minutes to complete and will ask questions regarding your experiences with physical activity, exercise and sport. This online survey is certified safe and secure, and contains security measures such as a firewall, advanced data encryption and user authentication to safeguard your data. Information that you provide will be indefinitely stored with the on-line survey provider (surveymonkey.com), but only the investigators listed below will have access to, will analyze, or will use your information. The purpose of the research is to gain an understanding of the personal, social, and environmental factors that influence participation in these activities.

The study is being conducted in accordance with research ethics procedures at the University of Ottawa. It is important for you to understand that your involvement in the research is entirely voluntary. You are not required to participate and there will be no negative consequences if you choose not to do so. If you agree to participate, all of the information that you provide will remain completely confidential. We may publish the findings from this research in the future, but all publications will pertain to data at the group level and will not include any personally identifiable information. There is the possibility that certain questions about barriers may cause you to feel psychologically or emotionally uncomfortable. In this case, you may contact the researchers below to request information for appropriate resources to help with such discomfort.

If you have any questions about the survey or the nature of the study, please feel free to contact either of the investigators below. If you have concerns about the content of the questionnaire or the ethical conduct of the study, you may contact the Protocol Officer for Ethics in Research at the following email address or phone number: ethics@uottawa.ca, (613) 562-5841. To complete the survey, you can click on the first link provided below. By clicking this link, you are acknowledging that you have read and understood the purpose of the research and that you have volunteered to participate.

[secure weblink to complete survey will be inserted here]

To opt out of this survey and email list, please click the following opt-out link.

[secure opt out link inserted here, provided by online survey provider]

Thank you for your interest in the research, your participation is appreciated.

Stacie C. Carey
Master of Arts Candidate
School of Human Kinetics

Bradley Young, PhD.
Assistant Professor
School of Human Kinetics

Appendix D

Reminder Email Script

Dear participant,

After you completed the last phase of this research study, you indicated that you were interested in continuing your participation and provided your email address. The study is currently still active and your response can still be included. Your participation is greatly appreciated and can contribute to a better understanding of the factors that influence adults' engagement in physical activity.

The following questionnaire will take approximately 10 minutes to complete and will ask questions regarding your experiences with physical activity, exercise and sport. The purpose of the research is to gain an understanding of the personal, social, and environmental factors that influence participation in these activities.

The study is being conducted in accordance with research ethics procedures at the University of Ottawa. It is important for you to understand that your involvement in the research is entirely voluntary. You are not required to participate and there will be no negative consequences if you choose not to do so. If you agree to participate, all of the information that you provide will remain completely confidential. We may publish the findings from this research in the future, but all publications will pertain to data at the group level and will not include any personally identifiable information. If you have any questions about the survey or the nature of the study, please feel free to contact either of the investigators below. If you have concerns about the content of the questionnaire or the ethical conduct of the study, you may contact the Protocol Officer for Ethics in Research at the following email address or phone number, ethics@uottawa.ca, (613) 562-5841.

To complete the survey, you can click on the first link provided below. By clicking this link, you are acknowledging that you have read and understood the purpose of the research and that you have volunteered to participate.

[secure weblink to complete survey will be inserted here]

To opt out of this survey and email list, please click the following opt-out link.

[secure opt out link inserted here, provided by online survey provider]

Thank you for your interest in the research.

Stacie C. Carey
Master of Arts Candidate
School of Human Kinetics

Bradley Young, PhD.
Assistant Professor
School of Human Kinetics

Appendix E

Questionnaire used in Study 1

PHYSICAL ACTIVITY QUESTIONNAIRE

1

Please answer the following two questions by circling YES or NO:

Have there been any circumstances that may have made it difficult for you interfered with, or prevented you from participating in physical activity, exercise or sport in the past six months?

YES

NO

Have you been satisfied with the frequency and intensity of your physical activity, exercise or sport participation in the last six months?

YES

NO

PHYSICAL ACTIVITY QUESTIONNAIRE

2

A **barrier** refers to anything that may have **prevented** you from participating in physical activity or achieving your desired frequency or intensity of participation. **Barriers are things that get in the way**, or make it a **hassle** for you to do physical activity.

Beginning with the barrier most significant for you, provide a list of barriers you have experienced recently. **Please try to describe each barrier using one or two sentences.**

1.

2.

3.

4.

5.

6.

7.

