Manual wheelchair users:
Understanding participation and skill development.

by

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Abstract

Wheelchair skills, required for manual wheelchair (MWC) use, are strongly associated with independent mobility, physical activity, and participation. Training can improve mobility and participation in meaningful activities for MWC users, but strategies are required to enhance skill development. Peer-led self-efficacy interventions have been effective at enhancing skills in other clinical areas, and present a novel approach to MWC training that may enhance use.

Purpose: develop an understanding of MWC use and current MWC training education and practices, and to explore and evaluate a novel approach to improving MWC use.

Methods: secondary analysis of a national survey to determine physical activity levels in older wheelchair users; surveys of rehabilitation centres and universities to describe MWC training practices and curriculum; systematic review and meta-analyses to evaluate the effect of peer-led interventions on physical activity and self-efficacy; and a pilot randomized controlled trial to evaluate a peer-led MWC training program for improving wheelchair self-efficacy and wheelchair use.

Results: Only 8% and 41% of older wheelchair users participated in physical and leisure activity, and wheelchair use was found to be a primary risk factor for low levels of participation. A description of current MWC training in practice showed that 78% of clinicians provided basic MWC mobility training, but only 12% taught the advanced skills needed to achieve optimal community participation. Nearly 80% of entry-to-practice programs included MWC skills training in curriculum; however, only 38% used a validated training program.
In a broad review, self-efficacy interventions had a small effect on physical activity (Cohen’s d = 0.2) and self-management self-efficacy (Cohen’s d = 0.2). Peer-led MWC training had a large effect on wheelchair use self-efficacy (Cohen’s d = 0.8), wheelchair skills capacity (Cohen’s d = 0.7) and satisfaction with participation (Cohen’s d = 0.7), and no effect on wheelchair skills performance or life-space mobility.

**Conclusion:** wheelchair use increases risk of physical inactivity. This may be related to wheelchair skills training, which currently relies on clinicians. Self-efficacy enhanced interventions can promote behaviour change. Peer-led MWC training may augment existing training, enhance self-efficacy and promote increased MWC use, which may elicit health benefits that are associated with physical activity.
Preface

The research for this dissertation was coordinated at the GF Strong Rehabilitation Research Lab, Vancouver, British Columbia. The five projects and associated methods that comprise this dissertation were developed by the student (Krista L. Best), in consultation with a supervisory committee, including supervisor (William C. Miller) and committee members (Janice J. Eng and Francois Routhier). Permission was obtained from the Social Sciences and Humanities Research Council Research Data Centre to access Statistics Canada data at the University of British Columbia for chapter 2 (certificate #: RDC 2212). Ethics was obtained from the Behavioural Research Ethics Board at the University of British Columbia for chapters 3 and 4 (certificate #: H11-02925) and from the Clinical Research Ethics Board at the University of British Columbia (certificate #: H11-02687) and Vancouver Coastal Health Research Institute (certificate#: V11-02687) for chapter 6. The protocol for Chapter 6 was registered at ClinicalTrials.gov (Identifier: NCT01837888)

Versions of chapters 2, 3, and 4 have been published in peer-review journals. Versions of chapters 5 and 6 will also be submitted for publication. Copyright permissions of previously published works included in this dissertation, including tables and figures, are covered by the Copyright Transfer Agreement.


KLB and WCM conceptualized each of the studies and developed the research designs. KLB completed the data collection, analyzed the data, and drafted the chapters/manuscripts for chapters 2, 3, 4 and 5. KLB supervised the data collection, analyzed the data, and drafted the chapters/manuscripts for chapter 6. WCM supervised all research projects, analyzed the data, contributed to interpretation of results, and provided feedback on and edited the chapters/manuscripts. JJE and FR were involved in the early stages of study and concept formation, and provided feedback on all chapters. FR assisted with data collection and provided feedback on manuscripts from chapters 3, 4 and 6. JJE contributed to interpretation of results and provided feedback on manuscripts from chapters 5 and 6.
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Glossary

Activity: Activity is defined as the execution of an act or task by an individual and is qualified as capacity, which describes what an individual can do at a given point in time (World Health Organization, 2001).

Confidence: Confidence is a nonspecific term that refers to strength of belief but does not necessarily specify what the certainty is about (Bandura, 1997). However, for the purpose of this dissertation, confidence will be used interchangeably with self-efficacy.

Life-space mobility: movement extending from within one’s home to movement beyond one’s town or geographic region (Baker et al., 2003).

Log Transformation: Transformations are used to re-express the data to satisfy the assumption of homogeneity of variance, conform to normal distribution, or to create a more linear distribution. Log transformations, defined as re-expression of the dependent variable using a logarithmic function, are commonly used to equal variance among comparison groups and to normal skewed observations (Portney & Watkins, 2009).

Manual wheelchair: a type of mobility device for personal transport that has a seating area positioned between two large wheels, with two smaller wheels at the front. A manual wheelchair requires human power, either through independent propulsion or being pushed by another person.
Odds Ratio: An odds ratio (OR) is a measure of association between an exposure and an outcome. The OR represents the odds that an outcome will occur given a particular exposure, compared to the odds of the outcome occurring in the absence of that exposure. (Szumilas, 2010).

Participation: Participation is defined as involvement in life situations and is qualified by performance, which describes what an individual does in his or her environment (World Health Organization, 2001).

Physical activity: Physical activity is defined as bodily movements produced by skeletal muscles that result in energy expenditure (WHO, 2009).

Self-efficacy: Self-efficacy is the belief an individual has in his or her ability to perform certain behaviours to achieve desired outcomes (Bandura, 1997).

Self-management: Self-management is defined as the personal application of behaviour change tactics that produces a desired change in behaviour (Cooper et al., 2010). According to Lorig (2004), the specific tasks required to achieve self-management include self-efficacy for medical management, role management, and emotional management.

Self-management program: The systematic application of strategies to enhance self-efficacy, including skills mastery, modeling, social persuasion, and reinterpretation of symptoms (Lorig, 2004).
Wheelchair skills capacity: Wheelchair skills capacity is defined as an individual’s ability to execute a specific wheelchair skill at a given point in time.

Wheelchair mobility: for the purpose of this thesis, wheelchair mobility will refer to the movement of an individual from one place to another in his or her manual wheelchair either independently or with assistance.

Wheelchair skills performance: Wheelchair skills performance is indicative of the wheelchair skills an individual uses in his or her current environment to engage in life situations.

Wheelchair use: for the purpose of this dissertation, wheelchair use will refer to the active use of a manual wheelchair, including using the wheelchair for mobility or to engage in chosen activities.

Wheelchair use self-efficacy: the belief individuals have in their ability to use their wheelchairs in a variety of challenging situations (Rushton et al., 2011).
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Dedication

To Mom and Dad,

On the day I graduated from high school you wrote “may you sail the sea of ambition and anchor in the harbour in success.” On that day I had no idea what that sea would look like, or which harbour that would be. Almost twenty years later, as I harbour in my greatest academic success, I dedicate this dissertation to you both for being the keel when the seas got rough and for the steady breeze you always put in my sails.
1 Introduction

1.1 Impetus for this study

The impetus for this study arose from my Masters research, which evaluated a community-based manual wheelchair skills training program for adults. Despite being able to effectively improve manual wheelchair skills, (Best et al., 2005) observations made by clinicians suggested that many wheelchair users did not continue to perform the wheelchair skills that they had previously learned (Rushton et al., 2012). Inkpen et al. 2012, support the notion that manual wheelchair users likely do not use their wheelchairs to their fullest potential for mobility or participation in important activities, as experienced wheelchair users report higher wheelchair skills capacity (i.e., ability to execute a skill) than performance (i.e., applied use of the skill in a real-world setting). This is not surprising as current manual wheelchair training interventions focus on acquisition of specific wheelchair skills, but do not explicitly address other behavioural factors that may influence wheelchair use.

