MOBILITY'S RELATIONSHIP WITH SELF-EFFICACY AND LEISURE-TIME PHYSICAL ACTIVITY IN PEOPLE WITH SPINAL CORD INJURY

WHEELS IN MOTION: MOBILITY'S RELATIONSHIP WITH SELF-EFFICACY AND LEISURE-TIME PHYSICAL ACTIVITY IN PEOPLE WITH SPINAL CORD INJURY

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Abstract

Using a cross-sectional design, Bandura's (1986) Social Cognitive Theory and Self-Efficacy Theory (1977) were used as a framework to determine whether wheelchair-use self-efficacy and exercise barrier self-efficacy mediate the relationship between wheelchair mobility and leisure-time physical activity (LTPA) in people with spinal cord injury (SCI). Fourty-six manual wheelchair users (76.1% male), with varying levels of SCI (80.4% paraplegic, 47.8% complete injuries) participated in this study. Participants completed The Wheelchair Skills Test version 4.1 (Wheelchair Skills Test Version 4.1 [WST 4.1], 2008) which measured wheelchair mobility, a modified barrier self-efficacy questionnaire (McAuley & Mihalko, 1998) which measured exercise barrier self-efficacy, the Wheelchair Mobility Confidence Scale (WMCS; Rushton & Miller, 2009) which measured wheelchair-use self-efficacy, and the Physical Activity Recall Assessment for people with SCI (PARA-SCI; Martin Ginis, Latimer, Hicks & Craven, 2005) which measured LTPA. It was hypothesized that (1) there would be a positive relationship between wheelchair mobility and LTPA, and (2) wheelchair-use self-efficacy and exercise barrier self-efficacy would mediate this relationship. Using linear regression models, a positive association between wheelchair mobility and LTPA was established ($\beta = .29$, $p < .05$). Exercise barrier self-efficacy was a significant partial mediator, explaining 47.7% of the variance in the mobility-LTPA relationship. Wheelchair-use self-efficacy was a non-significant mediator. This thesis has practical and theoretical implications for understanding and improving LTPA participation and represents the first study to determine the relationship between wheelchair mobility, self-efficacy, and LTPA in people living with SCI.

Key Words: Mediation, Self-Efficacy, Spinal Cord Injury, Leisure-Time Physical Activity, Wheelchair Skills, Wheeled Mobility

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"A teacher for a day is a parent for a lifetime"

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Wheels in Motion: Mobility's Relationship with Self-Efficacy and Leisure-Time Physical Activity in People with Spinal Cord Injury

What is Mobility?

Mobility is a multidimensional and complex concept. The World Health Organization (World Health Organization [WHO], 2008) defines mobility as an individual's ability to move about effectively in his/her surroundings and a necessary component for social integration. Others define mobility as independently moving oneself and changing or maintaining postures (van Bennekom, Jelles & Lankhorst, 1995). In a rehabilitation context, mobility may refer to the degrees of flexion or extension of a specific body part, like a knee or ankle (Maly, 2009), and at the same time, it may refer to a person's independence if seen through a social perspective. Although mobility is a multidimensional construct, the focus of this thesis was on a person's mobility competence and their ability to perform mobility-related skills in an efficacious manner.

The importance of mobility has been shown in various populations like the institutionalized elderly (Dirik, Cavlak & Akdag, 2006) and post-stroke patients (Kuys, Bew, Lynch, Morrison & Brauer, 2009). In a meta-analysis conducted on older adults with mobility limitations, results indicated that those with severe mobility limitations reported significantly more barriers to physical activity and less bouts of walking ≥ 3 times per week for fitness than those with moderate or no mobility limitations (Rasinaho, Hirvensalo, Leinonen, Lintunen & Rantanen, 2006). In addition to reduced physical activity levels, those with severe mobility limitations presented a higher prevalence of cardiopulmonary diseases, musculoskeletal diseases and chronic obstructive pulmonary diseases (Rasinaho et al.). Within the rehabilitation context, the inability to be fully mobile is a concern for many patients and can have negative effects on future health outcomes (Bussman & Stam, 1998).

Mobility can be studied from a social, cognitive, emotional or physical perspective and may play a significant role in shaping one's physical, mental and psychosocial well-being (Bussman & Stam, 1998). It would be of importance to explore mobility amongst people who have permanent or long-lasting mobility limitations and who constantly face mobility issues on a daily basis, such as people living with spinal cord injury (SCI).

What is a Spinal Cord Injury (SCI)?

A SCI occurs when a lesion on the spinal cord, caused by traumatic (e.g., automobile accident, violence, impact) or non-traumatic (e.g., surgery, disease) means, disrupts nervous transmission throughout the body, affecting a person's motor movement and sensory abilities (Eng & Miller, 2008). The spinal cord is integral to the central nervous system and is protected by 7 cervical, 12 thoracic and 5 lumbar vertebrae (Marieb, Mallatt & Wilhelm, 2005). The spinal cord is housed in the vertebral foramen where spinal nerves enter and exit the spinal cord. A typical spinal cord is the same width as a person's pinky finger, further emphasizing its delicate nature (Marieb et al.).

After SCI, the sensory and motor abilities below the level of injury may change significantly, resulting in full or partial loss of sensation and motor control of these areas

(Eng & Miller, 2008). Those who have an SCI are classified as paraplegics or tetraplegics, based on the lesion level (Alexander et al., 2009). Paraplegics have lesions below the cervical level of the spinal cord (i.e., thoracic, lumbar, and sacral) and tetraplegics have lesions located in the cervical region of the spinal cord. Injuries are further classified as complete or incomplete, which is determined by the presence or absence of sensory and motor function in the lowest sacral segments, with some preservation indicating incomplete SCI and no preservations indicating a complete SCI (Alexander et al.). People with incomplete injuries may also have better motor and sensory abilities compared to people with complete injuries.

Causes of SCI

According to the National Trauma Registry (National Trauma Registry [NTR], 2004), the main causes of SCI in Canada for men and women are motor vehicle accidents (43%) and falls (36%), where these types of SCI result from massive compression or laceration of the spinal cord (Norenberg, Smith & Marcillo, 2004). Additionally, men comprise over three-quarters of the Canadian SCI population, with the majority being less than 35 years of age at the time of injury (NTR, 2004). Men's SCI have been associated with more acts of violence (e.g., gunshot wound), while women's SCI have been associated with more medical complications, such as viral infections (Eng & Miller, 2008). Approximately 36,000 Canadians are currently living with SCI, with over 1000 new injuries occurring annually (Rick Hansen Spinal Cord Injury Registry [RHSCIR], 2005). Globally, the incidence of SCI is 10.4-83/ million in developed countries (Wyndaele & Wyndaele, 2006).

Secondary Complications Following SCI

A person with SCI may experience several secondary complications. These complications include, but are not limited to, an increased likelihood of developing bladder infections (Wolfe et al., 2008), depression (Orenczuk, Slivinski & Teasell, 2008), cardiovascular disease (Warburton, Sproule, Krassioukov & Eng, 2008) and an increased likelihood of bone fractures (Craven, Ashe, Krassioukov & Eng, 2008). In addition to these complications, a person's ability to become mobile is reduced due to limitations below the level of injury. According to previous studies (Canadian Paraplegic Association [CPA], 2000), this usually results in a person using a wheelchair as his/her main means of mobility, with higher functioning paraplegics and tetraplegics using manual wheelchairs. Approximately 91% of people living with SCI use a wheelchair, 68% manual and 23% powered (CPA), while only 3% use crutches or braces (Biering-Sørensen, Hansen & Biering-Sørensen, 2004). Many people with SCI face transportation and mobility barriers within various settings and free-living environments, making mobility a major concern for community participation and integration (Johnson, Gerhart, McCray, Menconi & Whiteneck, 1998).

Mobility and SCI

Within the SCI context, mobility is defined as the ability to independently move from one location to another (Vladusic & Phillips, 2008). Wheelchair mobility can be further defined as the ability to move one's chair and accessories in an effective and efficient manner, in order to accomplish lifestyle-related activities (Trombly & Quintana, 1989). As mentioned earlier, higher functioning people with SCI tend to use manual wheelchairs while lower functioning individuals often use powered wheelchairs as their main means of mobility. Approximately 70% of C1-C4 (cervical) injuries result in a person using a powered wheelchair, while approximately 90% of T1-T12 (thoracic) injuries result in a person using a manual wheelchair (CPA, 2000). Statistics show that, regardless of province/territory, the manual wheelchair is the most commonly used mobility device in the Canadian SCI population (CPA). With regards to people living with SCI, it is clear that being able to use one's wheelchair effectively can have implications for one's mobility. That is, for the SCI population, wheelchair mobility is an important issue when considering psychosocial and physical well-being.

The Importance of Mobility

Mobility is one of the most important factors in a successful rehabilitation process (Connolly et al., 2008) and is shown to be a primary predictor of employment after SCI (Anderson & Vegel, 2002). Mobility is also linked to increased physical activity and healthier blood pressure, body mass index (BMI) and body fat content, in people living with SCI (Warms, Belza & Whitney, 2007).

Mobility via one's wheelchair is also a personal form of transportation, which enables people with SCI to become fully reintegrated into their social systems (Tolerico et al., 2007). Wheelchair mobility is vital for full community participation (Wehman, Wilson, Targett, West, Bricout, & McKinley, 1999) and for performing various activities of daily living (van der Woude et al., 2009). Putzke, Richards, Hicken & DeVivo (2002) showed that mobility was a significant predictor of life satisfaction, up to 2-years post-discharge. Furthermore, a person with higher functional mobility has the opportunity to participate in a wider range of physical activities, giving him/her the potential to become more physically active (Haisma, van der Woude, Stam, Bergen, Sluis & Bussman, 2006). Clearly, people living with SCI can benefit physically and mentally from better wheelchair mobility.

The Mobility Deficit

Despite the wealth of information on the importance of mobility, many people with SCI do not reap the benefits of being adequately mobile (Johnson et al., 1998). Kirchberger et al. (2009) showed that people living with acute and long-term SCI have problems with certain aspects of mobility. Kirchberger et al. claim that these problems arise when one tries to use his/her assistive device (i.e., wheelchair) for mobility purposes. Specifically, 85% of people with acute SCI and 65% of people with long-term SCI reported problems using their mobility devices. It was shown that many people with SCI have problems maintaining posture, transferring from one position to another and performing daily activities while using their assistive devices (Kirchberger et al.).

According to Routhier, Vincent, Desrosiers & Nadeau (2003), wheelchair mobility is dependent on a number of factors. First, *characteristics of the injury* can influence mobility. In particular, the severity of the injury may render a person immobile without constant, personal assistance. According to recent studies (Canadian Institute for Health Information [CIHI], 2006), only 79% of people with SCI return home from rehabilitation, while 18% of those with complete tetraplegia are moved to long-term care facilities. While living in long-term care facilities, people with SCI are not always independently moving themselves from one location to another, thus, decreasing their overall mobility.

Second, *characteristics of the wheelchair* can influence mobility. That is, the wheelchair a person uses may not be suitable for his/her specific injury. Although there is no perfect prescription for the type of wheelchair to be used (Garber, 1985), the number of personal variables to be considered in selecting a wheelchair can be overwhelming (e.g., person's weight, trunk activation, arm length, etc.). In addition, there are many mechanical and electrical factors that may play a role in wheelchair mobility, such as rolling resistance, pitch axis, and static stability (Brubaker, 1986; Brubaker, 1990). Previous studies show that simple additions to the wheelchair, like a push-rim activated/power-assisted wheel or higher seat cushion, could provide assistance while one is performing a wheelchair-related skill. Also, these technological additions to standard wheelchairs have helped to decrease the amount of effort needed to accomplish certain wheelchair-related skills, like ascending inclines or wheeling through gravel (Best, Kirby, Smith & MacLeod, 2006). Kreutz (2002) suggests that completeness and level of injury, physical attributes and previous life activities should be taken into consideration if one is to properly select a wheelchair for a person with SCI.

Third, a person's *skill at operating his/her wheelchair* can influence mobility. If unable to properly use and manoeuver one's wheelchair to its highest functional purposes, a person with SCI may not be able to engage the physical environment in an effective manner. Routhier et al. (2003) suggest that proper training can help people acquire new wheelchair skills for participation in daily activities. For those living with SCI in Canada, there is no uniform rehabilitation program that teaches people how to properly use a wheelchair or develop their wheelchair skills capacity, resulting in disparities in wheelchair skills and mobility across individuals (Solutions, 2009). As mentioned earlier, although mobility is a multidimensional construct, the focus of this thesis was on the wheelchair skills aspect of mobility in people living with SCI.

Consequences of Poor Mobility

Poor mobility in the SCI population has many consequences. Physical inactivity may be a major result of poor wheelchair mobility. It is well known that regular physical activity can improve mental and physical health for people living with SCI (Latimer, Martin Ginis & Hicks, 2005). Additionally, aerobic fitness and muscular strength are positively associated with the amount of physical activity a person with SCI participates in (Latimer, Martin Ginis, Craven & Hicks, 2006b). Physical inactivity, however, is associated with an increased risk for type 2 diabetes, cardiovascular disease and obesity (Buccholz & Bugaresti, 2005), which are prevalent in the SCI population (Fraser, Rideout, Teasell & Foulon, 2008).

With regards to physical inactivity, Fitzgerald & Keller (2007) showed that a relationship exists between mobility and obesity in the SCI population. That is, obesity has a negative effect on one's physical and psychological capacities to perform daily activities (e.g., transferring, wheeling, etc.), which in turn, does not allow for a person to engage in physical activity that will decrease weight or improve physical fitness. Furthermore, people living with SCI may be impacted even more by physical inactivity as this population is already at risk for a plethora of other health issues. It is clear that the association between mobility and physical activity, in the SCI population, is an important relationship that needs to be explored further.

Types of Physical Activity

Physical activity, in the SCI population, can be broadly separated into three categories: Leisure-Time Physical Activities (LTPA), Activities of Daily Living (ADL) and Instrumental Activities of Daily Living (IADL). In general, LTPA refers to activities a person chooses to engage in during his/her free time and requires physical effort to complete (Godin & Shepard, 1985). Examples of LTPA are exercising, hobbies (e.g., gardening, woodworking) and playing sports (e.g., wheelchair tennis, sledge-hockey, and racing). Conversely, ADLs consist of activities that are essential for self-care, like bathing, dressing and feeding oneself while IADLs are additional activities that compliment daily living, such as housework, grocery shopping and managing medication (Lawton & Brody, 1969; Spector, Katz, Murphy & Fulton, 1987). IADL and ADL differ from LTPA because they are performed with a goal in mind, other than physical fitness enhancement or leisure. Evidence suggests that IADL and ADL have little fitness and health enhancing benefits for people living with SCI (Hetz, Latimer & Martin Ginis, 2009; Latimer et al., 2006b), thus, most physical activity research focuses on LTPA. The present study is consistent with this approach and focuses on LTPA.