PHYSICAL ACTIVITY QUESTIONNAIRE	3
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<p>Considering a 7-day period (a week), how many times on the average to do you the following kinds of exercise for more than 15 minutes during your free time (write on each line the appropriate number).</p>
--

A) STRENUOUS EXERCISE
(HEART BEATS RAPIDLY)

TIMES PER WEEK

(i.e., running, jogging, hockey, football, soccer, squash, basketball, cross country skiing, judo, roller skating, vigorous swimming, long distance bicycling)

B) MODERATE EXERCISE
(NOT EXHAUGHSTING)

TIMES PER WEEK

(i.e., fast walking, baseball, tennis, easy bicycling, volleyball, badminton, easy swimming, alpine skiing, popular and folk dancing)

C) MILD EXERCISE
(MINIMAL EFFORT)

TIMES PER WEEK

(i.e., yoga, archery, fishing from a river bank, bowling, horseshoes, golf)

<p>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)?</p>

1. OFTEN

2. SOMETIMES

3. NEVER

Appendix F

List of Questionnaire Items used in Study 2**Barriers to Exercise and Physical Activity Questionnaire Items**Intrapersonal Items

1. A) All things considered, if I tried a regular exercise routine over the next two weeks I would feel satisfied.
B) All things considered, if I tried a regular exercise routine over the next two weeks I would feel wise.
C) All things considered, if I tried a regular exercise routine over the next two weeks I would feel good.
2. A) Regardless of whether I succeed or fail, I would have a pleasant feeling toward the process of trying to do a regular exercise routine.
B) Regardless of whether I succeed or fail, I would expect the process of trying to do a regular exercise routine to be easy.
3. A) My doctor is likely to think I should try to do a regular exercise routine during the next two weeks.
B) My friends are likely to think I should try to do a regular exercise routine during the next two weeks.
C) My spouse is likely to think I should try to do a regular exercise routine during the next two weeks.
D) My family members are likely to think I should try to do a regular exercise routine during the next two weeks.
E) Most people who are important to me think I should perform physical activity regularly.
4. A) During the past three months, I have never tried to do a regular exercise routine.
5. A) If I tried to do a regular exercise routine over the next two weeks, it is likely that I could actually stick to the routine.
6. In the next two weeks, it is likely that I will try to do a regular exercise routine.
7. A) In the last month, I have never set a goal for how much physical activity or exercise I would like to do.
B) In the last month, I have never planned particular days on which I would do physical activity.

- C) In the last month, I have never arranged to meet someone to do physical activity with.
8. A) I am likely to continue to exercise or participate in physical activity if I am tired.
B) I am likely to continue to exercise or participate in physical activity if it is raining.
C) I am likely to continue to participate in exercise or physical activity if I feel pressed for time.
D) I feel confident about my ability to participate in exercise or physical activity.
9. I do not have time to exercise or participate in physical activity.
10. A) I do not experience enjoyment while exercising or participating in physical activity.
B) I am not motivated to participate in exercise or physical activity.
11. I think I am too old to participate in exercise or physical activity.
12. I think I am already physically active enough.
13. I would be more involved in physical activity, sport or recreational activities if it cost less.
14. Injury or poor health prevents me from being as involved in physical activity, sport or recreational opportunities as I would like to be.
15. Fear of injury or personal safety prevents me from being as involved in physical activity, sport or recreational opportunities as I would like to be.

Interpersonal Items

16. I consider myself to be a member of a sport, exercise, recreational or physically active group or club.
17. A) In the last month, my spouse participated in physical activity (including walking) more than once per week.
B) In the last month, my family members participated in physical activity (including walking) more than once per week.
C) In the last month, people at work participated in physical activity (including walking) more than once per week.
D) In the last month, people in my neighbourhood participated in physical activity (including walking) more than once per week.