In addition to providing skills training, manual wheelchair interventions should address mechanisms of behaviour that are potentially influential. A psychological factor (i.e., self-efficacy) may help to explain and predict patterns of behaviour among manual wheelchair users. The contribution of self-efficacy specific to manual wheelchair use has been reported (Geyh et al., 2012; Sakakibara et al., 2013a; Sakakibara et al., 2013b; Sakakibara et al., 2014a; Sakakibara et al., 2014b).
Self-efficacy\(^1\), defined as one’s belief in his or her capability to execute a task or behaviour, is theorized as a stronger predictor of behaviour than having the skill to perform the behaviour (Bandura, 1977). Empirical evidence supports this notion (Bandura, 1977; Pang et al., 2008; Schmid et al., 2012). Recent findings by Miller et al., (2012) show that nearly 40% of community-living manual wheelchair users 50 years of age and older experience low self-efficacy for wheelchair use. Twenty-seven percent of participants in this study also had discordance between wheelchair skill and wheelchair self-efficacy, with low self-efficacy and high skill or high self-efficacy and low skill. Moreover, recent regression modelling has demonstrated that wheelchair use self-efficacy is an important factor for both life-space mobility and participation frequency (Sakakibara et al., 2013a; Sakakibara et al., 2014a; Sakakibara et al., 2013b). Social cognitive theory and cross-sectional studies provide rationale for the development and evaluation of self-efficacy enhancing strategies that may optimize manual wheelchair mobility and participation.

1.2 Wheelchair use

Rehabilitation aims to enable individuals living with functional limitations to remain in or return to their home or community, live independently, and participate in education, the labour market and civic life (WHO, 2011). The ultimate goal of rehabilitation for wheelchair users includes safe and independent functioning in the wheelchair and using the wheelchair when needed to participate in meaningful activities (WHO, 2001). Therefore, the wheelchair is arguably the

\(^1\) Acknowledging the variation in the definition of self-efficacy and confidence in the literature, for the purposes of this dissertation the two terms are used synonymously.
most important assistive device used in rehabilitation by individuals with mobility impairments. Wheelchairs provide mobility options for individuals who have functional limitations regarding walking (Routhier et al., 2003), can enable functional independence (Hoenig et al., 2003), and may facilitate social participation (Rousseau-Harrison et al, 2009). In fact, merely acquiring a wheelchair was shown to have perceived social participation benefits for older adults (Rousseau-Harrison et al, 2009). Similar findings by Wee and Lysaght (2009) reported the wheelchair to be one of the most influential factors supporting the performance of activities of daily individuals with mobility impairments.

1.2.1 The manual wheelchair²

A manual wheelchair is defined as a type of mobility device for personal transport that has a seating area positioned between two large wheels, with two smaller wheels at the front. Although manual wheelchairs can be self-propelled or pushed by another person, the health-related and quality of life benefits associated with manual wheelchair provision are greatest when the individual can independently use the wheelchair (Krause et al. 2009). Independent wheelchair use is associated with higher levels of participation in activities outside of the home, fewer health problems and depressive symptoms, increased social engagement, and higher perceived health compared to individuals who require assistance using a manual wheelchair (Krause et al. 2009). Moreover, since manual wheelchairs require human power for self-propulsion, synonymous to walking for able-bodied individuals, there may be health benefits associated with the physical activation of skeletal muscles required to propel and maneuver the wheelchair.

² Reference is made specifically to manual wheelchairs throughout the introduction whenever possible. The research in this dissertation pertains specifically to manual wheelchair use, with the exception of Chapter 2, which is based on data from all types of wheelchair users.
1.2.2 Manual wheelchair use

The World Health Organization (WHO) estimated that approximately 1% of the worldwide population required a wheelchair for mobility (WHO, 2011). These estimates are consistent with prevalence estimates for all wheelchair use (i.e., manual and power wheelchairs) in first world countries (Table 1). Although the prevalence of manual wheelchair use has not been determined, Flagg (2009) estimated that approximately 70% of the total wheelchair user population is comprised of manual wheelchairs.

Table 1.1: Estimated prevalence of wheelchair use (i.e., manual and power wheelchairs) in first world countries.

<table>
<thead>
<tr>
<th>First world countries</th>
<th>Year</th>
<th>Total population</th>
<th>Wheelchair use (%)</th>
<th>Population of wheelchair users</th>
<th>Reference</th>
</tr>
</thead>
<tbody>
<tr>
<td>Canada</td>
<td>2005</td>
<td>32 million</td>
<td>0.09</td>
<td>265,000</td>
<td>Clark &amp; Colantonio, 2005</td>
</tr>
<tr>
<td>England</td>
<td>2000</td>
<td>50 million</td>
<td>1.2</td>
<td>600,000</td>
<td>NHS, 2004</td>
</tr>
<tr>
<td>France</td>
<td>2008</td>
<td>58 million</td>
<td>0.62</td>
<td>361,500</td>
<td>Vignier, 2008</td>
</tr>
<tr>
<td>Netherlands</td>
<td>2002</td>
<td>16 million</td>
<td>1.0</td>
<td>152,400</td>
<td>van Drongelen et al., 2002</td>
</tr>
<tr>
<td>United Kingdom</td>
<td>2000</td>
<td>61 million</td>
<td>1.0</td>
<td>640,000</td>
<td>Sapey, 2004</td>
</tr>
<tr>
<td>United States</td>
<td>2009</td>
<td>305 million</td>
<td>1.2</td>
<td>3.86 million</td>
<td>Flagg, 2009</td>
</tr>
</tbody>
</table>

According to Kaye et al. (2000), children under 18 make up the smallest proportion of wheelchair users in the United States (0.1%), but the reason for using the wheelchair was not reported. In the United States, approximately 1% of individuals 18-64 years of age reported using a wheelchair (LaPlante & Kaye, 2010), and in Canada individuals 12 to 44 years of age reported injury as the primary cause for wheelchair use (Shields, 2004).
The largest proportion of wheelchair users is older adults, with nearly 4.6% and 5.2% of community-living individuals aged 65 and older using a wheelchair in Canada (Shields, 2004) and the United States (LaPlante & Kaye, 2010) respectively. In individuals over 85 years of age, the prevalence of wheelchair use rose to 7.2% in Canada (Shields, 2004) and 12.3% in the United States (LaPlante & Kaye, 2010). As individuals age, the reason for using a wheelchair seems to be more associated with chronic diseases, illness, and natural aging processes (Shields, 2004). Kaye et al., (2000) confirms similar finding in the United States, with the leading conditions associated with wheelchair use as age-related conditions (i.e., stroke, arthritis, multiple sclerosis, amputation, and spinal cord injury).