Physical Activity and SCI

In a Canadian study that focused on the amount of LTPA performed, it was found that, on average, people with SCI participated in 27.14 (± 49.36) minutes of LTPA per day, with 50.1% reporting no LTPA whatsoever (Martin Ginis et al., 2010b). Latimer et al. (2006b) further revealed that the amount of minutes spent doing ADL far surpassed those of LTPA. In another study focused on physical activity in the SCI population, researchers found that there was a considerable decline in physical activity post-discharge when compared to in-patient stay (van den Berg-Emons et al., 2008). It is possible that this post-discharge decline in physical activity was due to mobility issues (e.g., not being able to get out of the house, not being able to wheel to the gym).

Although many people living with SCI do not engage in LTPA on a regular basis, there is considerable evidence suggesting positive benefits associated with physical activity. For instance, certain physical activities (e.g., swimming) have been associated with better overall motor scores (da Silva, de Oliveira, Conceicao, 2005), muscle strength (Hjeltnes & Wallberg-Henriksson, 1998), improved mean muscle fibre area (Stewart et al., 2004), upper body strength (Hicks et al., 2003) and physical fitness (Latimer et al., 2006b; Heesterbeek, Berkelmans, Thijssen, van Kuppevelt, Hopman & Duysens, 2005).

Physical activity interventions have also led to improvements in aerobic fitness for people living with SCI (Sutbeyaz, Koseoglu & Gokkaya, 2005). In addition, a literature review conducted by Fernhall, Heffernan, Jae & Hedrick (2008) showed that resistance training can help improve bone and lean tissue composition, and increase one's metabolism. This review also demonstrated that sedentary adults with SCI have stiffer arteries when compared to age-matched controls, which is an independent predictor of stroke and coronary heart disease (Mattace-Raso et al., 2006).

Previous SCI research also supports the positive benefits physical activity has on a person's psychosocial well-being and community integration. For instance, those who participate in regular physical activity report less pain, fewer bouts of depression, lower levels of fatigue and lower levels of anxiety (Tawashy, Eng, Lin, Tang & Hung, 2009). Blinde & McClung 's (1997) study showed that people with physical disabilities who engaged in recreational activities (e.g., weight lifting, tennis, tai-chi) reported greater control in both their physical and social lives. A meta-analysis conducted on a total of 21 studies showed a positive, small to medium-sized relationship between physical activity and subjective well-being among people living with SCI (Martin Ginis, Jetha, Mack & Hetz, 2009). In addition, regularly performed physical activity is associated with feelings of empowerment, motivation for continued exercise involvement, enhancement in one's quality of life, better mood states and greater functional capacity (Giacobbi, Stancil, Hardin & Bryant, 2008).

A comparison between sport participants and non-sport participants, within the SCI population, revealed that those who participated in sports reported higher community integration and reintegration to normal living (McVeigh, Hitzig & Craven, 2009). Although current studies show a relatively low level of community involvement by people living with SCI, a locomotor training intervention revealed its ability to improve mobility and integration within the community (Behrman et al., 2005). In addition to this, Fernhall et al. (2008) attribute the successful performance of ADL, which are essential to community integration, to regular physical activity. The results and conclusions drawn from the aforementioned studies highlight the importance of physical activity. However, in order to gain from these benefits, one must actively participate.

Participating in LTPA

The ability to participate in LTPA is related to personal characteristics and environmental factors. Attitudes, motivation, lack of energy and number of social contacts have been shown to influence the amount of LTPA a person with SCI performs (Buffart, Westendorp, van den Berg-Emons, Stam & Roebroeck, 2009). In addition to these findings, people living with a lower injury level (i.e. paraplegic) are only marginally more physically active and physically fit when compared to those with higher injury levels (Bostom, Toner, McArdle, Montelione & Stein, 1991; Martin Ginis et al., 2010b; Washburn & Hedricks, 1997). This emphasizes the fact that there are determinants of physical activity for this population other than injury level (Fernhall et al., 2008). However important these factors may be, the ability to actively search for and acquire physical activities is largely based on one's mobility. Without adequate mobility, people living with SCI may not be able to participate in their favourite LTPA, especially if that activity takes place outside of the home (e.g., wheelchair basketball).

Mobility can influence the amount of physical activity performed in a variety of different ways. Many studies have addressed the accessibility (i.e., structurally and architecturally) and barriers that people with SCI face on a daily basis (Scelza, Kalpakjian, Zemper & Tate, 2005; Warms et al., 2007). Not only do issues with accessibility impede on one's day to day activities, like crossing the street or wheeling into a store, but they can also impact whether a person decides to engage in LTPA or not. These structural barriers limit one's ability to actively participate in physical activity. In fact, in a study conducted by Scelza et al., participants reported poor accessibility to fitness facilities, while other studies indicated that, although many facilities may be accessible, only 8% of the exercise equipment was adapted for people with SCI (Cardinal, Kosma & McCubbin, 2004).

The ability to overcome such barriers can be seen as a facet of mobility. Those who are adequately mobile will have more opportunities to participate in sports-related physical activities that require one's wheelchair to be in constant movement (e.g., wheelchair racing). Carpenter, Forwell, Jongbloed & Backman (2007) have suggested that the participation in sports is facilitated by readily accessible transportation. With better mobility, people with SCI are able to have more efficacious transportation through independent propulsion and better success at overcoming barriers to other means of transportation, like public transit. Having adequate mobility may also play a role in non-sport physical activities such as wheeling around the block, playing with one's pet, or engaging in a hobby. With ample mobility, these LTPA could be accomplished by many people living with SCI.

Finally, mobility may not only facilitate physical activity through physical function but by psychosocial means as well. That is, by being mobile with one's wheelchair, people living with SCI may be more confident in using their wheelchair to engage in physical activities and more confident in overcoming barriers to LTPA. The concept of self-efficacy may help to explain mobility's role in physical activity participation.

Self-Efficacy

Self-efficacy is a key construct within Social Cognitive Theory (SCT; Bandura, 1986). Self-efficacy is a form of social cognition and refers to situation specific self-confidence, where it is a person's belief in his/her own abilities to perform the specific behaviours needed to accomplish a certain task (Bandura, 1997). Self-efficacy has been linked to physical activity participation in both the able-bodied and SCI populations (Lox, Martin Ginis & Petruzzello, 2006).

According to Self-Efficacy Theory (SET; Bandura, 1977), past performance accomplishments, vicarious experiences, social persuasion and physiological state/affect are the four primary sources of self-efficacy. Past performance accomplishments refer to the "degree of success perceived by an individual who has previously engaged in activities similar to, or same as, the current behaviour" (Lox et al., 2006, p. 48). Vicarious experiences occur when a person views the performance of a behaviour by another, who is similar in personal, physical or demographic characteristics as the viewer. Social persuasion is concerned with verbal and nonverbal tactics used to increase a person's self-efficacy. Lastly, physiological and affective states are concerned with feelings of pain, soreness, anxiety, enjoyment or even sweating associated with a behaviour. These physiological and affective states may further affect one's self-efficacy for the behaviour in question (Lox et al.). The concept of self-efficacy has helped to explain health promotion, disease prevention, physical activity, and other health-related behaviours (Bandura, 1997; 2004).

Self-efficacy is an important construct to investigate as it is associated with future behaviour and behaviour change (Holloway & Watson, 2002). By determining a person's self-efficacy for a specific behaviour (e.g., self-efficacy in using a wheelchair), one can predict the likelihood of that behaviour in the future (e.g., using the wheelchair for mobility purposes). For example, Cumming, Salkeld, Thomas & Szonyi (2000) looked at mobility issues in a sample of senior adults. This study demonstrated that seniors who had high scores on a fall-related self-efficacy scale (i.e., self-efficacy in fall-prevention) also had decreased risks of falling 12-months later. This study shows self-efficacy's ability to predict mobility-related outcomes. Additionally, the importance of studying self-efficacy is highlighted by Holloway & Watson when they suggested that further focus on self-efficacy would bring about greater success in health promotion and positive behaviour change.

Self-Efficacy in Physical Activity Research

Various forms of self-efficacy have been examined in past physical activity studies. For example, exercise self-efficacy (Fletcher & Banasik, 2001; Kinne, Patrick & Maher, 1999), exercise task self-efficacy (Rodgers, Hall, Blanchard, McAuley & Munroe, 2002), coping self-efficacy and barrier self-efficacy (Arbour-Nicitopoulos, Martin Ginis & Latimer, 2009) have been studied in past literature. Exercise self-efficacy refers to a person's confidence in performing bouts of exercise or exercise routines and is a significant predictor of the adoption and maintenance of exercise behaviours (Fletcher & Banasik). A validity study conducted on an exercise self-efficacy scale showed that regular exercisers reported significantly higher exercise self-efficacy scores when compared to non-exercisers (Kroll, Kehn, Ho & Groah, 2007). In contrast, exercise task self-efficacy is one's confidence in performing elements of an exercise task (Rodgers et al.). For example, a person who has high confidence in his ability to maintain an exercise at a recommended heart rate, specific duration, or with specific movements (i.e., proper form) would be considered to have high exercise task self-efficacy (Rodgers et al.). Coping self-efficacy is a person's confidence in performing a behavioural task under challenging situations (Maddux, 1995). Within a physical activity context, coping self-efficacy can be defined as one's confidence in performing LTPA in spite of challenging situations. A subtype of coping self-efficacy is barrier self-efficacy

(Arbour-Nicotopoulos et al.). Barrier self-efficacy refers to a person's confidence in his/her abilities to prevail over obstacles to perform a specific behaviour (Bandura, 1997).

Having good wheelchair mobility may improve a person's confidence in overcoming specific barriers to LTPA. With better wheelchair mobility, people will have more positive wheelchair mobility experiences, therefore being reflected in their confidence to overcome barriers to LTPA. For example, wheelchair mobility may improve peoples' confidence in their abilities to be more efficient in the amount of time required for LTPA participation (e.g., organizing equipment, transferring into adaptive machinery) and improving the number of transportation options to and from LTPA. In addition, with proper wheelchair mobility, a person's confidence in performing LTPA without formal supervision may improve as well. Lastly, a person with adequate wheelchair mobility may also overcome certain weather conditions because they have the confidence in their wheelchair skills to perform LTPA in light of environmental influences. For this reason, it is worth examining the relationship between wheelchair mobility and one's belief in his/her ability to overcome these barriers. More specifically, it is of particular interest to determine the relationship between one's wheelchair mobility and exercise barrier self-efficacy.

Exercise Barrier Self-Efficacy

Exercise barrier self-efficacy is one's confidence in his/her abilities to overcome specific barriers to engage in exercise (or LTPA). Originally, McAuley & Mihalko

(1998) developed a barrier self-efficacy questionnaire to determine adults' perceived capabilities to exercise five times a week while facing circumstances that may prevent exercise participation (e.g., pain and discomfort, boredom). Other researchers have adopted modified versions of this measure to suit their target sample or research question (Nigg & Courneya, 1998; Arbour-Nicitopoulos et al., 2009). For example, Arbour-Nicitopoulos et al. modified the original scale by only including 6 items that assessed confidence to overcome barriers that were identified as salient among people with SCI.

Exercise barrier self-efficacy has shown relatively strong relationships with physical activity and exercise behaviour, but mainly in able-bodied populations (Hausenblas, Nigg, Downs, Fleming & Connaughton, 2002). In a study conducted by DuCharme & Brawley (1995), exercise barrier self-efficacy was a significant predictor of behavioural intentions, which was shown to be the best predictor of exercise attendance in novice exercisers. In recent physical activity studies, researchers have noted the importance of improving one's barrier self-efficacy in order to facilitate LTPA behaviour (Latimer, Martin Ginis & Arbour, 2006a). Exercise barrier self-efficacy has demonstrated significant correlations with exercise self-efficacy and scheduling-efficacy and has shown to be a significant predictor of exercise attendance in beginner exercisers (Bray, Gyurcsik, Culos-Reed, Dawson & Martin, 2001) and a statistically significant predictor of exercise frequency and intensity in an able-bodied population (McAuley, 1992).

With regards to the SCI population, exercise barrier self-efficacy has shown mixed results regarding its ability to predict exercise and LTPA behaviour. Arbour-Nicitopoulos et al. (2009) showed that exercise barrier self-efficacy, alone, was not significantly associated with exercise maintenance, but argued the possibility of it being more predictive of exercise adoption. Latimer et al. (2006a) showed large effects for the change in barrier self-efficacy when comparing an intervention group (i.e., participants who formed implementation intentions to exercise) to a control group of people with SCI. Barrier self-efficacy, however, was never analysed with LTPA to provide an association between the two variables and a statistically significant relationship was not established.

When studying people with SCI, researchers must take into account a person's means of mobility when trying to overcome barriers in order to pursue LTPA or exercise behaviour. The wheelchair, as mentioned before, is integral to one's mobility. The ability to engage in exercise behaviours may also be explained by the confidence a person has in using his/her wheelchair. That is, wheelchair-use self-efficacy may help to explain the relationship between wheelchair mobility and LTPA.

Wheelchair-Use Self-Efficacy

To date, a formal definition of wheelchair-use self-efficacy does not exist as it is a new construct being explored in this study. With guidance from Bandura (1997) and his definition of general self-efficacy, we have developed a working definition of wheelchair use self-efficacy. Specifically, wheelchair-use self-efficacy refers to a person's confidence in his/her abilities to use a wheelchair when interacting with the physical, free-living environment. These interactions include negotiating various terrains, manoeuvring one's wheelchair through different spaces and dealing with different weather conditions that may influence wheelchair mobility.