18. A) In the past three months, my spouse participated in physical activity (including walking) **with me**.
B) In the past three months, my family members participated in physical activity (including walking) **with me**.
C) In the past three months, the people at work participated in physical activity (including walking) **with me**.
D) In the past three months, the people in my neighbourhood participated in physical activity (including walking) **with me**.
19. A) In the past three months, my spouse has encouraged me to stick with/start exercising or participating in physical activity.
B) In the past three months, my family members have encouraged me to stick with/start exercising or participating in physical activity.
C) In the past three months, the people at work have encouraged me to stick with/start exercising or participating in physical activity.
D) In the past three months, the people in my neighbourhood have encouraged me to stick with/start exercising or participating in physical activity.
20. A) In the past three months, my spouse has gotten angry at me for exercising or participating in physical activity.
B) In the past three months, my family members have gotten angry at me for exercising or participating in physical activity.
C) In the past three months, my friends have gotten angry at me for exercising or participating in physical activity.
21. A) In the past three months my friends have provided me with helpful reminders to exercise or participate in physical activity.
B) In the past three months, my family members have provided me with helpful reminders to exercise or participate in physical activity.
22. A) In the past three months, I have experienced emotional support from my family members in regards to my participation in physical activity or exercise.
B) In the past three months, I have experienced emotional support from my friends in regards to my participation in physical activity or exercise.
23. I would be more physically active if coaches, recreational instructors or exercise leaders were more available.
24. A) I am likely to do a regular exercise routine because it is expected of people my age.
B) People my age are expected to do a regular exercise routine.

Physical Environment Items

25. A) I do physical activity (e.g., walk, bike) **to get to** shops, services and places where I do everyday errands in my neighbourhood.
B) I do physical activity to get (e.g., walk, bike) **to get to** parks or other natural places for recreation in my neighbourhood.
C) I do physical activity (e.g., walk, bike) **to get to** recreational centres, gyms or fitness facilities in my neighbourhood.
26. A) I feel safe being physically active outside in my neighbourhood.
B) Footpaths and trails for physical activity (e.g., rail trails and bike lanes) are safe for being physically active in my neighbourhood.
C) Attractive natural sights, pleasant landscaping and interesting things to look at make me physically active in my neighbourhood.
27. A) In my home, I have the opportunity to use my own exercise equipment.
B) I have the opportunity to be physically active on the grounds of my place of residence.
C) There are built facilities (e.g., gyms, arenas, pools) that are welcoming, attractive and pleasant to attend when being physically active.
D) There are sport clubs, recreational clubs or physical activity groups near where I live.
E) Natural facilities (e.g., parks, footpaths) near the area I live provide opportunities to be physically active.
F) Natural facilities (e.g., parks, footpaths) near the area I work provide opportunities to be physically active.
G) Built recreational or sport facilities (e.g., gyms, arenas, pools) near the area I live provide opportunities to be physically active.
H) Built recreational or sport facilities (e.g., gyms, arenas, pools) near the area I work provide opportunities to be physically active.
28. A) There are sport clubs, recreational clubs or physical activity groups that are accessible to me near the area I live.
B) The sport clubs, recreational clubs or physical activity groups in the area I live provide programs that are of interest to me.
C) The sport clubs, recreational clubs or physical activity groups in the area I live provide programs that are suitable for my physical ability.
D) I find it easy to access natural facilities (e.g., parks, footpaths) for being physically active near my place of residence.

E) I find it easy to access natural facilities (e.g., parks, footpaths) for being physically active near my place of work.

F) I find it easy to access built recreational or sport facilities (e.g., gyms, arenas, pools) near my place of residence.

G) I find it easy to access built recreational or sport facilities (e.g., gyms, arenas, pools) near my place of work.

Appendix G

Online Questionnaire used in Study 2

1. THANK YOU FOR YOUR INTEREST IN OUR RESEARCH

Dear Participant,

By participating in this study, you will be contributing to a better understanding of the factors that may influence involvement in physical activity, exercise and sport for adults.

The questionnaire takes about 10 minutes to complete. It will ask questions about some of the things that might influence your participation in physical activity.

The study is being conducted in accordance with research ethics procedures at the University of Ottawa. It is important for you to understand that:

- Involvement in the research is entirely voluntary. You are not required to participate, and there will be no negative consequences if you choose not to do so.
- If you agree to participate, all of the information that you provide will remain completely confidential. We may publish the findings from our research at some point in the future, but those publications will not contain any personally identifiable information.
- If you have any questions about the content of the questionnaire or want more information about the study, you can contact the researchers shown at the bottom of this page.

By clicking on the NEXT PAGE button below, you are acknowledging that you have read and understood this description of the research project, and that you have volunteered to participate.

To begin, please press NEXT PAGE at the bottom.

Please note that once you begin the survey, no answers will be saved or recorded until you click "Submit" on the last page. Thus, if you do not finish the survey for any reason, you will have to start over again by clicking on the link in the email you received.