Due to predicted population estimates suggesting a two-fold increase in the number of adults aged 65 and older by 2020 (Li et al., 2007), and the increased likelihood of older adults using wheelchair, the number of wheelchair users is expected to rise (Clark & Colantonio, 2005, Shields, 2004).

In addition to age, other personal characteristics associated with wheelchair use include sex, socioeconomic status and perceived health status. Females have been shown to have a higher predisposition to wheelchair use than males. In Canada, Shields (2004), reported that 3.1% of females used a wheelchair compared to 2.3% of males. Similarly, LaPlante and Kaye (2010) reported higher prevalence of wheelchair use in females compared to males, 1.8% and 1.20% respectively.
Socioeconomic status and health factors also influence wheelchair use. Individuals with lower income and education levels are more likely to use a wheelchair than individuals with higher incomes and higher educational attainments (Shields, 2004; LaPlante & Kaye, 2010). In addition, wheelchair users are more likely to report a high number of co-morbidities and low health status (Vignier et al. 2008; LaPlante & Kaye, 2010). For example, in the United States, 75% of community-dwelling wheelchair users reported they had fair or poor health, compared to 14% of the general population (LaPlante & Kaye, 2010).

1.2.3 Personal, societal and economic consequences of manual wheelchair use

Manual wheelchairs are expensive, averaging costs of $4000 to $5000 (http://sci-can.ca/resources/sci-facts/). Wheelchairs require regular maintenance, often within six months of purchasing (Fitzgerald et al., 2005; McClure et al., 2009) and generally need to be replaced every three to five years (Cooper et al., 1996). This does not include the costs associated with assessment, prescription and customized seating. In some Canadian provinces the cost of the wheelchair and all related services (e.g., assessment, maintenance, and spare parts) are covered by the provincial government, while the other provinces have varying types of provincial support and medical insurance policies. Unfortunately, seniors aged 65 and older, who are among the largest proportion of wheelchair users, are among a group who do not receive provincial support for the provision of wheelchairs in many Canadian provinces (Mortenson et al., 2013). Therefore, the cost of wheelchairs and other assistive technology are often covered by the individual and his or her family, either through private insurance policies or out-of-pocket expenses. In fact, Carlson and Ehrlich (2006) reported that nearly 40% of individuals with
disabilities or their families assumed the costs of assistive technology devices, citing the most significant predictors for receiving financial support as occupational status, education level, severity of impairment, and personal income.

The need for mobility assistance is also associated with indirect costs. Over half of older manual wheelchair users in Canada require assistance getting around, and as wheelchair users age, this proportion increases (Shields, 2004). For those aged 65-84, 63% of females and 50% of males reported needing help to get around. Specifically, for those aged 85 and older 77% of females and 73% of males reported needing help to mobilize. In addition, 94% of females and 87% of males require assistance with completing basic and instrumental activities of daily living that require mobility, such as shopping (Shields, 2004). Reliance on others for mobility may reduce independence, limit participation in life activities, and lower quality of life, especially in older adults (Flagg, 2009; Carlson & Myklebust, 2002). Furthermore, lack of formal support services for wheelchair users can influence societal costs associated with dependence on family members to assume caregiver roles, such as lowered economic activity and reduced social inclusion (WHO, 2011). In fact, an American study reported that 70% of non-elderly seniors with a disability relied on family or friends for support (Hanson et al., 2003).

Wheelchair use is also associated with various psychological and physical implications for the wheelchair user, many of which are directly associated with mobility and participation. According to the World Health Organization, mobility is an activity that requires the execution of a task or action, and participation is the involvement in life situations (WHO, 2001). Both mobility and community participation are important indicators of quality of life for wheelchair
users (Tonack et al., 2008; McVeigh et al., 2009; Routhier et al., 2003), and the wheelchair may limit participation in community activities (Chaves et al., 2004; Laliberte Rudman et al., 2006). Less than optimal mobility and community participation influence the likelihood of depression (Mortenson et al., 2012; Wilkie et al., 2007), which may worsen perceived quality of life over time. Comparisons of lower perceived quality of life in wheelchair users compared to ambulatory individuals suggest that psychological factors need to be addressed (Patrick et al., 2000; Riggins et al., 2011).

From a physical health perspective, reduced mobility and participation in meaningful activities can reduce the amount of physical activity an individual receives. Physical activity, defined as bodily movements produced by skeletal muscles that result in energy expenditure, is important for health (WHO, 2009). According to Hoffman (2013), physical activity participation includes various components, including self-sufficiency (e.g., completing activities of daily living and instrumental activities of daily living), work (e.g., performing a job or task that involves bodily movement), leisure (e.g., engaging in chosen physical activities without obligation), health (e.g., exercising to achieve health benefits), and competition (e.g., engaging in sport).

The World Health Organization recognizes physical inactivity the greatest risk to health (WHO, 2009). This is particularly concerning for wheelchair users who tend to experience disruptions in recreation and physical activity participation (Warms et al., 2008; Noreau et al., 2000; Cooper et al., 1999b). The risk of sedentary lifestyles can exacerbate symptoms of depression, and may also worsen other secondary conditions associated with manual wheelchair use, pain, pressure ulcers, urinary tract infections, and contractures (Kinne et al., 2004; Santiago & Coyle, 2004).
Moreover, lack of physical activity makes wheelchair users even more susceptible to secondary chronic conditions, such as cardiovascular disease, diabetes, and stroke (US Department of Health and Human Services, 2000).

Only 13–16% of spinal cord injured manual wheelchair users reported participating in regular physical activity (Washburn & Hedrick, 1997; Fernhall et al., 2008). Inadequate levels of physical activity in individuals with spinal cord injury have been associated with decreased aerobic capacity, muscular strength and endurance, and flexibility, all of which have the potential for restricting functional independence and increasing risks for chronic diseases and secondary complications (Tawashy et al., 2009). Manual wheelchair users in general experience comparable risks, as a bidirectional relationship between wheelchair use and limited functioning that is associated with reduced physical functioning, health risks, morbidity and mortality has been established (Rimmer, 2006). Even small amounts of physical activity may have profound benefits for wheelchair users, who are prone to the negative consequences associated with sedentary lifestyles (Warms et al., 2008; Rimmer, 2006).

Physical activity guidelines suggest that wheelchair users with a spinal cord injury should engage in moderate to vigorous intensity physical activity for 20 minutes at least 2 times per week, and should perform 3 sets of 8-10 repetitions of strength training exercises for each major muscle group at least 2 times per week to obtain health benefits (Martin Ginis et al., 2011a). As with all physical activity guidelines, suggestions alone are not enough and interventions are often required to achieve desired behaviour change, and individuals often require specific instruction and exercise prescription (Sallis, 2009). Moreover, participation in physical activity for manual
wheelchair users is further complicated by the necessity for safe and effective wheelchair mobility that is needed to participate. Therefore, participation in physical activity requires wheelchair mobility, which requires adequate manual wheelchair skills.

Although the costs of manual wheelchairs and intended health benefits are squandered if the wheelchair is not actually used, using wheelchairs without proper skills is also not a desirable option. The unsafe use of wheelchairs may lead to accidents that range in severity from cuts and bruises to life-threatening head injuries (Kirby et al., 1994). A recent study on experienced, community-dwelling wheelchair users found that 55% of participants reported one accident in the past 3 years, and 17% reported 2 or more accidents (Chen et al., 2011). Injuries that result from wheelchair accidents may impede mobility, limit activities, restrict various participations and reduce quality of life. Furthermore, injuries due to wheelchair accidents may increase the burden on caregivers and may increase use of the health care system.