Wheelchair mobility may also be positively related to this particular definition of wheelchair-use self-efficacy. That is, people with greater wheelchair mobility may draw from their positive wheelchair mobility experiences and reflect those experiences in their confidence in using a wheelchair. For instance, people with greater wheelchair mobility due to practice or training may have greater confidence in operating their wheelchairs to perform meaningful skills, such as ascending inclines, wheeling over uneven surfaces or performing a wheelchair wheelie, based on previous successful attempts. Previous studies have shown that people who are more confident in using their assistive mobility devices are more likely to use them on a daily basis (de Boer, Peeters, Ronday, Mertens, Huizinga & Vliet Vlieland, 2009), therefore reaping the benefits of being adequately mobile. Other studies have found that the amount of practice (personal experience – the most important source of self-efficacy) one has had with his/her mobility device is associated with the ability to successfully operate and use it effectively (Best, Kirby, Smith & Macleod, 2005). These findings suggest that the higher people's self-efficacy for using their wheelchairs, the more often they will use them for purposeful movement, such as engaging in various forms of LTPA.

Measuring Self-Efficacy

Similar to other behaviour-specific self-efficacies, wheelchair-use self-efficacy and exercise barrier self-efficacy include the dimensions of *level*, *strength* and *generality* (Bandura, 1977). The *level* of self-efficacy refers to the belief an individual has in his/her ability to accomplish various portions of the task, while *strength* refers to the degree of conviction for successfully accomplishing such tasks. With regards to wheelchair-use self-efficacy, a person may have very high confidence (*strength*) for getting up a short curb, but that confidence may decrease when he/she must overcome a very tall curb (*level*). Conversely, a person may have low confidence (*strength*) when ascending a steep incline, but relatively high confidence in descending this steep incline (*level*). Lastly, *generality* is the degree to which the behaviour-specific self-efficacy carries over to another task similar in nature (Bandura). For example, a person's self-efficacy for heavy intensity wheelchair racing may carry over to a person's self-efficacy for playing wheelchair sports (e.g., wheelchair basketball, wheelchair rugby). With regard to the generality of exercise barrier self-efficacy, it is possible that a person's self confidence to overcome barriers to exercise is applicable to overcoming barriers in community participation (e.g., going to a social event despite having transportation problems) or other forms of LTPA participation (e.g., wheeling around the block).

According to Bandura (1977), it is imperative to measure self-efficacy using the previously mentioned dimensions as a guideline. Traditionally, the dimensions of *level* and *strength* have been used to create an operational score for a specific type of self-efficacy. The current study followed these suggestions, along with the principle of concordance. Concordance implies that the self-efficacy measure and the performance criteria (i.e., outcome variable) match in terms of construct specificity (Moritz, Feltz, Fahrback & Mack, 2000). For example, a study with acceptable concordance would assess a person's confidence in wheelchair tennis (i.e. measure self-efficacy playing a match in tennis) to predict a person's overall wheelchair tennis competitive record data. Moritz et al. state that studies with measures that do not match their measures concordantly will yield weaker predicted relationships. For this particular study, efforts were made to use concordant measures of mobility and self-efficacies.

In particular, the Wheelchair Skills Test version 4.1 (Kirby et al., 2004; Kirby, Swuste, Dupuis, Macleod & Monroe, 2002; Wheelchair Skills Test Version 4.1 [WST 4.1], 2008) was used to measure wheelchair mobility, while the Wheelchair Mobility Confidence Scale (WMCS; Rushton & Miller, 2009) was used to measure wheelchair-use self-efficacy. The WST 4.1 tests participants' abilities to perform specific wheelchair skills that would be essential for wheelchair mobility, while the WMCS measures participants' confidence to perform specific wheelchair-mobility related tasks. For example, participants were asked to wheel across a 10 degree incline on the WST 4.1 and were later asked about their self-efficacy for wheeling up steep slopes in the WMCS.

Summary

Theory-driven research allows scientists to better evaluate the relationships between constructs. The SCT (Bandura, 1986) and SET (Bandura, 1977) provide a framework for the present thesis examining the association between wheelchair mobility, wheelchair-use self-efficacy, exercise barrier self-efficacy and physical activity in people with SCI. A better understanding of mobility's role in physical activity may help to improve, change and even challenge the focus of rehabilitation programs. This study will examine how one's wheelchair mobility is associated with the amount of LTPA a person engages in, and if wheelchair-use self-efficacy and exercise barrier self-efficacy mediate this relationship.

Mediational analyses can be used to explain how and why two concepts are related to one another (Fairchild & McKinnon, 2009). In essence, a mediational analysis is interested in explaining the relationship of an independent variable and dependent variable by a third (mediating) variable. For this thesis, we state that the potential positive relationship between wheelchair mobility and LTPA is explained by self-efficacy. Mediation is useful for demonstrating a statistically plausible chain of events where the predictor causes the mediator, and in turn, the mediator influences the outcome variable. With regards to this thesis, it is proposed that wheelchair mobility leads to greater self-efficacy, and in turn, greater self-efficacy leads to greater LTPA participation.

Figures 1 and 2 (refer to Appendix A) illustrate the relationships of interest in this thesis, with the predictor variable (wheelchair mobility) and the outcome variable (LTPA). Both Figures 1 and 2 demonstrate how wheelchair mobility may be associated with physical activity, but are explained by wheelchair-use self-efficacy or exercise barrier self-efficacy. Figure 1 illustrates the mediated relationship, with the mediator being wheelchair-use self-efficacy while Figure 2 illustrates the mediator being exercise barrier self-efficacy. Lastly, Figure 3 illustrates the generic mediation process, where the predictor-outcome relationship becomes non-significant when the mediator is accounted for. This is the first study to examine these relationships within an SCI context.

Study Purpose

Using a cross-sectional design, Bandura's (1986) Social Cognitive Theory and Self-Efficacy Theory (1977) were used as a framework to determine whether wheelchair-use self-efficacy and exercise barrier self-efficacy mediate the relationship between wheelchair mobility and leisure-time physical activity (LTPA) in people with spinal cord injury (SCI)

Hypotheses

Informed by Bandura's Social Cognitive Theory (1986), Self-Efficacy Theory (1977) and evidence from past studies, the following hypotheses were proposed:

1. Wheelchair mobility will be positively associated with leisure-time physical activity.
2. Wheelchair-use self-efficacy will be a significant mediator of the relationship between wheelchair mobility and leisure-time physical activity.
3. Exercise barrier self-efficacy will be a significant mediator of the relationship between wheelchair mobility and leisure-time physical activity

Method

Participants

The study sample consisted of 46 participants: 26 from Toronto and 20 from Quebec City. Study participants had a mean age of 47.2 years (± 12.4), with the most common cause of injury being motor vehicle accidents (45.7%). Participants averaged 14.5 years (±12.3) of manual wheelchair experience.

The majority of participants were Caucasian (63%) and male (76.1%). In addition, most of the participants were paraplegics (80.4%) and almost half of the sample (47.8%) had motor-sensory complete injuries, according to the American Spinal Injury Association (ASIA, 2002). A total of 37% were classified as visible minorities (i.e., Asian, Black, Native Canadian). The mean BMI for participants was 25.9 kg/m² (±6.8), which falls within the average BMI for people with SCI (i.e., 20kg/m² to 27kg/m²), according to a study by Buccholz & Bugaresti (2005). With regards to education and marital status, exactly 50% of the participants had post-secondary school degrees and almost half (45.7%) were single. Based on these characteristics, the participants in this study were considered representative of the Canadian SCI population (CPA, 2000; CIHI; 2006). Additional demographic information can be found in Table 1 (Appendix C).

Participant recruitment. The majority of the participants were recruited from regions surrounding Toronto, Ontario and Québec City, Québec. In addition, several participants were recruited from a volunteer research participant database that was created from the McMaster University site of the Study of Health and Activity in People with Spinal Cord Injury (SHAPE-SCI; Martin Ginis et al., 2008), where the majority of these people lived within the Toronto, Ontario region.

The participants were tested at the Toronto Rehabilitation Institute – Lyndhurst Centre (TRI) or Institut de Réadaptation en Déficience Physique de Quebec (IRDPQ). It should be noted that the current study was part of a larger project that was initiated at Université Laval. The larger project was also concerned with wheelchair activity profiles, wheelchair user profiles, satisfaction with assistive technology, and distances travelled while using a wheelchair. The TRI Research Ethics Board, McMaster Research Ethics Board and IRDPQ - Research Ethics Board approved all study protocols. Consent forms are included in Appendix B.

Participants from Québec received the French version of the study, where all measures and self-report questionnaires were administered in French. In addition, all verbal communication was administered in French by the student investigator at the Québec City data collection site. It is worth noting that all measures used in this study were "back-translated" (Vijver & Hambleton, 1996) to ensure equivalency in both languages.

Inclusion and exlusion criteria. Prior to joining this study, all potential participants were screened on the basis of the following inclusion/ exclusion criteria. Participants were included if they were:

- A person with SCI, incurred at least 12 months prior to recruitment
- A paraplegic (both high and low) or tetraplegic (complete or incomplete)

- Using a manual wheelchair as their main means of mobility and have used it for at least 12 months and for at least 4 hours a day, at the time of this study
- 18 years of age or older

Participants were excluded from this study if they:

- Used a power wheelchair as their main means of mobility
- Had a previous myocardial infarction or other heart condition, as assessed by project the coordinator
- Had a cognitive impairment, as assessed by the project coordinator using our adapted version of the Mini-Mental State Examination (MMSE; Folstein, Folstein & McHugh, 1975) administered over the telephone. If a participant answered any question incorrectly, he/she was excluded from this study. All potential participants that were contacted did not have any cognitive impairment. The MMSE can be found in Appendix B.

Sample Size

Given the lack of previous research on mobility's relationship with LTPA and self-efficacy in people with SCI, it was difficult to precisely estimate sample size. Thus, we aimed for a sample size of 60 participants, which was based on very preliminary data suggesting a medium- large sized relationship ($r = \sim.40$) between mobility and physical activity (Manns & Chad, 1999). An effect-size is the magnitude of difference between test groups or the magnitude of a relationship (Portney & Watkins, 2000). According to Cohen (1992), correlations (r) are classified as having small, medium or large effect sizes if $r = .10$, $r = .30$ or $r =.50$, respectively. We managed to obtain a sample size of 46, which gave us 80% power to detect statistically significant correlations in the medium-large effect size range (Cohen)).

Measures

The following measures are included in Appendix B.

1. **Demographics.** The demographic data collected were the participant's birth date, age, gender, level and severity of injury, date of injury, cause of injury, the number of years post-injury, wheelchair experience, ethnicity, education and marital status. The demographic data collection sheet used to obtain this information has been previously used in other physical activity research involving the SCI population (Martin Ginis et al., 2008). The project coordinator was responsible for collecting demographic information over the telephone. This data collection sheet took approximately 5 minutes to complete.
2. **Wheelchair mobility.** Mobility was determined using the Wheelchair Skills Test version 4.1 for manual wheelchair users (WST 4.1; Kirby et al., 2004; Kirby et al., 2002; WST 4.1, 2008), which required participants to perform skills that were specific to wheelchair mobility (e.g., getting over a low curb or wheeling around obstacles). Performance of these activities was monitored and scored by a trained investigator. The WST 4.1 consisted of 32 wheelchair-related skills that were attempted by the participant. Participants received either a pass or a fail for each skill on the test. The scores participants received were based on their

performance (accomplishing the skill) and safety (accomplishing the skill safely). Performance scores and safety scores were scored separately and are two entirely different concepts. For the purposes of this thesis, only performance scores were used to determine wheelchair mobility. Performance scores were created by dividing the number of skills successfully passed by the number of applicable skills. Certain skills may have been classified as "no part" or "not tested." For example, some participants were unable to fold their wheelchair due to lack of necessary parts, and not due to a lack of skill, which would be recorded as "no part." Certain skills (e.g., ascending a 15cm curb) were "not tested" if easier skills (e.g., ascending a 2cm curb) were not passed successfully. Performance scores were only influenced by the "no part" classification and were not influenced by the "not tested" classification as per scoring guidelines (WST 4.1, 2008).

Participants were verbally instructed to perform certain skills by the trained student investigator. For example, one of the components of the WST 4.1 (Kirby et al., 2004; Kirby et al., 2002; WST 4.1, 2008) was to ascend a 15cm curb. The trained student investigator would say to the participant, "Please ascend this 15cm curb." In no way did the student investigator teach or give advice to a participant while performing a wheelchair skill. The participant was allowed to adjust, remove or modify his/her wheelchair during the WST 4.1 in ways he/she saw fit (e.g., remove anti-tip devices to perform a 30-second "wheelie"). In addition, participants were not allowed to use any devices they did not already have when attending the testing session. For example, participants who required a transferring board to perform the "ground-to-wheelchair transfer skill" were required to have it in their possession (e.g., in their backpacks or on their wheelchair) in order to use it during this assessment.

For all skills performed, the student investigator used a "spotter strap" to help control participants if they were about to tip or lose their balance. The "spotter strap" was attached to the bottom of participants' wheelchairs and adjusted to the appropriate length of the "spotter" (i.e. student investigator conducting the test). This protocol was developed by Kirby et al. (2002), as a precaution for people attempting wheelchair skills in an unsafe manner.

Participants were allowed a second attempt at a skill if their first attempt was unrepresentative of their actual skill or if there was something clearly unfair about the first attempt (e.g., somebody walking in the participant's way). A second attempt was not permitted if the first attempt was not safe. The allowance of second attempts was not routine, but was left to the discretion of the tester. Participants' scores were converted into percentages once the WST 4.1 (Kirby et al., 2004; Kirby et al., 2002; WST 4.1, 2008) was completed. Performance scores on the WST 4.1 were used to determine wheelchair mobility of the participants. It took approximately 30 minutes to complete the WST 4.1, which is consistent with past studies (Kirby et al., 2004).

3. **Wheelchair-use self-efficacy.** The Wheelchair Mobility Confidence Scale (WMCS; Rushton & Miller, 2009) was used to assess wheelchair-use self-efficacy. In particular, the "Confidence Interacting with the Physical Environment" subscale from the WMCS was used to assess wheelchair-use self-efficacy. The WMCS is an interviewer-administered questionnaire containing 33 items that determined a participant's self-efficacy to use his/her wheelchair in a variety of situations while interacting with the physical environment (e.g., "As of now, how confident are you moving your wheelchair through freshly mowed grass?" and "As of now, how confident are you ascending a 15cm curb without a curb cut?"). Each item on the questionnaire was rated using a Likert-scale, ranging from 0 to 100 (0 = not confident; 50 = moderately confident; and 100 = completely confident). A mean wheelchair-use self-efficacy score was calculated by summing the WMCS items to obtain a total, and dividing by the number of items on this scale (i.e. 33). This questionnaire took participants approximately 10 minutes to complete and showed acceptable internal consistency (α =.98).
4. **Exercise barrier self-efficacy.** A modified version of McCauley & Mihalko's Barrier Self-Efficacy Questionnaire (BSEQ; 1998) was used to determine self-efficacy in overcoming obstacles to exercise performance (i.e., exercise barrier self-efficacy). The BSEQ was modified to suit the SCI population with regards to the most salient barriers to LTPA and has been used in previous SCI physical activity studies (Arbour-Nicitopoulos et al., 2009; Latimer et al., 2006a). The

BSEQ used in this thesis was comprised of six barriers to LTPA performance for people living with SCI (e.g., transportation problems, not having someone to help you exercise). The definition of LTPA was explained thoroughly to the participant, examples of LTPA were listed, and participants were encouraged to ask questions if anything was unclear.