Thank you.

Stacie Carey, Master of Arts Candidate
School of Human Kinetics
University of Ottawa,
Ottawa, Canada

Bradley Young, Ph.D
School of Human Kinetics
University of Ottawa
Ottawa, Canada

2. PHYSICAL ACTIVITY PARTICIPATION

Considering a 7-DAY PERIOD (ONE WEEK), how many times on the average do you do the following kinds of exercise for MORE THAN 15 MINUTES during your FREE TIME.

Please type on each line the appropriate number indicating the number of TIMES PER WEEK you do each kind of exercise.

1. Strenuous Exercise (Heart beats rapidly)

(e.g., running, jogging, hockey, football, soccer, squash, basketball, cross country skiing, judo, roller skating, vigorous swimming, vigorous long distance bicycling)

2. Moderate Exercise (Not exhausting)

(i.e., fast walking, baseball, tennis, easy bicycling, volleyball, badminton, easy swimming, alpine skiing, popular and folk dancing)

3. Mild Exercise (Minimal effort)

(i.e., yoga, archery, fishing from a river bend, bowling, horseshoes, golf, snow-mobiling, easy walking)

4. 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)?

1. Often

2. Sometimes

3. Never

How often per week you engage in activity
long enough to work up a sweat.

3. PHYSICAL ACTIVITY QUESTIONNAIRE

1. Please rate the following statements as they pertain to you with a value of 1,2,3,4 or 5 according to the specified scale. For example, answering a value of ‘1’ would indicate that you feel the statement is ‘not at all true for you.’

In the following statements, 'regular exercise routine' is defined as: 30 minutes of light (e.g., walking or gardening) or moderate (e.g., jogging, brisk walking) exercise each day of the week OR 20 minutes of vigorous (e.g., running, aerobic exercise, sport) activity three times per week.

	1 (not true at all for me)	2	3	4	5 (very true for me)
I would be more involved in physical activity, sport or recreational activities if it cost less.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
All things considered, I would feel foolish if I were trying to do a regular exercise routine over the next two weeks.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I think I am too old to participate in exercise or physical activity.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Fear of injury or personal safety prevents me from being as involved in physical activity, sport or recreational opportunities as I would like to be.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I feel confident about my ability to participate in exercise or physical activity.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
If I were trying to do a regular exercise routine over the next two weeks, it is likely that I could actually stick to the routine.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Regardless of whether I succeed or fail, I have a pleasant feeling when I try to do a regular exercise routine.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
It is likely that I will be trying to do a regular exercise routine in the next two weeks.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
In the last month, I have set a goal for how much physical activity or exercise I want to do.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
All things considered, I would feel satisfied if I were trying to do a regular exercise routine over the next two weeks.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Injury or poor health prevents me from being as involved in physical activity, sport or recreational opportunities as I would like to be.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I tried to engage in a regular exercise routine during the past month.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I do not have time to exercise or participate in physical activity.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I experience enjoyment while exercising or participating in physical activity.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I think I am already physically active enough.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I am motivated to participate in exercise or physical activity.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Regardless of whether I succeed or fail, I expect the process of trying to do a regular exercise routine to be easy.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I planned particular days on which would do physical activity in the last month.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
All things considered, I would feel good if I were trying to do a regular exercise routine over the next two weeks.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

4. PHYSICAL ACTIVITY QUESTIONNAIRE

1. Please rate the following statements as they pertain to you with a value of 1,2,3,4 or 5 according to the specified scale. For example, answering a value of '1' would indicate that you feel the statement is 'not at all true for you.'

	1 (not at all true for me)	2	3	4	5 (very true for me)
In the last month, my spouse or partner participated in physical activity (including walking) more than once per week.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
The people in my neighbourhood that I know have encouraged me to stick with/start participating in physical activity in the past month.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
My family members have encouraged me to stick with/start participating in physical activity in the past month.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
My spouse or partner participated in physical activity (including walking) with me in the past month.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
My spouse or partner has encouraged me to stick with/start participating in physical activity in the past month.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
My family members are likely to think I should be doing a regular exercise routine during the next two weeks.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
My family members participated in physical activity (including walking) with me in the past month.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
My family members have gotten angry at me for exercising or participating in physical activity in the past month.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
In the last month, people in my neighbourhood participated in physical activity (including walking) more than once per week.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I consider myself to be a member of a sport, exercise, recreational or physically active group or club.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
My spouse or partner is likely to think I should be doing a regular exercise routine during the next two weeks.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
In the last month, my family members participated in physical activity (including walking) more than once per week.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
My friends are likely to think I should be doing a regular exercise routine during the next two weeks.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
The people in my neighbourhood that I know participated in physical activity (including walking) with me in the past month.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
My spouse or partner has gotten angry at me for exercising or participating in physical activity in the past month.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Most people who are important to me think I should perform physical activity regularly.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
My doctor is likely to think I should be doing a regular exercise routine during the next two weeks.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