1.2.4 Framework for the assessment of variables related to wheelchair use

The International Classification of Functioning, Disability and Health (ICF) provides a useful framework for categorizing and organizing the variables that may determine wheelchair mobility and participation, and for understanding the bi-directional relationships that exist among the variables (WHO, 2001) (Figure 1.1). Application of the ICF specifically for wheelchair use is discussed in the following section. The ICF framework is comprised of two parts, including functioning and disability, and contextual factors, such that functioning and disability are viewed as outcomes of interactions between health conditions (diseases, disorders and injuries) and
influential contextual factors. The functioning and disability component is broken down into three interrelated domains, including body functions and structures, activity, and participation. Body functions and structures are defined as anatomical, physiological and psychological functions of body systems (e.g., strength, neuromuscular function, and self-efficacy). Activity is defined as the execution of a task or action, and is qualified by an individual’s capacity to execute a specific task (e.g., mobility). Participation is the involvement in life situations and is qualified as performance, which describes what an individual does in his or her environment (e.g., physical activity) (WHO, 2001). Among contextual factors are external environmental factors (e.g., social attitudes, architectural characteristics, physical environment), and internal personal factors (e.g., age, sex, education, characteristics).

**Figure 1.1**: Study variables organized according to International Classification or Functioning, Disability and Health framework.
1.2.5 Determinants of wheelchair mobility and participation

Optimizing mobility and participation in meaningful life situations are important elements of rehabilitation (Heinemann, 2006). Wheelchair mobility is defined as the ability of individuals to independently use wheelchairs to move around in different environmental contexts (Auger et al., 2010; Baker et al., 2003). Impaired wheelchair mobility limits mobilizing inside and outside of the home, thus reducing independence (Mollenkopf et al., 1997; Barker et al., 2004. Participation is conceptualized as an individual’s involvement in society as defined by social roles, which may include work, relationships with others, leisure, and community involvement (Jette et al., 2003; Hastings et al., 2011). Participation restrictions are common among wheelchair users (Wilkie et al., 2006). Wheelchair mobility is a basic and necessary activity that supports the ability of wheelchair users to participate in desired situations (Routhier et al., 2003), thus impaired wheelchair mobility can reduce social participation (Laliberte Rudman et al., 2006).

Organized according to the ICF framework, influential factors of wheelchair mobility and participation are summarized below. Wheelchair mobility is often measured subjectively using self-reports of the number of life-spaces obtained (e.g. Life-Space Assessment) or objectively using data-loggers and accelerometers (e.g. speed, distance). In the wheelchair use literature, participation measurement is highly dependent on the specific participation of interest, and therefore the outcomes used are highly variable.
Health conditions

Although no evidence was found specific to associations between wheelchair mobility and health condition, there is evidence suggesting that increasing numbers of comorbid conditions is associated with lowered social participation, including participation in physical activity (Hoenig et al., 2003; Barker et al., 2004). Current health promotion efforts are focused on reducing the number of chronic conditions through the development of physical activity guidelines (Martin Ginis et al., 2012), but accessible interventions and individualized exercise prescription are needed (Sallis, 2009). Considerations for various diagnoses are also important, as injury severity was shown to be a determinant of physical activity that was done during leisure time in individuals with spinal cord injury. Martin Ginis et al., (2012) found that individuals with lower level injuries reported higher levels of participation in leisure-time physical activities than individuals with higher level injuries.

Functioning and disability

Body function and structures

Depression has been shown to influence both life-space mobility and participation frequency, but this study only examined older adults living in long term care settings (Mortenson et al., 2012). More recently, self-efficacy for manual wheelchair use has been identified as an important body function that influences life-space mobility for wheelchair users (Sakakibara et al., 2014b). After controlling for sex, number of comorbidities, geographic location, and assistance with using a wheelchair, Sakakibara et al., (2014b) found that wheelchair-use self-efficacy had both a direct and indirect association with life-space mobility. Interventions targeted toward improving self-efficacy may lead to improvements in life-space mobility, and this has been demonstrated using
a convenience sample of older non-wheelchair users (Sakakibara et al., 2013b). Since wheelchair use self-efficacy is associated with improvements in wheelchair skill, it was not surprising that a wheelchair skills training intervention lead to improvements in self-efficacy (Sakakibara et al., 2013b). Experimental research examining effective self-efficacy enhancing strategies is needed in wheelchair using populations to confirm the validity of these findings in manual wheelchair users.

Preliminary regression modelling suggested that when sex is controlled for, manual wheelchair use self-efficacy is predictive of participation frequency (Sakakibara et al., 2013a). Further analyses confirmed that when mediated by life-space mobility, wheelchair use self-efficacy indeed influences outcomes of participation frequency in a group of manual wheelchair users aged 50 years and older (Sakakibara et al., 2014a). Previous findings support the influence of wheelchair use self-efficacy on leisure-time physical activity (Phang et al., 2012).

**Wheelchair use self-efficacy is a relatively new construct that influences wheelchair use. Low-self-efficacy may pose an invisible barrier to both manual wheelchair mobility and community participation. Therefore, Sakakibara et al., (2013a, 2014a, 2014b) suggest the development and evaluation of self-efficacy enhancing strategies as essential step to understanding wheelchair self-efficacy as a determinant of wheelchair mobility and participation.**

There are additional body functions and structure variables that have been identified as important determinants of participation for wheelchair users, including pain and cognition. There is a high prevalence of overuse injuries among manual wheelchair users that has been examined (Curtis et
al., 1999; Cooper et al., 1999a), particularly injuries associated with repetitive strain of the shoulders (Jain et al., 2010). In a sample of younger individuals with spinal cord injury, reduced social participation was attributed to chronic shoulder pain, and after a 12-week intervention, reduced shoulder pain was associated with statistically significant increases in social participation (Kemp et al., 2011). Additionally, higher cognition has been shown to positively influence participation frequency in older adults living in long-term care (Mortenson et al. 2012).

Activity

Contextualized as activity factors, both wheelchair skills and functional abilities have been reported to have significant positive associations with life-space mobility. Lemay et al. (2011) showed that manual wheelchair skills have moderate statistically significant correlations with daily distance travelled in a sample of younger individuals with a SCI. After controlling for wheelchair related and personal factor variables, Mortenson et al. (2011; 2012) also found that manual wheelchair skills had the strongest association with life-space mobility compared with all other variables in the model.

Although there is reason to believe that manual wheelchair skills influence participation, there is limited and contradictory support to date. While Kilkens et al. (2005) found that manual wheelchair skills influenced participation for individuals living with a spinal cord injury in the community, Mortenson et al., (2011) found that power wheelchair skills were not a significantly important factor for participation in wheelchair users in long-term care. More recently Phang et al. (2012) confirmed that wheelchair skills had a statistically significant association with leisure-
time physical activity, and Sakakibara et al. (2014) confirmed that wheelchair skills were an important mediating factor in prediction frequency of participation.