Each question on the BSEQ (McAuley & Mihalko, 1998) began with: "Assuming you were very motivated, how *confident* are you that you will participate in moderate to heavy LTPA for 30 minutes, at least 3 days per week over the next month even if you have transportation problems?" Exercise barrier self-efficacy was measured using the same Likert-type scale as the WMCS (0 = not confident; 50 = moderately confident; and 100 = completely confident). The total exercise barrier self-efficacy score was divided by the number of items on this measure (i.e., six) to provide a mean score for each participant. The BSEQ (McAuley & Milhalko) took approximately 5 minutes to complete and showed acceptable internal consistency (α =.88).

5. **Physical activity.** Physical activity (PA) was measured using the Physical Activity Recall Assessment for People with Spinal Cord Injury (PARA-SCI; Martin Ginis, Latimer, Hicks & Craven, 2005). The PARA-SCI is a questionnaire that measures the type, frequency, duration and intensity of PA performed in the past three days. Self- reported PA was further classified as either activities of daily living (ADL) or leisure-time physical activities (LTPA). Participants

reported each ADL and LTPA they performed in the past 3-days, and told the interviewer the duration and intensity of each activity (e.g., resistance training at mild intensity, for 45 minutes). Participants also had a chart (which contained descriptions of each intensity type) in front of them as they completed the questionnaire (Appendix B). This measure has shown test-retest reliability, construct validity and criterion validity in previous studies (Martin Ginis et al., 2005; Latimer et al., 2006b). The PARA-SCI took approximately 20-30 minutes to complete, depending on the amount of physical activity reported by the individual.

Although information on mild, moderate and heavy LTPA was collected, consistent with other SCI-physical activity studies, (Arbour-Nicitopoulos et al., 2009; Latimer et al., 2006b) only moderate and heavy LTPA were used to test the hypotheses in this thesis. Previous studies have indicated that moderate and heavy LTPA data are more valid and reliable than mild LTPA data (Phang, Martin Ginis, Latimer, Arbour-Nicitopoulos, 2010; Martin Ginis et al., 2005). In addition, other studies have shown that moderate and heavy LTPA associated with physical and psychological well-being, while mild LTPA is not (Acree et al., 2006; Martin Ginis et al.; Yu, Yarnell, Sweetnam & Murray, 2003).

Procedure

This study used a cross-sectional design. Trained student investigators administered all aforementioned tests and interview-questionnaires. The research coordinator at the TRI and IRDPQ sites recruited participants, administered consent forms and collected demographic data.

Initial contact[1]. The project coordinator made initial contact with potential participants drawn from the database, while other potential participants contacted the project coordinator first. Using a telephone script developed for studies involving the SCI population (Latimer et al., 2006b), the project coordinators introduced themselves to the participants and fielded questions about the study. Here, verbal consent was obtained and participants were scheduled to be tested. To reduce scheduling conflicts, participants were given the opportunity to choose the time and day of their assessment, therefore reducing the possibility of rescheduling or hastening any of the tests conducted.

Assessment[2]. The student investigator greeted each participant and reminded the participant of his/her rights to discontinue the study at any time. The trained student investigator first administered the WST 4.1 (Kirby et al., 2004; Kirby et al., 2002; WST 4.1, 2008) and attached all necessary safety devices as indicated by protocol. The participant attempted to complete these wheelchair-related skills, and was given a score reflective of his/her performance. One of the skills was a wheelchair-to-bench transfer. This skill required a person to successfully transfer their entire body (upper and lower) from his/her wheelchair to a flat bench. Once transferred and lying on the bench, participants' body compositions were measured for demographic data collection purposes. This was done to avoid an additional and unnecessary transfer after the WST 4.1.

After the WST 4.1 (Kirby et al., 2004; Kirby et al., 2002; WST 4.1, 2008), the participants were given 5 minutes to rest and recuperate before the Wheelchair Mobility Confidence Scale (WMCS; Rushton & Miller, 2009) was administered. The WMCS was conducted in person, with the participants' responses recorded by the student investigator. After the WMCS, the student investigator administered the Barrier Self-Efficacy Questionnaire (BSEQ; 1998). The BSEQ was conducted in the same manner as the WMCS.

Following the BSEQ, participants received a physical activity intensity classification index that was necessary for the completion of the PARA-SCI (Martin Ginis et al., 2005). The student investigator explained the definitions of mild, moderate and heavy physical activity and made sure the participant understood the difference between the three intensities. This chart was present throughout the PARA-SCI and participants were encouraged to make reference to it at anytime. Once the PARA-SCI was completed, the participant was officially finished with the study. Participants were mailed their compensation along with a debriefing package containing the performance score on the WST 4.1 and their body composition (BMI).

Statistical Analyses

Data were analyzed using Predictive Analytics SoftWare (PASW) Statistics version 18. Using this software, the descriptive statistics for the study variables were calculated and can be found in Table 2 (Appendix C). The following statistical analyses were conducted to address the hypotheses. A p-value of < 0.05 was used to determine statistical significance in all analyses.

The association between wheelchair mobility and LTPA performance (Hypothesis 1) was determined using a linear regression. LTPA was regressed on wheelchair mobility, and the standardized regression coefficient (β) was used to determine the significance of the association. With only one predictor (wheelchair mobility), the β in a linear regression model is equivalent to a Pearson's product moment correlation (r).

To test if wheelchair-use self-efficacy and exercise barrier self-efficacy were mediators of mobility-LTPA (Hypothesis 2 and Hypothesis 3), the following statistical tests were conducted as per suggestions from Baron & Kenny (1986) and Frazier, Tix & Baron (2004):

First, linear regression equations were used to test pathways A, B, C and C' as illustrated in Figures 1 and 2 (Frazier et al., 2004). To test Path A, the mediator (wheelchair-use self-efficacy or exercise barrier self-efficacy) was regressed on the predictor variable (wheelchair mobility) to establish that Path A exists in the meditational chain. To test Path B, the outcome variable (LTPA) was regressed on the mediating variable. To test Path C, the outcome variable (LTPA) was regressed on the predictor (wheelchair mobility) to establish if there was, indeed, a relationship to mediate. To test Path C', the relationship between the predictor and outcome was estimated, while controlling for the mediator. A complete mediating effect is said to exist if the predictor-outcome relationship results in zero, when controlling for the mediating variable. Partial mediation occurs when the predictor-outcome relationship is significantly smaller, after controlling for the mediating variable (Frazier et al., 2004).

Second, because tests of mediation lack power in small samples, the data were bootstrapped with 10,000 replications (Preacher & Hayes, 2004). To test the significance of the mediated effect, a Sobel test was conducted on the bootstrapped estimates (Baron & Kenny, 1986; Sobel, 1982). A Sobel test determines statistical significance by dividing the product of the unstandardized regression coefficients of Paths A and B (refer to Figure 1 and 2) by a pooled standardized error of Paths A and B. A significant Sobel test statistic is $p < .05$.

Third, the magnitude of the mediating effects was calculated as ab/c (Kenny, 2010), where each variable in this equation is the unstandardized regression coefficients for their respective paths (i.e., a = Path A regression coefficient).

Results

Assumptions of Regression

Before analyzing the data, it was imperative that the assumptions for linear regression were met. Frequency histograms, residual scatter plots and normal probability plots were examined in order to ensure normality of distributions, linearity of relationships between variables, and homoscedasticity of the data for each linear regression analysis used in the mediation models. Covariance matrices and collinearity statistics were examined to determine whether there was multicollinearity between the predictor variables. Analyses indicated that bivariate correlations did not exceed the maximum tolerance ($r = .90$; Tabachnick & Fidell, 2001).

The LTPA data, however, were positively skewed and did not represent a normal distribution. In order to address this issue, LTPA scores underwent necessary statistical transformation (i.e., log transformation; Portney & Watkins, 2000). A transformation is a "mathematical conversion of a distribution to a different scale by a constant to change the shape or variance characteristics of the distribution" (Portney & Watkins, p. 732). A base 10 log transformation was used as it has shown precedence in normalizing skewed data in previous studies (Portney & Watkins). Before the log transformation, a value of one was added to all LTPA data in order to address the issues that would arise when attempting to log transform the zeros that existed in the dataset (i.e., a log transformation of a zero would create an error). After transforming LTPA data, moderate and heavy intensity LTPA were summed to create a total LTPA score. Essentially, this log transformation remedied the problem of non-normal residuals and established a normal distribution for LTPA. Specifically, the skewness (1.12) and kurtosis (.49) values indicated a normal distribution for LTPA data (Tabachnick & Fidell , 2001).

Descriptive Findings

The means and standard deviations of the primary variables of interest were determined. A series of Analyses of Variance (ANOVA) were conducted to determine if there were any significant differences in the variables of interest, across the data collection sites. In general, wheelchair mobility scores for Toronto participants (M = 80.83 ± 12.88) were almost identical to Quebec City participants (M = 80.01 ± 11.74) and were relatively high (i.e., maximum score was 100). In addition, wheelchair-use self-efficacy scores and exercise barrier self-efficacy scores were not significantly different ($p > .05$) across the data collection sites. Only LTPA (i.e., log moderate + log heavy LTPA) showed a significant difference ($p < .05$) between the Toronto and Quebec City participants (M = 1.13 ± 1.09; M = .49 ± .87, respectively). Additional descriptive findings are presented in Table 2. For descriptive purposes, the correlation matrix for the study variables is shown in Table 3a, while Tables 3b and 3c show the correlation matrices for the Toronto and Quebec City testing sites, respectively (Appendix C).

Hypothesis Testing

Hypothesis 1: Wheelchair mobility will be positively associated with leisure-time physical activity. Overall, a significant positive association between wheelchair mobility and LTPA was observed ($\beta = .29, p < .05$). This value can be seen in Step 1 of Tables 4 and 5 (Appendix C).

Hypothesis 2: Wheelchair-use self-efficacy will be a significant mediator of the relationship between wheelchair mobility and LTPA. The paths tested in this regression model can be seen in Figure 1 and Table 4. Step 1 tested for Path C, the wheelchair mobility-LTPA relationship, and as alluded to previously, this was significant (Path C: $\beta = .29, p < .05$). Step 2 tested for Path A, where wheelchair-use self-efficacy was regressed on wheelchair mobility. This regression showed a significant positive relationship between these two variables (Path A: $\beta = .73, p < .05$). Step 3, however, demonstrated that wheelchair-use self-efficacy was not significantly associated with LTPA (Path B: $\beta = .16, p > .05$). In Step 4, the inclusion of wheelchair-use self-efficacy into the linear regression equation improved wheelchair mobility's predictive ability ($\beta = .37$) while making the wheelchair-use self-efficacy and LTPA relationship negative ($\beta = -.11$). It is possible that wheelchair-use self-efficacy acted as a suppressor, which is a variable that improves the predictive ability of other independent variables in the regression equation it is added to (Shrout & Bolger, 2002). That is, after adding wheelchair-use self-efficacy to the regression equation, the variance shared between wheelchair-use self-efficacy and wheelchair mobility was accounted for, which allowed the variance shared between wheelchair mobility and LTPA to increase proportionally. These results indicate that wheelchair mobility did not mediate the mobility- LTPA relationship.

Hypothesis 3: Exercise barrier self-efficacy will be a significant mediator of the relationship between wheelchair mobility and LTPA. The paths tested in this regression model can be seen in Figure 2 and Table 5. Step 1 tested for Path C, the wheelchair mobility-LTPA relationship, and a significant relationship was found (Path C: $\beta = .29$, $p < .05$). Step 2 tested for Path A, where exercise barrier self-efficacy was regressed on wheelchair mobility and a significant positive relationship was shown (Path A: $\beta = .44$, $p < .05$). Step 3 indicated a significant relationship between exercise barrier self-efficacy and LTPA (Path B: $\beta = .38$, $p < .05$), as well. Satisfying the initial three steps, step 4 proceeded. In step 4, wheelchair mobility was no longer significantly associated with LTPA (Path C': $\beta = .15$, $p > .05$), when exercise barrier self-efficacy was included as a predictor in the regression model. Exercise barrier self-efficacy, however, remained a significant predictor of LTPA (Path B: $\beta = .31$, $p < .05$). This multiple-linear regression model indicated that the necessary conditions for mediation were met and partial mediation was observed (Baron & Kenny, 1986). This is considered partial mediation because the predictor-outcome relationship (wheelchair mobility –LTPA relationship) was significantly smaller, but was not reduced to zero, when exercise barrier self-efficacy was taken into account (Frazier et al., 2004).

Next, the model was bootstrapped with 10,000 replications (MacKinnon, Fairchild & Fritz, 2007; Preacher & Hayes, 2004) and the significance of the mediated effect was tested with a Sobel test. The bootstrapped betas (regression coefficients) for these models are shown in Table 6 (Appendix C). The Sobel test in the bootstrapped model indicated a significant mediated effect, 95% upper and lower CIs = .0015, .0232. This is considered statistically significant because the confidence interval does not include zero.

Using the bootstrapped values, the variance explained by wheelchair-use self-efficacy in the wheelchair mobility – LTPA relationship was calculated. This was calculated as *ab/c* (Kenny, 2010), where *a* = the unstandardized regression coefficient for the regression of exercise barrier self-efficacy on wheelchair mobility, *b* = the unstandardized regression coefficient for the regression of LTPA on exercise barrier self-efficacy while accounting for wheelchair mobility, and *c* = the unstandardized regression coefficient for the regression of LTPA on wheelchair mobility, alone. The total variance explained by exercise barrier self-efficacy was 47.7% and it was concluded that exercise barrier self-efficacy was a significant partial mediator of the wheelchair mobility-LTPA relationship.