5. PHYSICAL ACTIVITY QUESTIONNAIRE

1. Please rate the following statements as they pertain to you with a value of 1,2,3,4 or 5 according to the specified scale. For example, answering a value of '1' would indicate that you feel the statement is 'not at all true for you.'

	1 (not at all true for me)	2	3	4	5 (very true for me)
It is easy for me to access sport clubs, recreational clubs or physical activity groups.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I am likely to do a regular exercise routine because it is expected for people my age.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I do physical activity (e.g., walk, bike) to get to shops, services and places where I do everyday errands in my neighbourhood.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I have the opportunity to be physically active on the grounds of my place of residence.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I do physical activity (e.g., walk, bike) to get to parks or other natural places for recreation in my neighbourhood.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I would be more physically active if coaches, recreational instructors or exercise leaders were more available.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I feel safe being physically active outside in my neighbourhood.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I find that people my age are expected to do a regular exercise routine.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
There are sport clubs, recreational clubs or physical activity groups near where I live.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Natural facilities (e.g., parks, footpaths) near the area I live provide opportunities to be physically active.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I do physical activity (e.g., walk, bike) to get to recreational centres, gyms or fitness facilities in my neighbourhood.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
In my home, I have the opportunity to use my own exercise equipment.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I find that there are built facilities (e.g., gyms, arenas, pools) that are welcoming, attractive and pleasant to attend for the purpose of being physically active.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Attractive natural sights, pleasant landscaping and interesting things to look at make me physically active in my neighbourhood.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Footpaths and trails for physical activity (e.g., rail trails and bike lanes) are safe for being physically active in my neighbourhood.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Built recreational or sport facilities (e.g., gyms, arenas, pools) near the area I live provide opportunities to be physically active.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

6. PHYSICAL ACTIVITY QUESTIONNAIRE

1. Please rate the following statements as they pertain to you with a value of 1,2,3,4 or 5 according to the specified scale. For example, answering a value of '1' would indicate that you feel the statement is 'not at all true for you.'

	1 (not at all true for me)	2	3	4	5 (very true for me)
My friends have provided me with helpful reminders to exercise or participate in physical activity in the past month.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
It is easy to access built recreational or sport facilities (e.g., gyms, arenas, pools) near my place of residence.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I arranged to meet someone to do physical activity with in the last month.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
It is easy for me to access sport clubs, recreational clubs or physical activity groups that provide programs of interest to me.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
My friends have gotten angry at me for exercising or participating in physical activity in the past month.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I have experienced emotional support from my friends in regards to my participation in physical activity or exercise in the past month.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
My family members have provided me with helpful reminders to exercise or participate in physical activity in the past month.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I have experienced emotional support from my family members in regards to my participation in physical activity or exercise in the past month.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
It is easy to access natural facilities (e.g., parks, footpaths) for being physically active near my place of residence.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I am likely to continue to exercise or participate in physical activity even when I am tired.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I am likely to continue to participate in exercise or physical activity even when I feel pressed for time.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I am likely to continue to exercise or participate in physical activity even when it is raining.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
It is easy to access sport clubs, recreational clubs or physical activity groups that provide programs that are suitable to my physical ability.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

7. PHYSICAL ACTIVITY QUESTIONNAIRE

1. Do you currently work in a paid or unpaid position (e.g., job, volunteer work)?

Yes

No

8. PHYSICAL ACTIVITY QUESTIONNAIRE

1. Please rate the following statements as they pertain to you with a value of 1,2,3,4 or 5 according to the specified scale. For example, answering a value of '1' would indicate that you feel the statement is 'not at all true for you.'