There is considerable amount of evidence supporting the effectiveness of a validated wheelchair skills training program for improving specific wheelchair skills (Best et al., 2005; Coolen et al., 2004; MacPhee et al., 2004; Oztürk & Ucsular, 2011; Routhier et al., 2012; Kirby et al., 2011). The importance of wheelchair skills for independent mobility (Mortenson et al., 2011) and functioning (Kilkens et al., 2003) has also been documented.

Despite the potential benefits, the prevalence of wheelchair skills training for adults in the United States ranged from 18% of wheelchair users who had varying diagnoses, to 66% of individuals who acquired a spinal cord injury (Zanca et al., 2011). In Canada, only 11% of older adults who received a manual wheelchair after stroke received any training at all (Charbonneau et al., 2013). Moreover, it is not clear what skills were taught, or how training was administered. More research is needed to understand how wheelchair users receive skills training and the causal effect of wheelchair skills on wheelchair mobility and community participation, specifically for participation in physical activities.

Contextual factors

Environmental factors

The wheelchair itself has proven to be an important determinant of both mobility and community participation. Problems associated with wheelchair design and seating systems are well documented (Masse & Lamontagne, 1992; Kirby, 1997) and the importance of individualized wheelchair selection and custom seating has been established (Koontz et al., 2010; Sprigle et al.,
The International Organization for Standardization has developed guidelines and wheelchair standards that aid in the wheelchair selection process (ISO, 2001), and these standards are continually challenged and evaluated (Gebrosky et al., 2013; Kwerciak et al., 2005).

Both manual and power wheelchair mobility has been shown to be influenced by the environment and the wheelchair. For example, lighter weight manual wheelchairs have been shown to improve functional mobility compared to heavier wheelchairs (Rogers et al., 2003), and increased camber of the rear wheels lead to higher wheeling efficiency (Perdios et al., 2007). Better life-space mobility for older wheelchair users living in long-term care settings has been associated with fewer perceived physical barriers (Mortenson et al., 2012), more social visits from friends and family (Mortenson et al., 2011), and less need for wheelchair seating interventions (Bourbonniere et al., 2007).

Studies examining influential environmental factors of participation in wheelchair users have also documented the wheelchair itself to be a barrier to participation (Barker et al., 2003; Chaves et al., 2004). For example, in a study of younger individuals with a SCI, the manual was the most frequently reported factor limiting participation in physical activities in the community (Chaves et al., 2004).

Among wheelchair users, factors pertaining to the physical environment have been shown to influence participation outcomes (Barker et al., 2003; Hoenig et al., 2003; Laliberte-Rudman et al., 2006; Meyers et al., 2002; Mortenson et al., 2012; Wee & Lysaght, 2009). For example,
Hoenig et al. (2003) reported that perceived barriers in the home and community negatively influenced community participation among new wheelchair users. Similarly, Rosenberg et al. (2013) explain how accessibility issues in the community can limit participation among wheelchair users. Physical barriers have been reduced through implementation of new policies enforcing accessible communities (Americans with Disability Act, 1991) and through improving wheelchair skills to negotiate the physical environment (Bennet et al., 2009).

The social environment may pose invisible determinants of participation, as social support from family and friends has been described as a facilitator among assistive technology users (Wee et al., 2009). There is also evidence suggesting that professional’s lack of knowledge of how and where to exercise (i.e., accessible locations) may negatively influence participation in physical activity (Froehlich et al., 2002, Rimmer et al., 2010). Social implications and barriers continue to be addressed through public awareness and advocacy for disability rights (Herrera-Saray et al., 2013; Sapey et al., 2005).

Recent studies have addressed some of the environmental barriers to participation in physical activity for wheelchair users (Froehlich-Grobe et al., 2014; Van Straaten et al., 2014). Interventions that take into account accessibility issues and individuality of needs have lead to increased physical activity for some wheelchair users. However, the long term effects of continued participation are unknown and the need for more research on effective physical activity strategies for wheelchair users has been identified.
**Personal factors**

Age and employment have been documented as personal factors that influence objective measures of wheelchair mobility. A study of younger, community-dwelling manual wheelchair users found that individuals who were employed were travelled longer distances at faster speeds in their wheelchair compared to unemployed individuals (Oyster et al., 2011). In this same study, age was also observed to have a significant negative correlation with average speed travelled per day. Similarly, Lemay et al. (2011) reported age to have moderate correlations with daily distance travelled in younger individuals with a spinal cord injury who used manual wheelchairs.

There is less information on personal factors associated with participation. However, younger male manual wheelchair users were reported to participate in more leisure-time physical activity compared to older females (Martin Ginis et al., 2010; Martin Ginis et al., 2012). Warner et al. (2010) also found that individuals with less education, higher personal assistance, and who lived alone reported lower levels of leisure-time physical activity than individuals with more education, less personal assistance, who lived with others.

### 1.2.6 Predictive models of wheelchair mobility and participation

Predictive models for wheelchair mobility and participation have examined various combinations of the determinants summarized in the previous section and have accounted for a moderate amount of variance. However, much of the participation and mobility research of wheelchair users has been on younger, community-dwelling individuals with SCIs, and older individuals living in long-term care settings. Previous predictive models for wheelchair mobility have accounted for 40% and 19% of the variance (Bourbonniere et al., 2007; Mortenson et al., 2010).
However, there was limited complexity in the variables studied according to the multiple interacting factors of the ICF framework as described above. Most recently Sakakibara et al., (2014a) established a model that explained 37% of the variance in the life-space mobility of older manual wheelchair users, in which the unique contribution of self-efficacy was 3.5%.

Less variance has been accounted for in predictive models of participation, as Mortenson et al. (2010), Bourbonniere et al. (2007), and Kilkens et al. (2005) have only accounted for 9%, 26% and 38% respectively. However, a recent model defined by Sakakibara et al., (2014a) explained 55% of the variance in participation frequency in a group of older manual wheelchair users. Moreover, when other important variables were controlled for (i.e., wheelchair skill, life-space mobility), self-efficacy explained 17% of the variance in participation frequency. Establishment of the importance of self-efficacy for predicting wheelchair mobility and participation outcomes has lead to recommendations for the consideration of self-efficacy enhancing strategies in the development of wheelchair interventions.

1.3 Self-efficacy and Social Cognitive Theory

1.3.1 Self-efficacy

Self-efficacy is defined as the belief in personal ability to perform a behaviour or activity (Bandura, 1997). While skill is important, research indicates that adequate levels of self-efficacy are more likely to lead to behaviour changes (Bandura, 1986; Pang et al., 2008; Schmid et al., 2012). Self-efficacy influences choices and decisions, in addition to efforts, perseverance, and
motivation (Bandura, 1997). High perceived self-efficacy leads to the likelihood of setting challenging goals, having positive outcomes, and recovering more quickly after setbacks, than low self-efficacy (Bandura, 1997). Individuals with high self-efficacy are also more likely to perceive barriers as surmountable, expend greater effort to overcome the barriers, and persevere to reach their goals. Therefore, self-efficacy is an important factor to consider in rehabilitation as it is a remediable condition that may influence adherence to rehabilitative programs, goal setting, efforts and persistence (Bandura, 1997).