Discussion

The purpose of this study was to determine whether wheelchair-use self-efficacy and exercise barrier self-efficacy would mediate the relationship between wheelchair mobility and leisure-time physical activity (LTPA) in people with spinal cord injury (SCI). In summary, two of the three hypotheses were supported. The findings and their implications are discussed in the following sections.

Hypothesis 1: Wheelchair Mobility – LTPA Association

A significant, medium-sized (Cohen, 1992), positive association was established between wheelchair mobility and LTPA. This finding supports hypothesis 1 and is consistent with preliminary research that also demonstrated positive associations between mobility and physical activity in people with SCI (Manns & Chad, 1999). This finding also parallels the positive association between mobility and sport-specific LTPA found in people living with SCI (Anneken, Hanssen-Doose, Hirschfeld, Scheuer & Thietje, 2010).

Clearly, the strength of the wheelchair mobility-LTPA relationship was modest, indicating that other factors are related to LTPA among people with SCI besides wheelchair mobility. Indeed, other statistically significant correlates of LTPA among people with SCI are gender, injury characteristics, age (Martin Ginis, et al., 2010b) and neighbourhood characteristics (Arbour-Nicitopoulos, Martin Ginis, Wilson & The SCI Research Group, 2010). Similarly, Latimer & Martin Ginis (2005) also demonstrated that attitudes, subjective norms, intentions, and perceived behavioural control were significant predictors of LTPA. The modest association between wheelchair mobility and

LTPA further illustrates the complex nature of LTPA. Wheelchair mobility is one of many other variables that are of importance to participation in LTPA.

This modest association may also be partially explained by the possibility that participants performed LTPA that did not require substantial wheelchair skills/mobility. A recent study demonstrated that the most common LTPA performed by people with SCI was resistance training and individual fitness routines (Martin Ginis et al., 2010a), activities that may require very little wheelchair mobility (i.e., participants can be lifting weights without ever moving their wheelchairs). In the same study, it was reported that few physically active people (18%) with SCI participated in wheelchair sports (Martin Ginis et al., 2010a). It can be argued that the successful participation in wheelchair sports is more dependent on wheelchair mobility than resistance training and most fitness routines. Indeed, Wu & Williams (2001) reported that people with SCI had difficulty learning wheelchair skills associated with playing wheelchair sports, and thus, had difficulty participating in wheelchair sports. These findings suggest that participation in wheelchair sports requires greater use of wheelchair skills, making the importance of wheelchair mobility greater for this particular type of LTPA and not as influential on the forms of LTPA that were probably most common among our participants in the present study (e.g., resistance training).

Hypothesis 2: Wheelchair-Use Self-Efficacy as a Mediator

Wheelchair-use self-efficacy was not a significant mediator of the wheelchair mobility-LTPA relationship. However, individual paths within the mediation model

(Figure 1) showed that wheelchair mobility was positively associated with wheelchair-use self-efficacy. This finding is in support of the principles of Self-Efficacy Theory (SET; Bandura, 1977) which state that self-efficacy is positively related to behaviour (Bandura, 1989). Furthermore, of the four sources of self-efficacy (i.e., personal mastery/past performance accomplishments, vicarious experience, social persuasion and physiological/affective states), personal mastery/past performance accomplishments have the strongest influence on self-efficacy (Bandura, 1997).

Presumably, the wheelchair skills test provided a mastery experience for the participants in the study, which was later reflected in their wheelchair-use self-efficacy. Those who experienced greater mastery on the wheelchair mobility test had more positive accomplishments on which to base their self-efficacy estimates. In addition, participants' everyday interactions with wheelchairs provided mastery experiences for them to draw from when reporting wheelchair-use self-efficacy. Given that personal mastery/ past performance accomplishments influence self-efficacy more than any other source of self-efficacy (Bandura, 1997), it is not surprising that a positive association emerged between wheelchair mobility and wheelchair-use self-efficacy.

The positive association between wheelchair mobility and wheelchair-use self-efficacy extends findings from previous literature. In particular, positive associations between assistive device use and self-efficacy in using the device have been reported in people living with knee osteoarthritis (de Boer et al., 2009). Specifically, de Boer et al. (2009) showed that self-efficacy was positively related to the number of times a day people with knee osteoarthritis used their assistive device (i.e., walkers, special shoes) for mobility purposes. The present results extend de Boer's findings by showing mobility's relationship to wheelchair use self-efficacy among people living with SCI. In addition, a skill-based measure of mobility was used in the present thesis in comparison to de Boer's et al. (2009) self-reported measures of assistive device usage through frequency of use. This particular study by de Boer et al. focused on different assistive devices and was not specifically concerned with wheelchairs.. . Our study was concerned with wheelchairs specifically, and used a skill-based test to assess wheelchair mobility, improving the specificity of the type of mobility being studied. The present study's findings also extend previous research that has reported a positive relationship between mobility and sport-specific self-efficacy amongst wheelchair athletes (Greenwood, French & Dzewaltowski, 1990) by showing that the relationship between mobility and self-efficacy generalizes to non-athletes and other relevant types of self-efficacy. Thus, taken together, the results from the present study make an important contribution to the mobility literature by showing the importance of wheelchair mobility to wheelchair-use self-efficacy in people with SCI.

Contrary to hypothesis, wheelchair-use self-efficacy and LTPA were not significantly associated. This finding does not support the principles of SET (Bandura, 1977) which suggests greater self-efficacy should lead to greater energy invested in pursuing and maintaining the behaviour in question (Ajzen & Madden, 1986; Bandura, 1997). We assumed that wheelchair-use self-efficacy would be a type of self-efficacy necessary for the performance of LTPA, as people with SCI often use their wheelchairs to perform a variety of activities. Presumably, greater wheelchair-use self-efficacy would reflect greater LTPA.

However, Bandura (1997) states that little efficacy value is derived from behaviours performed with external assistance as people are likely to credit these accomplishments to external aids rather than personal capabilities. People with SCI may believe that their ability to perform LTPA is strongly based on external assistance (i.e., personal care workers, trainers helping them set up equipment) rather than their own capabilities. This principle may help to explain the non-significant relationship between wheelchair-use self-efficacy and LTPA. That is, people with SCI may not attribute their LTPA participation to wheelchair-use self-efficacy, but rather external assistance. In addition, Bandura (1997) states that success in behaviour achieved through laborious amounts of effort can actually lower self-efficacy. It is possible that the amount of effort needed to accomplish LTPA, by people with SCI, lowers their self-efficacy to a point where it cancels out any positive association that may exist between wheelchair-use self-efficacy and LTPA. Thus, although the observed relation between wheelchair-use self-efficacy and LTPA is not consistent with the tenets of SET (Bandura, 1977), the SCI population's characteristics may help to explain the null relationship.

Bandura (1997) also suggests that self-efficacy measures must be suited to the behaviour in question and representative of the domains within that behaviour. Wheelchair-use self-efficacy was determined using a questionnaire (WMCS; Rushton &

Miller, 2009) that included wheelchair-related tasks which most participants were highly confident in accomplishing. It is possible that this particular questionnaire does not discriminate between beginner, intermediate and advanced wheelchair mobility skills, thus, creating a ceiling effect for self-efficacy scores and undermining the ability to detect a relationship with LTPA.

Another possible explanation for the non-significant association between wheelchair-use self-efficacy and LTPA may be explained by the types of LTPA that people with SCI engage in. As previously noted, a recent study of 357 physically active paraplegics and tetraplegics (Martin Ginis et al., 2010a) reported that very few participated in wheelchair sports (18%). The most common types of LTPA reported were resistance training and individual fitness routines (Martin Ginis et al.). Although these types of LTPA may require some form of self-efficacy for using a wheelchair, sports participation may be more influenced by wheelchair-use self-efficacy than any other form of wheelchair-based LTPA. This is because a wheelchair sport (e.g., wheelchair basketball) requires a person to be highly skilled with the wheelchair at all times, whereas other forms of LTPA do not require the same degree of confidence and skill in using one's wheelchair. Thus, if we had looked at the correlation between wheelchair-use self-efficacy and sport participation we may have seen a significant relationship.

The non-significant association between wheelchair-use self-efficacy and LTPA is contrary to past literature which shows a positive association between task self-efficacy and physical activity (McAuley, 1992). In particular, research has shown that greater exercise task self-efficacy is related to greater exercise participation (measured in frequency), in able-bodied samples (e.g., middle-aged adults; McAuley, 1992). Also, research has shown that sport-specific self-efficacy (i.e., self-efficacy for wheelchair racing) is related to race performance (measured in race results), in a sample of people with SCI (Martin, 2002). Our results may have differed from previous findings due to the characteristics of the population being studied and the broad scope of our definition of LTPA. Unlike the participants in McAuley's (1992) study, our participants had mobility limitations and may have had other secondary health complications (i.e., pressure sores, bladder infection) that limited participation in LTPA, despite having strong wheelchair-use self-efficacy. In addition, our task self-efficacy measure was not specifically tailored to LTPA, unlike Martin's (2002) measure of wheelchair racing self-efficacy, which was used to predict a specific type of LTPA (i.e., wheelchair racing) and showed concordance between the study variables. These differences could help to explain the non-significant relationship between wheelchair-use self-efficacy and LTPA.

Hypothesis 3: Exercise Barrier Self-Efficacy as a Mediator

Exercise barrier self-efficacy was a significant partial mediator of the wheelchair mobility-LTPA relationship. Individual paths within the mediation model (Figure 2) showed that wheelchair mobility was positively associated with exercise barrier self-efficacy which was, in turn, positively associated with LTPA. The results from hypothesis 3 support and uphold the principles of SET (Bandura, 1977), which state that mastery is related to self-efficacy and self-efficacy is positively related to behaviour (Bandura, 1989).

Again, it can be argued that the wheelchair skills test provided a personal mastery experience for participants to reflect upon when their exercise barrier self-efficacy was measured. It is possible that participants who did well on the wheelchair skills test were more aware of, and more confident in, their abilities to perform skills useful for overcoming barriers to LTPA. For instance, participants need to use wheelchair mobility skills to overcome barriers such as wheeling to the gym due to transportation problems, transferring on and off exercise equipment without assistance, and having adequate mobility to overcome time restraints to LTPA. People who displayed these skills during the wheelchair skills test may have, in turn, felt more efficacious about their ability to apply their mobility to manage LTPA barriers. Personal mastery/past performance accomplishments have the strongest influence on self-efficacy (Bandura, 1997). The positive association between wheelchair mobility and exercise barrier self-efficacy makes sense and is consistent with the tenets of SET (Bandura, 1977).

The current results extend previous literature that has studied people with mobility limitations and their barriers to exercise participation (Rasinaho et al., 2006). Similar to many other studies, Rasinaho et al. demonstrated that people with more severe mobility limitations report a larger number of barriers to LTPA. The current study builds on Rasinaho et al's findings by showing mobility's association (in people with mobility limitations) with people's self-confidence in overcoming barriers to LTPA. This is the first study to examine and demonstrate this relationship. The current study also strengthens the results from Rasinaho et al. (2006) by using a skill-based test to determine mobility, rather than a self-report measure of walking mobility. The skill-based test used in the present thesis adds a level of specificity to the type of mobility being studied (i.e., wheelchair mobility), whereas Rasinaho et al. used a face-to-face interview focused on "yes" or "no" responses to a participant's ability to walk a specific number of kilometres. It is clear that Rasinaho et al. were not focused on including assistive technology such as wheelchairs in their assessment of mobility. In summary, our findings expand on past research and establish a positive relationship between mobility and self-efficacy in overcoming barriers to LTPA. Furthermore, the current findings make an important contribution to mobility literature by demonstrating the importance of wheelchair mobility to exercise barrier self-efficacy in people with SCI and potentially others with mobility limitations.

Individual paths within the mediation model (Figure 2) also showed that exercise barrier self-efficacy was positively associated with LTPA. This positive association supports the principles of SET (Bandura, 1977). According to SET, exercise barrier self-efficacy should be positively associated with the amount of LTPA performed because participants with high self-efficacy will invest more energy and persist longer (Bandura, 1997) in overcoming barriers to LTPA.

Exercise barrier self-efficacy is different from task self-efficacy as it reflects a more cognitively complex conceptualization of self-efficacy, by capturing one's confidence in overcoming challenges to behaviour and not simply performing the behaviour itself (Bandura, 1977). According to Bandura (1997), self-efficacy for getting oneself to perform LTPA in light of personal, social and situational obstacles is more important than task self-efficacy when determining exercise adherence. Bandura (1997) further suggests that a lack of exercise barrier self-efficacy is predictive of poor adherence to organized forms of exercise. Likewise, it is quite possible that self-confidence in overcoming barriers is paramount in predicting LTPA among people with SCI. Although barriers to LTPA exist for the able-bodied population as well, people with SCI are affected much more by what may be trivial obstacles for others. For example, if an able-bodied person needs to find transportation to exercise at a gym, many public options are often readily available. Conversely, people with SCI do not have access to the same resources (e.g., wheelchair-accessible bus). The influence of these barriers can be even greater in comparison. Our finding that exercise barrier self-efficacy was significantly associated with LTPA, while wheelchair-use self-efficacy was not, further speaks to the centrality of barrier self-efficacy to LTPA participation and supports the tenets of SET (Bandura, 1977).

In addition, Scelza et al. (2005) determined that architectural and structural barriers were among the most frequently cited barriers to exercise in people living with SCI. The current findings extend Scelza et al.'s study by suggesting that if people have greater exercise barrier self-efficacy, these structural barriers will not be as great of an impediment to LTPA participation. As well, Rasinaho et al. (2006) showed that people with more severe mobility limitations reported more barriers to exercise, such as poor health, lack of companionship, negative past experiences and accessibility. Again, the current study extends Rasinaho et al.'s findings by suggesting that if we can improve people's confidence to overcome barriers to LTPA, we can increase the amount of LTPA they participate in.

Finally, the current results extend previous studies that have looked at the exercise barrier self-efficacy-LTPA relationship in people with SCI (Arbour-Nicitopoulos et al., 2009, Latimer et al., 2006a). Previous studies have failed to demonstrate the statistical significance of exercise barrier self-efficacy to intervention-related changes in LTPA (Arbour-Nicitopoulos et al.; Latimer et al.). In addition, previous studies have not analyzed exercise barrier self-efficacy as their main research objective, in people with SCI (Arbour-Nicitopoulos et al.; Latimer et al.). This is the first study to show significant direct associations between exercise barrier self-efficacy and LTPA in a SCI sample.