	1 (not at all true for me)	2	3	4	5 (very true for me)
In the last month, people at work participated in physical activity (including walking) more than once per week.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Built recreational or sport facilities (e.g., gyms, arenas, pools) near the area I work provide opportunities to be physically active.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
It is easy to access natural facilities (e.g., parks, footpaths) for being physically active near my place of work.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
It is easy to access built recreational or sport facilities (e.g., gyms, arenas, pools) near my place of work.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Natural facilities (e.g., parks, footpaths) near the area I work provide opportunities to be physically active.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
The people at work participated in physical activity (including walking) with me in the past month.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
The people at work have encouraged me to stick with/start participating in physical activity in the past month.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

9. FINAL PAGE

Thank you for participating. Please answer the following questions as they pertain to you.

1. Date of Birth:

Date of Birth: MM DD YYYY
 / /

2. Gender:

- Male
 Female

3. For this research study, it will be helpful to know whether you live in an urban, suburban, or rural area.

For this purpose, please enter your POSTAL CODE:

4. Education (highest completed)

- High School
 University
 College

5. Marital Status

- Married Widowed
 Single, never married Separated/ divorced
 Common law/ defacto

6. Do you consider yourself to be a masters athlete?

- Yes Somewhat No Don't know

7. If you answered 'yes' or 'somewhat' to the previous question, how many competitive Masters events did you participate in during the past 12 months?

8. Have you ever been a participant at a Seniors Games sporting event?

- Yes Somewhat No Don't Know

9. If you answered 'yes' or 'somewhat' to the previous question, how many Seniors Games events did you participate in during the past 12 months?

10. Would you consider yourself to be a 'sporty' type of person?

Yes Somewhat No Don't know

11. Would you like to receive a summary of the results of this study once they are ready? If YES, please type your email address below, and the results summary will be sent to this address. Your email will not be used for any other purpose.**12. Thank you for your time and participation. Your efforts are greatly appreciated. Our research at the University of Ottawa is ongoing. Would you be interested in being contacted to participate again at a later date? Please answer YES or NO. If you answer YES and you have NOT provided your email in the previous question, please provide your email below. This email will not be used for any other purpose.**

Yes

No

Email:

Appendix H

**Certificate of Approval from the Protocol Office of Ethics in Research at the University of
Ottawa**

Ethics Approval Notice
Health Sciences and Science REB

This is to confirm that the University of Ottawa Research Ethics Board identified above, which operates in accordance with the Tri-Council Policy Statement and other applicable laws and regulations in Ontario, has examined and approved the application for ethical approval for the above named research project as of the Ethics Approval Date indicated for the period above and subject to the conditions listed the section above entitled "Special Conditions / Comments".

During the course of the study, the protocol may not be modified without prior written approval from the REB except when necessary to remove subjects from immediate endangerment or when the modification(s) pertain to only administrative or logistical components of the study (e.g. change of telephone number). Investigators must also promptly alert the REB of any changes which increase the risk to participant(s), any changes which considerably affect the conduct of the project, all unanticipated and harmful events that occur, and new information that may negatively affect the conduct of the project and safety of the participant(s). Modifications to the project, information consent documentation, and/or recruitment documentation, should be submitted to this office for approval using the "Modification to research project" form available at: http://www.iges.uottawa.ca/ethics/application_dvna.asp

Please submit an annual status report to the Protocol Officer 4 weeks before the above-referenced expiry date to either close the file or request a renewal of ethics approval. This document can be found at: http://www.iges.uottawa.ca/ethics/application_dvna.asp

If you have any questions, please do not hesitate to contact the Ethics Office at extension 5841 or by e-mail at: ethics@uottawa.ca.

Germain Zongo
 Protocol Officer for Ethics in Research
 For Dr. Daniel Lagace, Chair of the Health Sciences and Sciences REB

Principal Investigator / Supervisor / Co-Investigator(s) / Student(s)

First Name	Last Name	Affiliation	Role
Burdley	Yong	Health Sciences, Physiotherapy	Supervisor
Stacie C.	Carey	Health Sciences, Human Kinetics	Student Researcher

File Number: H05-10-14

Type of Project: Master's Thesis

Title: Examining Barriers to Physical Activity in Middle-aged and Older Adults using and Ecological Framework

Approval Date (mm/dd/yyyy) **Expiry Date (mm/dd/yyyy)** **Approval Type**

07-27-2010 07-26-2011 In

(Re: Approval, If: Approval for initial stage only)

Special Conditions / Comments:
 N/A