According to Bandura’s Social Cognitive Theory, self-efficacy can be constructed and modified through four main sources, including enactive mastery, vicarious learning, verbal persuasion, and physiological and affective states (Bandura, 1977). Enactive mastery, or performance accomplishments, is based on personal mastery experiences of the targeted task or behaviour. Success performances raise self-efficacy and expectations, while failure attempts lower them. Self-efficacy is also derived through vicarious learning, or learning by watching others. Vicarious learning is best achieved by watching a role model who is similar to oneself, as seeing similar others perform desired tasks or behaviours without adverse consequences reinforces an individual’s belief that he or she may attain similar outcomes. Verbal persuasion arises through reinforcement of one’s capabilities through the use of encouragement and positive suggestion. Although verbal persuasion alone has limited influence on self-efficacy, when combined with situations that are arranged to facilitate success, verbal persuasion can enhance self-efficacy. However, expectations raised by persuasions of personal competence without arranging conditions to facilitate effective performance will most likely discredit the persuaders and may reduce and individuals self-efficacy. Finally, emotional arousal that can arise during stressful and
taxing situations may have informative value concerning personal competency. Since high arousal can debilitative successful performances, reinterpretation of affective states and somatic responses may help to achieve higher levels of self-efficacy. Enactive mastery has been identified as the most important source of self-efficacy, but the most effective way improve self-efficacy comes from a combination of all four sources (Bandura, 1997).

1.3.2 Self-efficacy is an important determinant of behaviour change

There is a broad scope of literature supporting the influence of self-efficacy on specific activity, participation and health outcomes, including: exercise, exercise adherence, and walking (Ashford et al., 2010; MacAuley et al., 2011; Fletcher & Banasik, 2001; Marcus et al., 1992), accidental falls in people with lower limb amputation (Miller et al., 2003), health status in multiple sclerosis (Riazi et al., 2004) and chronic disease (Lorig et al., 2001a), performance of activities of daily living after stroke (Andersson et al., 2008; Salbach et al., 2005; Hellstrom et al. 2001), satisfaction with community re-integration after stroke (Pang et al., 2007), and perceived stroke recovery (Best et al., 2011). Self-efficacy is also an important factor of quality of life in older adults and self-efficacy decreases with age (Bowling & Iliffe, 2011). Despite confirming the importance of self-efficacy in determining behaviour change, the majority of the aforementioned studies are cross-sectional or longitudinal in design. Therefore, conclusion regarding the explicit influence of self-efficacy on behaviour could not be confirmed. A systematic review of intervention studies would allow for a summary of useful strategies for self-efficacy modification, as well as help to understand whether self-efficacy interventions change behaviour.
1.3.3 Self-efficacy is modifiable

Self-efficacy has been shown to be modifiable in various populations. Compared to usual care control groups, interventions that have incorporated self-efficacy enhancing strategies have lead to higher levels of perceived self-efficacy for physical activity (Allison & Keller, 2004; Anderson-Bill et al., 2011), overcoming barriers to exercise (Lee et al., 2008), reducing number of falls (Clemson et al., 2004), management of chronic diseases (Davis et al., 2006; Damush et al., 2010; Lorig et al., 1999a; Lorig et al., 1999b; Lorig et al., 2001b; Jerant et al., 2008; Farrell et al., 2004), arthritis (Barlow et al., 2009; Callahan et al., 2011; Goeppinger et al., 2007), diabetes (Lorig et al., 2009; Rosal et al., 2011; van der Wulp et al., 2012), and asthma (Chen et al., 2010). Although the interventions target varying clinical populations and non-clinical populations, they share the common goal of improving self-efficacy through intervention as a mechanism to induce behaviour change. It is plausible that similar self-efficacy enhancing strategies can be applied to manual wheelchair use.

1.3.4 Self-efficacy for wheelchair use

Self-efficacy is situation specific, and until the recent development of a tool to measure wheelchair use self-efficacy, had not been evaluated in wheelchair users. Self-efficacy for wheelchair use has been conceptualized as the belief individuals have in their ability to use their wheelchair in a variety of challenging activities and physical environments (Rushton et al., 2011).
Observational studies indicate that self-efficacy using a manual wheelchair is particularly low in older adults (Miller et al., 2012). In a recent report of experienced manual wheelchair users who were 50 years of age or older, approximately 40% had low self-efficacy (Miller et al., 2012). Although cross-sectional studies have confirmed that self-efficacy for wheelchair use influences successful wheelchair mobility and participation (Phang et al., 2012; Sakakibara et al., 2013a; Sakakibara et al., 2014a; Sakakibara et al., 2014b), experimental study designs are required to determine causal factors that may influence wheelchair use self-efficacy.

1.3.5 Self-efficacy for wheelchair use is modifiable

As with other types of self-efficacy, preliminary evidence suggests that manual wheelchair use self-efficacy is modifiable. Sakakibara et al., 2013b demonstrated that with two hours of training, wheelchair use self-efficacy could be effectively improved in a group of older able-bodied adults who were not regular manual wheelchair users. In this pilot study, the treatment group, who received 2 hours of training according to the Wheelchair Skills Training Program (Wheelchair Skills Program Manual Version 4.1 2008 (www.wheelchairskillsprogram.ca), was compared to a control group that received social contact by telephone only.

Although the Wheelchair Skills Training program led to improvements in wheelchair use self-efficacy, the intervention does not explicitly state the inclusion of self-efficacy as a mechanism of training. However, improvements in wheelchair use self-efficacy may have been attributable to enactive mastery of specific wheelchair skills, which is the most influential source of self-efficacy. Moreover, since the sample consisted of individuals who had no previous manual
wheelchair experience, the potential influence of exposure to sitting in the wheelchair alone may have limited findings. The Wheelchair Skills Training Program may have also indirectly integrated verbal persuasion as part of training through positive encouragement from the trainer. However, verbal persuasion is not part of the training protocol. Finally, the intervention does not include vicarious experience or strategies for reinterpreting physiological and somatic responses.

The prevalence of low wheelchair self-efficacy is high (40%) among adult manual wheelchair users, and evidence confirms the influence of wheelchair use self-efficacy on wheelchair mobility and participation frequency (Sakakibara et al., 2014a; Sakakibara 2014b; Geyh et al., 2012; Miller et al., 2012). Developing interventions that address low self-efficacy has been suggested as one possible strategy for improving mobility and participation outcomes of manual wheelchair use. According to Bandura (1997), self-efficacy is the fundamental concept explaining human behaviour. Bandura’s Social Cognitive Theory provides a useful framework for the development of a self-efficacy enhanced wheelchair training intervention that may influence behaviours related to manual wheelchair use.

Although the Wheelchair Skills Training Program has been effectively used to improve the manual wheelchair skills of wheelchair users during initial rehabilitation (MacPhee et al., 2004) and in the community (Best et al., 2005; Ozturk & Ucsular, 2011; Routhier et al., 2012), no studies to date have applied social cognitive approaches to wheelchair training that includes the four sources of self-efficacy. Similar to the improvements in self-efficacy observed in other clinical populations, it is plausible that social cognitive strategies may improve self-efficacy for manual wheelchair use. Exploring how wheelchair use self-efficacy can be modified may also provide useful information for understanding the relationships between wheelchair use self-
efficacy, mobility and community participation for manual wheelchair users. A *systematic review and meta-analysis on the effect of existing social cognitive approaches on participation outcomes and self-efficacy may serve to inform the development of a self-efficacy enhanced manual wheelchair training program.*

1.4 Self-efficacy enhanced wheelchair training

With the goal of providing optimal quality of life, rehabilitation interventions should strive to positively influence mobility and participation (WHO, 2001). The World Health Organization recognizes the need for skills training to ensure safe and effective use of the wheelchair (WHO, 2009). Wheelchair skills influence wheelchair mobility, which logically influences participation in meaningful activities for manual wheelchair users (Routhier et al., 2003; Oyster et al., 2011), including participation in leisure-time physical activity (Phang et al., 2012).