Implications

Wheelchair mobility-LTPA association. Although the wheelchair mobility-LTPA relationship was modest, the results show the importance of wheelchair mobility for the participation in LTPA and shed light on a relatively new relationship that has held little attention in previous research. This positive association between wheelchair mobility and LTPA advocates the need for standardized wheelchair skills training programs to be available in rehabilitation centres. With standardized wheelchair skills training programs, people with SCI will have the opportunity to improve or maintain their wheelchair skills; thus, they can develop adequate wheelchair mobility to participate in LTPA. The current findings suggest that people with SCI have some degree of control over the amount of LTPA they perform through improvements in mobility. This is an idea that warrants further study.

Self-efficacy as a mediator. Although wheelchair mobility was related to wheelchair-use self-efficacy (task self-efficacy), wheelchair-use self-efficacy was not a significant mediator of the wheelchair mobility- LTPA relationship. Rather, the important mediator was exercise barrier self-efficacy as it was shown to be a significant partial mediator.

The present study is the first to examine the mediating role of exercise barrier self-efficacy on the wheelchair mobility- LTPA relationship in a sample of people with SCI. This finding has practical implications for improving LTPA participation, within a rehabilitation context. Exercise barrier self-efficacy questionnaires can be used as assessment tools to profile participants who want to increase their LTPA participation. By encouraging participants to learn specific wheelchair skills that will deal with barriers to their preferred LTPA, they may be more likely to overcome the physical barriers associated with their preferred LTPA. Other barriers that are unaffected by mobility (e.g., not having someone to exercise with, motivational barriers) can then be addressed through counseling, education, or other strategies, thereby improving exercise barrier self-efficacy and improving the likelihood of LTPA participation.

The current results also have theoretical implications for understanding the wheelchair mobility-LTPA relationship. These findings provide support for Bandura (1997), who suggests that perceived self-efficacy for the behaviour itself (e.g., task self-efficacy) is not as important as the efficacy to overcome obstacles to the behaviour, especially for behaviours that need to be performed regularly for desired results (i.e., LTPA). It is clear that Bandura's (1997) theorizing is supported, as exercise barrier self-efficacy was a significant mediator while wheelchair-use self-efficacy is not. From a theoretical perspective, these results support the idea that overcoming barriers to the behaviour surpasses task self-efficacy when predicting participation. In summary, the current results demonstrate the importance of exercise barrier self-efficacy and its practical and theoretical implications for the wheelchair mobility-LTPA relationship in people with SCI.

Limitations

It is important to address the limitations of the present study. The biggest limitation to the current study is the temporal ordering of the variables with regards to mediation analysis. MacKinnon (2008) suggests that single-mediator models assume temporal precedence, whereby the predictor precedes the mediator, and the mediator precedes the dependent variable. In our case, the constructs should have been measured in the following order: Wheelchair mobility, self-efficacy, leisure-time physical activity. The Toronto participants followed this order, but the Quebec City participants did not. In addition, MacKinnon suggests that the measurement of the predictor, mediator and dependent variable should appropriately match the true timing of change in the predictor, mediator and dependent variable. That is, measurements should take place as change in the variables take place. The current study administered all measures in one assessment which did not appropriately match the true timing of change in wheelchair mobility, self-efficacy and LTPA. This design could have limited the mediators' (i.e., wheelchair-use self-efficacy and exercise barrier self-efficacy) association with the dependent variable (i.e., LTPA).

Second, a number of items on the WST 4.1 (Kirby et al., 2004; Kirby et al., 2002; WST 4.1, 2008) were relatively easy to accomplish, resulting in many participants obtaining high wheelchair mobility scores. The WST 4.1 is based on a pass/fail system, making the quality and efficiency of the skill performed indistinguishable between participants. For future studies, including an index on how well a person completed each skill would help to resolve this problem (e.g., barely able to complete skill, satisfactory in completing skill, thoroughly competent in completing skill). If many participants complete the same skill, an index of how well each individual completed the skill will help to differentiate performance levels between participants. In addition, the WMCS (Rushton & Miller, 2009) does not distinguish between the easy, moderate or difficult skills making it problematic to separate wheelchair-use self-efficacy into different levels. As noted by Bandura (1977), it is important for self-efficacy scales to have the dimensions of *strength* and *level* present, in order for self-efficacy to be measured properly. For future studies, the items on the WMCS should be separated into three distinct categories of beginner, intermediate and advanced skills, with the previously mentioned index to determine how well each skill is performed. With an equal representation of items in each category, this will satisfy the dimensions of *strength* and *level*, previously mentioned.

Another notable limitation is the statistically significant difference ($p < .05$; Table 2) in LTPA scores across Toronto and Quebec City participants. This difference may be attributed to the time of the year when data collection occurred (i.e., October 2009 – March 2010). Specifically, weather has been shown to influence the amount of LTPA performed in an able-bodied population (Pivarnik, Reeves & Rafferty, 2003). In addition to influencing total LTPA, weather has shown to change the type of LTPA performed and the intensity of energy expenditure as well (Pivarnik et al.), which can help to explain the lower LTPA in Quebec participants, as the winter climate in that region does not promote outdoor LTPA. Follow-up weather analysis showed that, indeed, Quebec City participants were subject to greater amounts of precipitation and lower overall temperatures during data collection in comparison to Toronto participants (National Climate Data and Information Archive [NCDIA], 2010). Specifically, Quebec City participants experienced a mean temperature = 1.72°C and mean precipitation = 75.07cm, while Toronto participants experienced milder weather with a mean temperature = 5.2°C and mean precipitation = 49cm (NCDIA, 2010).

Differences in participant demographics respective of the data collection site may also help to explain the significant difference in LTPA participation. With reference to

Table 1, participants from Toronto were more ethnically diverse than Quebec City participants. These different ethnicities may have different values or beliefs that promote LTPA participation in comparison to the predominantly Caucasian sample from Quebec City. In addition, causes of SCI may help to explain the difference in LTPA participation between data collection sites. It is clear that Quebec City participants had a larger proportion of people incurring SCI from a traumatic means, thereby changing one's motor and/or sensory abilities almost instantly. Toronto participants, however, had a larger proportion of participants who incurred SCI from other non-traumatic means, making their SCI progressive and allowing them more time to prepare for and experiment with adaptive LTPA. Lower education levels in the Quebec City participants may also help to explain the differences in LTPA participation between data collection sites. Previous studies have shown that those with less than a highschool education report little or no control in fitting regular physical activity into their daily lifestyles. Conversely, those with higher levels of education report higher levels of physical activity participation (Canadian Fitness and Lifestyle Research Institute [CFLRI], 2008).Lastly, the order of the WST 4.1 and self-efficacy scales differed depending on the data collection site. Participants in Ontario performed the WST 4.1 first, while Quebec City participants completed questionnaires first. According to Bandura (1997), the self-efficacy questionnaires should have been administered after the WST 4.1 to allow every participant a consistent mastery experience before determining their self-efficacy. This inconsistency in administering the tests and questionnaires was an oversight that wasn't detected until data collection was completed. Post hoc analysis confirms these procedural differences had no effect on the magnitude of the relationships between constructs.

Directions for Future Research

The present study provides support for the principles of SET (Bandura, 1977) in addition to shedding light on a previously understudied relationship (wheelchair mobility – LTPA) in the SCI population. However, further research is required to develop a better understanding of this relationship and its impact on people living with SCI. In the present study, two constructs were proposed as potential mediators to this relationship where, in truth, there are many other important constructs that could play a part in determining LTPA participation. For instance, community participation and wheelchair satisfaction may be other potential mediators of the wheelchair mobility – LTPA relationship. With this said, it would be interesting to see if a multiple mediation model can be applied to understand the wheelchair mobility – LTPA relationship. From these models, intervention or health promoting programs can be developed to focus on the most effective mediators to target for behaviour change while disregarding ineffective or counterproductive variables (MacKinnon, 2008). By applying a multiple mediation model, it could be possible to fully explain the wheelchair mobility – LTPA relationship.

Another suggestion for future research would be to examine the role of mobility-related barriers in the wheelchair mobility- LTPA relationship. This concept can be examined in future research by exploring other barriers to LTPA that are influenced by mobility such as access to community programs, accessibility of fitness facilities and architectural barriers to LTPA. With additional research on mobility-related barriers to LTPA, we can pinpoint the most influential barriers to LTPA, and invest resources to help people with SCI overcome these obstacles.

Lastly, in order to address the main limitation of this thesis, future research should use an experimental design and ensure measures are administered in temporal order. For example, future research could assess wheelchair mobility across several time points, perhaps during an intervention, in order to truly determine whether improvements in wheelchair mobility influence self-efficacy, and in turn, improve LTPA. This would allow for inferences of causality regarding the effects of mobility on LTPA and the mediating role of self-efficacy.

Conclusion

In summary, the present study provides preliminary evidence of a positive relationship between wheelchair mobility and LTPA. Exercise barrier self-efficacy was shown to be a significant mediator to the wheelchair mobility – LTPA relationship, while wheelchair-use self-efficacy was not. Importantly, this is the first study to examine the constructs of wheelchair-use self efficacy and exercise barrier self-efficacy and their relation to LTPA among people living with SCI. In addition, this is the first study to demonstrate a statistically significant relationship between exercise barrier self-efficacy and LTPA in people with SCI. The findings have practical and theoretical implications for understanding and improving LTPA participation. In particular, strategies to improve mobility may help increase self-efficacy for overcoming barriers to LTPA and ultimately lead to improvements in LTPA participation.

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Footnotes

[1]Participants from Quebec City were recruited through an archive consisting of people who were once participants in IRDPQ's rehabilitation program. Participants were mailed letters of information and replied by telephone if they were interested in participating.

[2]Participants from Quebec City followed a different order of assessment. They completed their measures in the following order: wheelchair-use self-efficacy (WMCS), exercise barrier self-efficacy (BSEQ), leisure-time physical activity (PARA-SCI), wheelchair mobility (WST 4.1).

Appendix A

Figures 1-3

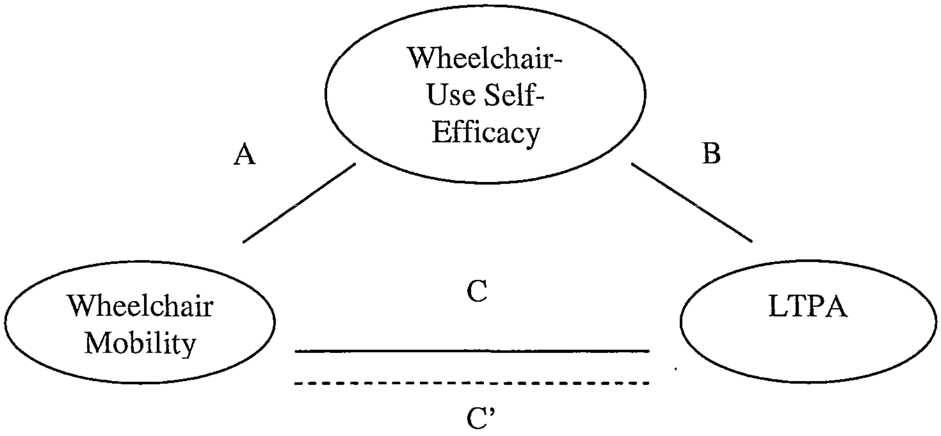

Figure 1. Wheelchair-use self-efficacy as a mediator to the wheelchair mobility - leisure-time physical activity relationship. This figure illustrates the paths tested in the mediation model. Path C: leisure-time physical activity is regressed on wheelchair mobility, Path A: wheelchair-use self-efficacy is regressed on wheelchair mobility, Path B: leisure-time physical activity is regressed on wheelchair –use self-efficacy, and Path C': leisure-time physical activity is regressed on wheelchair mobility while controlling for wheelchair-use self-efficacy

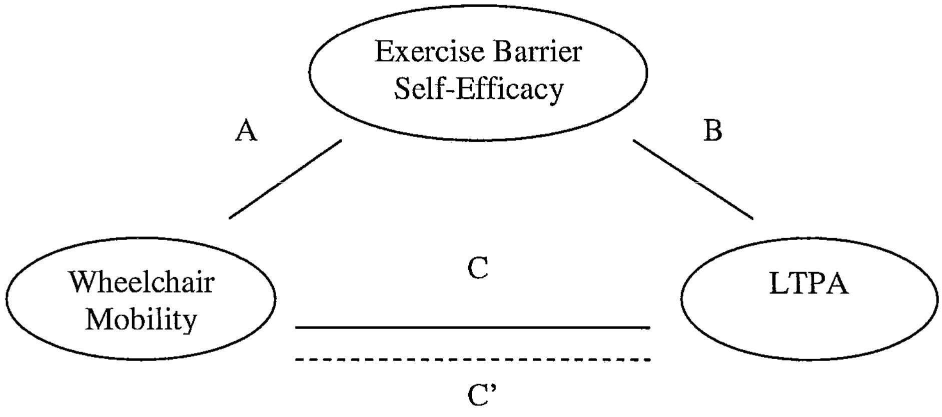

Figure 2. Exercise barrier self-efficacy as a mediator to the wheelchair mobility - leisure-time physical activity relationship. This figure illustrates the paths tested in the mediation model. Path C: leisure-time physical activity is regressed on wheelchair mobility, Path A: exercise barrier self-efficacy is regressed on wheelchair mobility, Path B: leisure-time physical activity is regressed on exercise barrier self-efficacy, and Path C': leisure-time physical activity is regressed on wheelchair mobility while controlling for exercise barrier self-efficacy

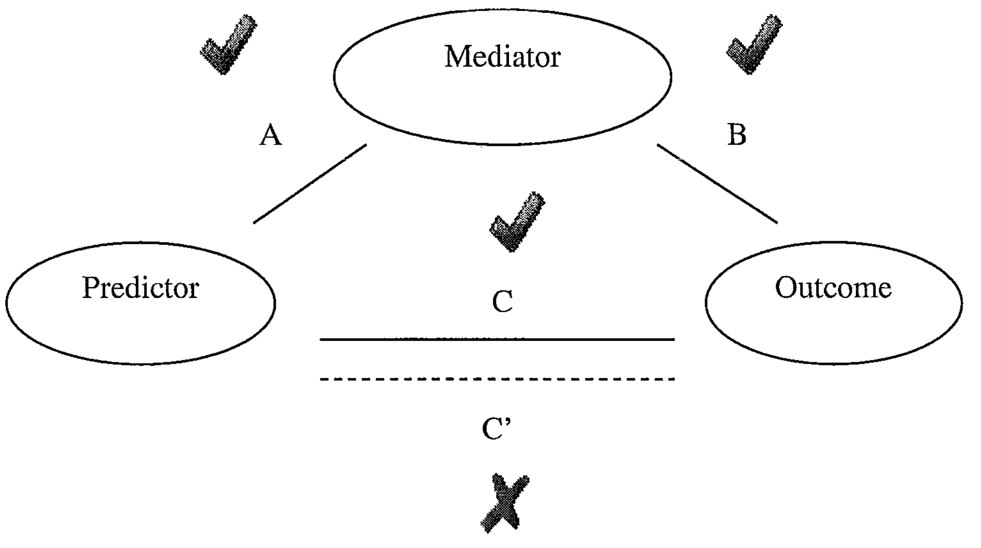

Figure 3. Generic mediation model. This figure illustrates what partial and complete mediation. Both types of mediation result in the predictor-outcome relationship being non-significant when controlling for the mediator. Path C: outcome variable is regressed on predictor variable, Path A: mediator is regressed on predictor, Path B: outcome is regressed on mediator, and Path C': outcome is regressed on predictor while controlling for mediator.