Self-efficacy has been identified as an important factor for manual wheelchair mobility and participation and low self-efficacy is prevalent (Sakakibara et al., 2013a; Sakakibara et al., 2014a; Sakakibara et al., 2014b; Miller et al., 2012). A relationship between wheelchair use self-efficacy and life-space mobility (Sakakibara et al., 2014b) and participation frequency that is mediated by wheelchair skills has been identified (Sakakibara et al., 2014a). The usefulness for evaluating self-efficacy enhancing wheelchair training interventions has been established to support mobility and participation outcomes for manual wheelchair users (Sakakibara et al., 2013a; Sakakibara et al., 2014a; Sakakibara et al., 2014b; Geyh et al., 2012; Miller et al., 2012). *Development and evaluation of self-efficacy enhanced manual wheelchair training*
Interventions may help to understand how self-efficacy influences wheelchair skills, mobility and participation.

1.5 Research purpose

Before adequate wheelchair interventions can be developed, a better understanding of current participation levels in wheelchair users is needed. Additionally, comprehensive knowledge of current manual wheelchair training procedures may be advantageous toward the development of novel approaches to augment existing practices. There is theoretical rationale for the use of self-efficacy enhancing interventions to achieve desired behaviour change in other clinical areas, and many of these approaches have used a peer-trainer. The effect of peer-led self-efficacy enhancing interventions on participation outcomes, such as physical activity is unclear. Although peer-training has empirical support in other clinical areas, application of peer-training to enhance self-efficacy for manual wheelchair user is a novel research idea with sound theoretical backing. In this overview gaps have been identified in our understanding of: 1) participation in physical activity levels of wheelchair users; 2) how wheelchair training is included in current clinical practices and entry-to-practice curriculum; 3) the effect of peer-led interventions on physical activity and self-efficacy; and 4) the effect of a peer-led wheelchair training program to improve wheelchair self-efficacy and wheelchair use. My dissertation endeavors to address these shortcomings.

Findings from this research are presented in Chapters 2 to 6. Chapter 2 describes the influence of wheelchair use as a risk factor for physical and leisure inactivity. Chapters 3 and 4 investigate
the current wheelchair training practices of occupational and physical therapists in rehabilitation, and the existing entry-to-practice wheelchair training curriculum that is provided to students in university, respectively. Through systematic review of the social cognitive literature, Chapter 5 evaluates the use of self-efficacy enhancing strategies for improving physical activity to establish the application of social cognitive theory for the development of a self-efficacy enhanced wheelchair training program. In Chapter 6, the development of a self-efficacy wheelchair training intervention is described and the effects of the intervention on the primary end point of wheelchair use-self-efficacy as well as secondary endpoints including wheelchair skills, life-space mobility and satisfaction with participation are evaluated in community-living, manual wheelchair users.
2 Participation in physical and leisure activities among older wheelchair users.

2.1 Introduction

Despite its importance for mobility, the wheelchair commonly limits participation in meaningful activities in the home and community (Chaves et al., 2004). Participation, defined as involvement in life situations (WHO, 2002), is strongly associated with quality of life for wheelchair users (Ravenick et al., 2012), and must be maintained to avoid deterioration of health (Trieschmann, 1988). Due to the sedentary nature of prolonged periods of sitting, participation in activities that engage wheelchair users to mobilize are increasingly important.

Both aging and wheelchair use are associated with deteriorations in physical functioning, which can lead to physiological deconditioning that is associated with numerous health risks, morbidity and early mortality (Rimmer, 2006). Lack of participation in physical activities seemingly exacerbates physiological deconditioning, which can result in further accumulation of functional limitations and disability as people age (Rejeski et al., 2003). In fact, physical inactivity has been named the greatest health risk factor for older adults by the World Health Organization (WHO, 2009). It has been suggested that interventions which promote or maintain physical activity behaviour among older adults with disabilities might provide an effective strategy for lessening the health risks of functional decline (Motl & McAuley, 2010).
Physical activity, defined as bodily movements produced by skeletal muscles that result in energy expenditure (WHO, 2009), is a proven modality of health promotion. Physical activity interventions may optimize physical functioning and slow the spiralling effects of deconditioning in adults with chronic conditions (Ashe et al., 2009) and disabilities (Durstine et al., 2000). Physical activity is associated with decreased morbidity and early mortality risk for older adults (Sawatzky et al., 2007), improved stamina and muscle strength in individuals with chronic and disabling conditions, reduced anxiety and depression, and improved mood and general feelings of well being (National Centre for Chronic Disease Prevention and Health Promotion, 1999). Similarly, physically active adults with mobility impairments are healthier than their less active peers and have decreased mortality risk (Warms et al., 2007) and younger physically active wheelchair users have improved functioning and less risk of early mortality risk compared to their inactive peers (Durstine et al., 2000; Warms et al., 2007).

General improvements in health and well being for older individuals with a disability are also highly associated with participation in leisure activities. In fact, participation in leisure activities, defined as a non-obligatory activity that a person is engaged in during discretionary time (American Occupational Therapy Association, 2008), has been shown to be the primary predictor of well being after stroke (Sveen et al., 2004). Participation in active leisure pursuits, which may include long walks, attending entertainment venues, and gardening, may also fit the definition of physical activity. Therefore, participation in active leisurely pursuits may provide health benefits similar to those of participation in physical activity.
Previous findings have suggested that much of the association between physical impairment and lower well-being can be explained by disability (Sveen et al., 2004; Abas et al., 2009). Adults with chronic conditions (Cott et al., 1999) and older adults with arthritis (Freelove-Charton et al., 2007) who participate in physical activity, report having better perceived health than those who don’t participate in physical activity. Similarly, older stroke-survivors who participate in leisurely pursuits report higher perceived health than their leisurely inactive peers (O'Sullivan & Chard, 2010). Participation in physical and leisure activities has also been shown to improve general wellbeing for individuals of varying age with disabilities (National Centre for Chronic Disease Prevention and Health Promotion, 1999; Ball et al., 2007). Due to the associations of perceived health with objective health measures (Pinquart, 2001), health care costs and mortality (Jylha, 2009), improved perceived health due to increased physical activity is arguably just as important as the physical health benefits (Cooper et al., 1999b).

The benefits of participation in physical and other leisure activities would be similar for older adult wheelchair users, but the likelihood of participation for people with disabilities is low (Warms et al., 2007; Sveen et al., 2004; Canadian Fitness and Lifestyle Research Institute, 1996). The lack of participation may be a result of the numerous unique barriers faced by wheelchair users and the limited number of interventions that specifically address their complex needs. Physical activity participation levels among individuals with disabilities are affected by a complex set of barriers and facilitators that are unique to this population. These barriers and facilitators include the environment, emotional and psychological barriers, equipment barriers, information-related barriers, professional knowledge and training issues, attitudinal barriers and availability of resources (Hoenig et al., 2003; Vanner et al., 2008). Since wheelchair users are a
heterogeneous group, with varying disabilities, functional limitations, and a diverse range of likes and dislikes, current physical activity models provide few choices given the environmental barriers that wheelchair users face. Finding suitable durations, frequencies and types of physical activity for wheelchair users also poses a complex challenge due to the variations in ability and in ways of moving (Warms et al., 2008). Strategies that incorporate methods for enhancing self-efficacy along with the promotion of physical and other leisure activities have been suggested as a means of improving quality of life among older adults who have a disability (Motl & McAuley, 2010; Ball et al., 2007).