Appendix B

Participant Consent Forms

Mini-Mental State Examination Measure

Wheelchair Skills Test Version 4.1

Wheelchair Mobility Confidence Scale

Exercise Barrier Self-Efficacy Scale

Physical Activity Intensity Classification Index

Wheels in Motion Study

sponsored by the Ontario Neurotrauma Foundation (ONF) grant and the Reseau Provincial de Recherche en Adaptation-Readaptation (REPAR) grant

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Greetings! You are being invited to participate in a study about wheelchair mobility among people with a spinal cord injury (SCI). Should you agree to take part, it is important that you read the information below. The information describes the purpose of the study, risks or benefits to yourself and your right to withdraw at anytime. You will need to understand this information before signing this form. Make sure all your questions have been answered to your satisfaction.

Purpose: The purpose of this study is to see how mobility, physical activity, secondary complications, wheelchair self-confidence and community participation are related to one another. We are asking you to participate because this study can be helpful in providing much needed knowledge about the importance of wheelchair mobility. Also, the information gathered from this study can help to improve rehabilitative programs for people with SCI nationwide. This study will have a total sample size of 60 participants and will last approximately 6 months, including data gathering and analysis, but we will only need 2 days of your time. We are recruiting participants affiliated with the Toronto Rehabilitation Institute (TRI) – Lyndhurst Centre and people who have previously expressed interest in participating in studies regarding physical activity.

In order to participate in this study, you must:

- Have an SCI at the paraplegic or tetra/quadriplegic level
- Use a manual wheelchair as your main mobility device for at least 4 hours a day
- Have had your SCI at least 12 months ago
- Have no cognitive impairments
- Be 18 years of age or older
- Have no history of a heart attack or other cardiac event

Your rights as a participant:

- Participation is completely voluntary
- You have the right to withdraw at any time
- If you refuse to participate in tasks, it does not affect the way research assistants treat you during the study
- Remember: You can choose whether to be in this study or not. If you volunteer to be in this study, you may withdraw at any time without consequences of any kind. You may exercise the option of removing your data from the study. You may also refuse to answer any questions you don't want to answer and still remain in the study. The investigator may withdraw you from this research if circumstances arise which warrant doing so, for example, if performing the task is not possible or if performing a task seems too dangerous for your personal capabilities.
- At the end of the study, each participant will receive his/her scores on the Wheelchair Skills Test and body composition (height and weight).
- Participants will be debriefed and compensated $25.00 at the end of the study.

Participation:

- This study uses a cross sectional design, which means you will be required to participate on two days, where one day there will be measurements at TRI-Lyndhurst centre and the attachment of an activity monitor, the other day you will return the activity monitor
- Participants will be scheduled for one day of measurements at Toronto Rehabilitation Institute (TRI), which will last approximately 2-2.5 hours.
  - A total of 2 trips will be made to TRI
  - 1st trip: wheelchair skills test, questionnaires and attaching activity monitor
  - 2nd trip: returning activity monitor

- The measures on 1st trip: The Wheelchair Skills Test version 4.1 (WST 4.1), interview-administered questionnaires , height and weight, and activity monitor (device attached to wheelchair)
- There are no expected side-effects from these measures
- Activity monitors will be returned to TRI one week after initial measurements, which will be scheduled with participants

Confidentiality:

- All data collected will be stored in a desktop / laptop, secured with password and the latest internet virus protection/ firewall available
- Data gathered may be used in manuscripts to be published, but individuals in the study will never be identified
- The people who have access to this information are the student investigators, co-investigators and the principal investigator if this study
- Personal information will be destroyed at the end of the study
- Hardcopies of data will be stored securely at the institutions involved with this study for a maximum of 5 years, after, they will be destroyed
- Sponsors and other health-related studies will not have access to this information

Potential Benefits:

For Participant

- Participants have the opportunity to exercise and try out various wheelchair skills with trained supervision
- At the end of the study, you will receive the results for your wheelchair skills and body composition measurements which can inform you on your level of mobility, physical activity, and body mass index.
- Potential health issues related to mobility and physical activity can be addressed and identified

For Society

- Increase body of knowledge for mobility's association with physical and psychosocial well-being in the SCI population
- Improve rehabilitative programs and direct attention to mobility's role in the lives of people with SCI

- The results can influence the way people view mobility in the SCI population and improve its level of importance
- Potential to create clinical guidelines from the resulting information

Potential Risks:

- The Wheelchair Skills Test 4.1 requires the use of physical exertion to perform certain tasks and skills
- Note: participants will not be forced to complete tasks they are not comfortable with or are unable to do

If you become ill or are physically injured as a result of participation in this study, medical treatment will be provided. In no way does agreeing to verbal consent waive your legal rights nor does it relieve the investigators, sponsors or involved institutions from their legal and professional responsibilities.

For any questions about rights as a research participant, Dr. Gaetan Tardif (416) 597-3422 ext 3730, Chair of Toronto Rehabilitation Institute Research Ethics Board, will be happy to address any of your questions.

Compensation:

- Upon completion of this study, participants will be presented with $25.00 to off-set the costs for transportation and parking
- Compensation will not be changed even if participants withdraw from the study or choose to not participate in certain aspects of the study.

Want to be a participant in this study?
If you are interested in this study and want to participate, leave your contact information (telephone number, e-mail address) with the project coordinator at TRI-Lyndhurst Institute:

Ms. Jean Hum, M.Sc.
Telephone: **416 - 597-3422 x 6288**
e-mail: Hum.Jean@TorontoRehab.on.ca

Be sure to mention that you are interested in the **"Wheels in motion study"**

Signature of Research Participant/Legal Representative

I understand the information provided for the study "Wheels in motion: Mobility's relationship with physical activity and psychosocial factors in people with SCI" as described herein. My questions have been answered to my satisfaction, and I agree to participate in this study. I have been given a copy of this form.

____

Name of Participant

____

Name of Legal Representative (if applicable)

____

Signature of Participant or Legal Representative

____

Date

Signature of Investigator
In my judgement, the participant is voluntarily and knowingly giving informed consent and possesses the legal capacity to give informed consent to participate in this research study.

____

Signature of Investigator

____

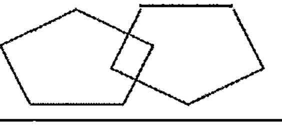
Date

Mini-Mental State Examination (MMSE)

Patient's Name and Date: ______________________________

***Instructions:** Ask the questions in the order listed. Score one point for each correct response within each question or activity.*

Maximum Score	Patient's Score	Questions
5		"What is the year? Season? Date? Day of the week? Month?"
5		"Where are we now: State? County? Town/city? Hospital? Floor?"
3		The examiner names three unrelated objects clearly and slowly, then asks the patient to name all three of them. The patient's response is used for scoring. The examiner repeats them until patient learns all of them, if possible. Number of trials: ___________
5		"I would like you to count backward from 100 by sevens." (93, 86, 79, 72, 65, ...) Stop after five answers. Alternative: "Spell WORLD backwards." (D-L-R-O-W)
3		"Earlier I told you the names of three things. Can you tell me what those were?"
2		Show the patient two simple objects, such as a wristwatch and a pencil, and ask the patient to name them.

1		"Repeat the phrase: 'No ifs, ands, or buts.'"
3		"Take the paper in your right hand, fold it in half, and put it on the floor." (The examiner gives the patient a piece of blank paper.)
1		"Please read this and do what it says." (Written instruction is "Close your eyes.")
1		"Make up and write a sentence about anything." (This sentence must contain a noun and a verb.)
1		"Please copy this picture." (The examiner gives the patient a blank piece of paper and asks him/her to draw the symbol below. All 10 angles must be present and two must intersect.) 
30		TOTAL

<u>Instructions for administration and scoring of the MMSE</u>

<u>Orientation (10 points):</u>

Ask for the date. Then specifically ask for parts omitted (e.g., "Can you also tell me what season it is?"). One point for each correct answer.
Ask in turn, "Can you tell me the name of this hospital (town, county, etc.)?" One point for each correct answer.

<u>Registration (3 points):</u>

Say the names of three unrelated objects clearly and slowly, allowing

approximately one second for each. After you have said all three, ask the patient to repeat them. The number of objects the patient names correctly upon the first repetition determines the score (0-3). If the patient does not repeat all three objects the first time, continue saying the names until the patient is able to repeat all three items, up to six trials. Record the number of trials it takes for the patient to learn the words. If the patient does not eventually learn all three, recall cannot be meaningfully tested.
After completing this task, tell the patient, "Try to remember the words, as I will ask for them in a little while."

Attention and Calculation (5 points):

Ask the patient to begin with 100 and count backward by sevens. Stop after five subtractions (93, 86, 79, 72, 65). Score the total number of correct answers.
If the patient cannot or will not perform the subtraction task, ask the patient to spell the word "world" backwards. The score is the number of letters in correct order (e.g., dlrow=5, dlorw=3).

Recall (3 points):

Ask the patient if he or she can recall the three words you previously asked him or her to remember. Score the total number of correct answers (0-3).

Language and Praxis (9 points):

Naming: Show the patient a wrist watch and ask the patient what it is. Repeat with a pencil. Score one point for each correct naming (0-2).
Repetition: Ask the patient to repeat the sentence after you ("No ifs, ands, or buts."). Allow only one trial. Score 0 or 1.
3-Stage Command: Give the patient a piece of blank paper and say, "Take this paper in your right hand, fold it in half, and put it on the floor." Score one point for each part of the command correctly executed.
Reading: On a blank piece of paper print the sentence, "Close your eyes," in letters large enough for the patient to see clearly. Ask the patient to read the sentence and do what it says. Score one point only if the patient actually closes his or her eyes. This is not a test of memory, so you may prompt the patient to "do what it says" after the patient reads the sentence.
Writing: Give the patient a blank piece of paper and ask him or her to write a sentence for you. Do not dictate a sentence; it should be written spontaneously. The sentence must contain a subject and a verb and make sense. Correct grammar and punctuation are not necessary.
Copying: Show the patient the picture of two intersecting pentagons and ask

the patient to copy the figure exactly as it is. All ten angles must be present and two must intersect to score one point. Ignore tremor and rotation.

Interpretation of the MMSE

Method	Score	Interpretation
Single Cutoff	<24	Abnormal
Range	<21	Increased odds of dementia
	>25	Decreased odds of dementia
Education	21	Abnormal for 8th grade education
	<23	Abnormal for high school education
	<24	Abnormal for college education
Severity	24-30	No cognitive impairment
	18-23	Mild cognitive impairment
	0-17	Severe cognitive impairment

Wheelchair Skills Test 4.1- Manual Wheelchair - Wheelchair User

Name: ______________________________

Date: _______________ Time start: __________

Tester: ______________ Time finish: __________

Scoring Guide
✓ = pass ✗ = fail

NT = not tested (easier skill has been failed)

	Individual Skills	Skill		Safety			Comments
		✓	✗	✓	✗	NT	
1.	Rolls forward 10m						
2.	Rolls forward 10m in 30s						
3.	Rolls backward 5m						
4.	Turns 90° while moving forward L&R						
5.	Turns 90° while moving backward L&R						
6.	Turns 180°in place L&R						
7.	Maneuvers sideways L&R						
8.	Gets through hinged door in both						
9.	Reaches 1.5m high object						
10.	Picks object from floor						
11.	Relieves weight from buttocks						
12.	Transfers from WC to bench and back						
13.	Folds and unfolds wheelchair						No Part ❑
14.	Rolls 100m						
15.	Avoids moving obstacles L&R						
16.	Ascends 5° incline						
17.	Descends 5° incline						
18.	Ascends 10° incline						
19.	Descends 10° incline						
20.	Rolls 2m across 5° side-slope L&R						
21.	Rolls 2m on soft surface						
22.	Gets over 15cm pot-hole						
23.	Gets over 2cm threshold						

24.	Ascends 5cm level change						
25.	Descends 5cm level change						
26.	Ascends 15cm curb						
27.	Descends 15cm curb						
28.	Performs 30s stationary wheelie						
29.	Turns 180° in place in wheelie position [L&R]						
30.	Gets from ground into wheelchair						
31.	Ascends stairs						
32.	Descends stairs						
	Total Percentage Scores						(Total passed

TIPS FOR SCORIN G

No Part: (record "NP")

- The wheelchair does not have the component. This score should only be used if both left and right parts are missing.

Scale for Scoring Skill Performance

Pass: (record "P" or ✔)

- Task independently and safely accomplished. Unless otherwise specified, the skill may be performed in any manner. The focus is on the task requirements, not the method used. Aids may be used.
- A pass may be awarded if the subject passed a more difficult version of the same skill (e.g. if a subject successfully ascends a 15cm curb, a pass may be awarded on the 5cm level change without the subject needing to actually perform the latter).

Fail: (record "F" or ✕)

- Task incomplete.
- Subject requires spotter intervention (verbal or physical).
- Unsafe performance.
- Likely to be unsafe in the opinion of the clinician or tester (e.g. on the basis of the subject's description of how a task will be attempted).
- Unwilling to try.
- Has failed an easier version of the same skill (e.g. if the subject cannot roll forward 10m, he/she need not be asked to roll 100m.
- If a caregiver is the subject of testing, he/she may not enroll the wheelchair occupant to ask for advice or physical assistance in the performance of the skill unless specifically permitted in the caregiver section of the individual skill descriptions.
- Wheelchair part malfunction.

Mandatory Scoring of Individual Skills on Safety

Although a skill must have been performed safely for a pass to be awarded, it is possible to fail in a safe or unsafe manner. For this reason, in addition to scoring each skill on performance, the tester scores each skill for safety. The nature of any potentially dangerous incident should be documented in the Comments section.

Scale for Scoring Skill Safety

Safe: (record "S" or ✓)

- None of the unsafe criteria were met.
- Although a failing performance score will be awarded in such circumstances, a safe score can be awarded to a person who states that he/she cannot do and will not attempt a skill.

Unsafe: (record "US" or ✕)

- Subject requires significant spotter intervention (verbal or physical).
- If a significant acute injury occurred. Significant injuries include sprains, strains, fractures or head injury, but not minor blisters, abrasions or superficial lacerations.
- During screening questions, the subject describes a method of performing a skill that the tester considers dangerous.
- If a caregiver creates more than minimal discomfort or potential harm (e.g. using excessive force with the knee against a flexible backrest of the wheelchair to help push the wheelchair through gravel).
- Specific risks and whether they warrant an unsafe score or merely a recorded comment can be found later in the section on individual skills.

Not Tested: (record "NT")

- If an easier version of the skill has been failed, the skill under consideration is not tested, so it is not possible to determine whether the attempt would have been safe or unsafe.

Left and Right: (L&R)

- For skills with a left and right component, the participant needs to pass the skill on both sides to receive a pass. If the participant is successful on only one side, a fail is awarded and a note should be made in the comment section.

THE WHEELCHAIR MOBILITY CONFIDENCE SCALE

Instructions: This questionnaire will assess your level of confidence when using your wheelchair to do different activities. For this assessment, **confidence refers to your belief in your ability to do the activities itself.**

For example, an answer to the question "How confident are you that you can lift a 5 lb. box?" might be 82%, whereas "How confident are you that you can lift a 10 lb box?" might be 48%.

Answer **all items** even if they are activities you would not normally do or are unsure about.

Rate how confident you are by recording a number from 0 to 100 using the scale below:

0 10 20 30 40 50 60 70 80 90 100

Not Confident — Moderately Confident — Completely Confident

<u>As of now</u>, **how confident are you moving your wheelchair:**	**Confidence Level**
1) around furniture in your own home?	
2) over carpet?	
3) over thresholds, such as between rooms?	
4) over freshly mowed grass?	
5) through snow?	
6) along a paved sidewalk that is cracked and uneven?	
7) through a pothole on a sidewalk?	
8) along a level path with unpacked gravel?	
9) across a street with light traffic, at a crosswalk **without** traffic lights?	
10) across a street with traffic, at a crosswalk **with** traffic lights?	

<u>As of now</u>, how confident are you moving your wheelchair:	**Confidence Level**
11) up a standard ramp?	
12) down a standard ramp?	
13) up a steep slope?	
14) down a steep slope?	
15) down a steep slope and stopping **as soon as** you are off the slope?	
16) through a crowded mall?	
17) through a store with just enough space between the aisles for your wheelchair?	
18) in tight spaces, such as elevators?	
19) through an elevator door?	
20) up a curb cut?	
21) down a curb cut?	
22) over a drainage grate and then up a curb cut?	

<u>As of now</u>, how confident are you moving your wheelchair:	**Confidence Level**
23) down a curb cut then over a drainage grate?	
24) through a puddle then up a curb cut?	
25) down a curb cut then through a puddle?	
26) through slush then up a curb cut?	
27) down a curb cut then through slush?	
28) down a curb cut then though snow?	
29) through snow then up a curb cut?	
30) up a standard height curb (15cm) without a curb cut?	
31) down a standard height curb without a curb cut?	
32) through a doorway you have just opened and then closing the door behind you?	
33) through a doorway with a spring loaded door?	
Total	

THE EXERCISE BARRIER SELF-EFFICACY QUESTIONNAIRE

Rate how confident you are by recording a number from 0 to 100 using the scale below:

0	10	20	30	40	50	60	70	80	90	100
Not Confident					Moderately Confident					Completely Confident

Assuming you were very motivated, how <u>confident</u> are you that you will participate in moderate to heavy *Leisure-Time Physical Activity for 30 minutes, at least 3 days per week over the next month even if:

(a) you feel tired or fatigued ____________

(b) you get busy or have limited time ____________

(c) you have transportation problems ____________

(d) you have pain or soreness ____________

(e) the weather is very bad ____________

(f) you do not have someone to help you exercise ____________

*Leisure-Time Physical Activity: any activity that you choose to do on your free time that requires physical exertion. Ex: Exercising, lifting weights, playing a sport or playing with your pet, hobbies (woodworking, gardening), wheeling around the block. **Please ask** if you are unsure about this definiti

Physical Activity Intensity Classification Index

	Nothing at all	Mild	Moderate	Heavy
How hard are you working?	• Includes activities that even when you are doing them, you do not feel like you are working at all.	• Includes physical activities that require you to do very light work. You should feel like you are working a little bit but overall you shouldn't find yourself working too hard	• Includes physical activities that require some physical effort. You should feel like you are working somewhat hard but you should feel like you can keep going for a long time.	• Includes physical activities that require a lot of physical effort. You should feel like you are working really hard (almost at your maximum) and can only do the activity for a short time before getting tired. These activities can be exhausting
How does your body feel? Breathing & Heart rate	Everything is normal	• Stays normal or is only a little bit harder and/or faster than normal	• Noticeably harder and faster than normal but NOT extremely hard or fast	• Fairly hard and much faster than normal.

Muscles	• Feel loose, warmed-up and relaxed. Feel normal temperature or a little bit warmer and not tired at all	• Feel pumped and worked. Feel warmer than normal and starting to get tired after awhile.	• Burn and feel tight and tense. Feel a lot warmer than normal and feel tired.
Skin	• Normal temperature or is only a little bit warmer and not sweaty	• A little bit warmer than normal and might be a little sweaty	• Much warmer than normal and might be sweaty
Mind	• You might feel very alert. Has no effect on concentration	• Require some concentration to complete	• Requires a lot of concentration (almost full) to complete

Appendix C

Tables 1-7

Table1

Demographic Characteristics of the Sample

Demographic Information	Toronto, Ontario $n = 26$ M (SD)	Quebec City, Quebec $n = 20$ M (SD)	All participants $N = 46$ M (SD)
Age	46.07 (12.54)	48.60 (12.47)	47.17 (12.44)
Gender			
Male	21 (80.8%)	14 (70%)	35 (76.1%)
Female	5 (19.2%)	6 (30%)	11 (23.9%)
BMI (kg/m²)	24.05 (4.13)	28.31 (8.68)	25.91 (6.77)
Lesion Level			
Tetraplegia	5 (19.2%)	4 (20%)	9 (19.6%)
Paraplegia	21 (80.8%)	16 (80%)	37 (80.4%)
Injury Severity			
Complete	9 (34.6%)	13 (65%)	22 (47.8%)
Incomplete	17 (65.4%)	7 (35%)	24 (52.2%)
Cause of Injury			
MVA	10 (38.5%)	11 (55%)	21 (45.7%)
Falls	1 (3.8%)	4 (20%)	5 (10.9%)
Other	5 (19.2%)	4 (20%)	9 (19.6%)

WC Experience (years)	12.11 (11.06)	17.56 (13.33)	14.48 (12.26)
Ethnicity			
White	9 (34.6%)	20 (100%)	29 (63%)
Other	17 (66.4%)	0	17 (37%)
Education obtained			
High School	10 (38.5%)	5 (25%)	15 (32.6%)
College	7 (26.9%)	6 (30%)	13 (28.3%)
University	7 (26.9%)	3 (15%)	10 (21.7%)
Post Graduate	2 (7.7%)	0	2 (4.3%)
Other	0	6 (30%)	6 (13%)
Marital status			
Single	11 (42.3%)	10 (50%)	21 (45.7%)
Common law	3 (11.5%)	2 (10%)	5 (10.9%)
Married	7 (26.9%)	6 (30%)	13 (28.3%)
Divorced	4 (15.4%)	2 (10%)	6 (13%)
Widowed	1 (3.8%)	0	1 (2.2%)
ASIA classification			
A	9 (34.6%)	13 (65%)	22 (47.8%)
B	1 (3.8%)	0	1 (2.2%)

C	9 (34.6%)	6 (30%)	15 (32.6%)
D	7 (26.9%)	1 (5%)	8 (17.4%)
E	0	0	0

Note. Values with percentages (%) are accompanied by count data, *M* = mean, (*SD*) = standard deviation, BMI = body mass index, MVA = motor vehicle accident, WC = wheelchair, ASIA = American Spinal Injury Association.

Table 2

Descriptive Statistics for Wheelchair Mobility, Wheelchair-Use Self-Efficacy, Exercise Barrier Self-Efficacy, and Leisure-Time Physical Activity

Variables of Interest	Toronto participants $n = 26$ M (SD)	Quebec City participants $n = 20$ M (SD)	p
Wheelchair Mobility	80.83 (12.88)	80.01 (11.74)	.83
Wheelchair-Use Self-Efficacy	83.82 (15.03)	77.37 (23.45)	.26
Exercise Barrier Self-Efficacy	69.96 (21.31)	61.71 (34.38)	.32
Leisure-Time Physical Activity (LTPA)			
Moderate LTPA (min/day)	15.06 (20.73)	7.42 (15.86)	.18
Heavy LTPA (min/day)	8.03 (17.91)	2.16 (7.19)	.18
Moderate + Heavy LTPA (min/day)	23.09 (32.91)	9.58 (21.42)	.12
Log(moderate + heavy LTPA)	1.13 (1.09)	.49 (.87)	.04*

Note. Wheelchair mobility, wheelchair-use self-efficacy and exercise barrier self-efficacy were scored on a possible range of 0% - 100%.

n = sample size, M = mean, (SD) = standard deviation.

*$p < .05$.

Table 3a

Correlations (Pearson's Product Moment) Between Study Variables: All Participants

Study Variable	Wheelchair mobility	Wheelchair-use self-efficacy	Exercise barrier self-efficacy	LTPA
Wheelchair mobility	1.00	.73**	.44**	.29*
Wheelchair-use self-efficacy		1.00	.56**	.16
Exercise barrier self-efficacy			1.00	.38**
LTPA				1.00

Note. LTPA = Log(Moderate + Heavy LTPA min/day).

$*p < .05$, $** p < .01$.

Table 3b

Correlations (Pearson's Product Moment) Between Study Variables: Toronto Participants

Study Variable	Wheelchair mobility	Wheelchair-use self-efficacy	Exercise barrier self-efficacy	LTPA
Wheelchair mobility	1.00	.72**	.36*	.31
Wheelchair-use self-efficacy		1.00	.56**	.17
Exercise barrier self-efficacy			1.00	.45*
LTPA				1.00

Note. LTPA = Log(Moderate + Heavy LTPA min/day).

*$p < .05$, ** $p < .01$.

Table 3c

Correlations (Pearson's Product Moment) Between Study Variables: Quebec City Participants

Study Variable	Wheelchair mobility	Wheelchair-use self-efficacy	Exercise barrier self-efficacy	LTPA
Wheelchair mobility	1.00	.80*	.56**	.27
Wheelchair-use self-efficacy		1.00	.54**	.07
Exercise barrier self-efficacy			1.00	.30
LTPA				1.00

Note. LTPA = Log(Moderate + Heavy LTPA min/day).

*$p < .05$, ** $p < .01$.

Table 4

Multiple Regression Models to Test Wheelchair-Use Self-Efficacy as a Mediator of the Wheelchair Mobility – LTPA Relationship

Testing steps in mediation	*B*	*SE B*	95% CI	β
Testing step 1 (Path C)				
Outcome: LTPA				
Predictor: Wheelchair mobility	.03	.01	.00, .05	.29*
Testing step 2 (Path A)				
Outcome: Wheelchair-use self-efficacy				
Predictor: Wheelchair mobility	1.14	.16	.81, 1.47	.73*
Testing step 3 (Path B)				
Outcome: LTPA				
Predictor: Wheelchair-use self-efficacy	.01	.01	-.01, .03	.16
Testing step 4 (Path B and C')				
Outcome: LTPA				
Mediator: Wheelchair-use self- efficacy (Path B)	-.01	.01	-.03, .02	-.11
Predictor: Wheelchair mobility	.03	.02	-.01, .07	.37

Note. B = unstandardized regression coefficient, $SE\ B$ = standard error, CI = confidence interval, β = standardized regression coefficient, LTPA = Log(Moderate + Heavy LTPA min/day).

$^*p < .05$.

Table 5

Using Multiple Regression to Test Exercise Barrier Self-Efficacy as a Mediator of the Wheelchair Mobility – LTPA Relationship

Testing steps in mediation	*B*	*SE B*	95% CI	β
Testing step 1 (Path C)				
Outcome: LTPA				
Predictor: Wheelchair mobility	.03	.01	.00, .05	.29*
Testing step 2 (Path A)				
Outcome: Exercise barrier self-efficacy				
Predictor: Wheelchair mobility	1.00	.31	.39, 1.62	.44*
Testing step 3 (Path B)				
Outcome: LTPA				
Predictor: Exercise barrier self-efficacy	.01	.01	.00, .03	.38*
Testing step 4 (Path B and C')				
Outcome: LTPA				
Mediator: Exercise barrier self-efficacy (Path B)	.01	.01	.00, .02	.31*
Predictor: Wheelchair mobility	.01	.01	-.01, .04	.15

Note. B = unstandardized regression coefficient, $SE\ B$ = standard error, CI = confidence interval, β = standardized regression coefficient, LTPA = Log(Moderate + Heavy LTPA min/day).

$^{*}p < .05$.

Table 6

Bootstrapped Model of Exercise Barrier Self-Efficacy as a Mediator of the Wheelchair Mobility-LTPA Relationship (10,000 replications)

Step	Path	Coefficient (B)	Standard Error	*t*	*p*
1	C	.0248	.0123	2.0165	.0499
2	A	1.0029	.3051	3.2871	.0020
3	B	.0118	.0059	1.9968	.0522
4	C'	.0130	.0133	.9805	.3323

Note. LTPA = leisure-time physical activity, Path C = the relationship between the independent variable (wheelchair mobility) and the dependent variable (LTPA), Path A = the relationship between the independent variable and the mediator (exercise barrier self-efficacy), Path B = the relationship between the mediator and the dependent variable, while controlling for wheelchair mobility, and Path C' = the relationship between the independent variable and the dependent variable, while controlling for the mediator.