The association between wheelchair use and participation in physical activity and other leisure activities has not been documented to date. A better understanding of the prevalence of physical activity in community-dwelling wheelchair users and its association with perceived health may provide insight and rationale for the development of appropriate physical and leisure activity interventions, which forms the purpose of this study.

The primary objectives of this study were to: 1) examine participation in physical and leisure activity in older wheelchair users; 2) determine if there is an association between wheelchair use and participation in physical and leisure activity. The secondary objectives were to: 1) examine perceived health in older wheelchair users; and 2) determine if participation in physical and leisure activity mediates the relationship between wheelchair use and perceived health. The primary hypotheses were: 1) wheelchair users would report lower levels of participation in physical and leisure activity compared to older adults who do not use a wheelchair; and 2) wheelchair use would be a significant risk factor for reduced participation in physical and leisure
activity. The secondary hypotheses were: 1) older wheelchair users would have lower perceived health than older adults who do not use a wheelchair; and 2) participation in physical and leisure activity would positively mediate the relationship between wheelchair use and perceived health in older wheelchair users.

2.2 Method

2.2.1 Design

Findings from this study were based on data collected for Canadian Community Health Survey (CCHS) Cycle 3.1, which were collected by Statistics Canada between January and December 2005. The CCHS cycle 3.1 was the third cross-sectional survey in a series of larger national surveys designed to estimate health determinants, health status, and health system utilization of Canadians. Subsample 1 of CCHS 3.1 was chosen as it was specifically designed to provide additional estimates for the Health Utility Index, which included questions related to functioning and mobility, including wheelchair use. Details of the CCHS, including a methodological overview have been previously published (Beland, 2002).

2.2.2 Subjects and data collection

The target population of the CCHS was Canadians aged 12 and over. Individuals living on Indian Reserves and on Crown Lands, institutional residents, including nursing homes and long-term care facilities, full-time members of the Canadian Forces, and residents of certain remote regions
were excluded from the sampling frame. A total of 32,153 Canadians were surveyed. For the purposes of this study, responses from all adults aged 60 and older (n= 8301) were included in the analyses. This sub-group was further divided into three mobility categories: wheelchair users; non-wheelchair users who required some form of assistance to walk; and non-wheelchair users who did not require any assistance to walk. The data were collected by Statistics Canada under the authority of the Statistics Canada Act. Access to the data was granted by Statistics Canada based on a peer-reviewed proposal for the study. While the research and analysis are based on data from Statistics Canada, the opinions expressed do not represent the views of Statistics Canada.

2.2.3 Classification of mobility

Wheelchair use was identified using the Health Utility Index module of the CCHS. Respondents were initially asked, ‘Do you walk without difficulty or without support’. Responses were coded dichotomously as ‘yes/no’. If their answer was ‘no’ or ‘unsure’, respondents were asked, ‘Do you walk with assistance from another person’ and ‘Do you walk with assistance using an assistive device’. For the purposes of this study, responses from these two questions were collapsed into one variable, ‘walk with assistance’, which was coded dichotomously as ‘yes/no’. In addition, those who responded they required assistance to walk were also asked, ‘Do you require a wheelchair for mobility’. If the respondent used a wheelchair, and could walk with assistance, they were classified as a wheelchair user in this study and the responses were coded dichotomously as ‘yes/no’. Two sub-groups of older adults who did not use a wheelchair were
identified (walk without difficulty or without support; walk with assistance) for comparisons with older wheelchair users and both were coded dichotomously as ‘yes/no’.

2.2.4 Dependent variables

Participation in physical and leisure activities were assessed using two questions from the Physical Activity module of the CCHS. The Physical Activity Index provided an indication of the amount of participation in physical activity through estimates of overall energy expenditure from physical activity. This was calculated using the type of physical activity, frequency and duration of each physical activity session, and the MET (metabolic equivalent) values for each physical activity. First, respondents were asked which physical activities they participated in during the past 3 months from a pre-set list determined by Statistics Canada, which included activities such as going for a walk, gardening, and/or lifting weights (complete list of activities is shown in Table 2.1). If the list did not include a specific activity, the respondent was given the option to respond ‘other’. The ‘other’ option was able to be selected up to three times by the respondent, thus capturing physical activities that were not necessarily included on the list. The response option, ‘did not take part in any physical activity for at least 15 minutes during the past 3 months’ was also available to respondents.
Table 2.1: Questions used to calculate the Physical Activity Index.

Respondents were asked: ‘Have you participated in the following physical activities for at least 15 minutes during the past 3 months.’

<table>
<thead>
<tr>
<th>Physical Activity</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Walking</td>
<td>Bowling</td>
</tr>
<tr>
<td>Gardening/ yard work</td>
<td>Baseball or softball</td>
</tr>
<tr>
<td>Swimming</td>
<td>Tennis</td>
</tr>
<tr>
<td>Bicycling</td>
<td>Weight training</td>
</tr>
<tr>
<td>Popular/ social dance</td>
<td>Fishing</td>
</tr>
<tr>
<td>Home exercises</td>
<td>Volleyball</td>
</tr>
<tr>
<td>Ice hockey</td>
<td>Basketball</td>
</tr>
<tr>
<td>Ice skating</td>
<td>Soccer</td>
</tr>
<tr>
<td>In-line skating/ roll</td>
<td>Other (#1)</td>
</tr>
<tr>
<td>Jogging or running</td>
<td>No physical activity</td>
</tr>
<tr>
<td>Golfing</td>
<td>Other (#2)</td>
</tr>
<tr>
<td>Exercise class/ aerobics</td>
<td>Other (#3)</td>
</tr>
<tr>
<td>Skiing/ snowboarding</td>
<td></td>
</tr>
</tbody>
</table>

If the respondent indicated they did participate in a physical activity in the past 3 months, they were asked ‘What was the activity?’, ‘How many times did you participate in this activity?’, and ‘About how much time was spent on each activity? Information about activity type, frequency and duration during the past 3 months was used to calculate the metabolic equivalent (MET).

MET, expressed as kilocalories expended per kilogram of body weight per hour of activity, is a physiological measure assessing the energy cost of a physical activity.

The MET was then used to derive a Physical Activity Index (Statistics Canada, 2005), which was categorized into three categories, including ‘Active’, ‘Moderately Active’, and ‘Inactive’.

‘Active’ corresponded to an average of 3.0 +kcal/kg/day of energy expenditure, or the amount of exercise required for cardiovascular health benefits. ‘Moderately Active’ corresponded to energy expenditure of 1.5-2.9 kcal/kg/day, or some health benefits but little cardiovascular benefit.
‘Inactive’ corresponded to energy expenditure below 1.5 kcal/kg/day or little to no health benefits. Although the Physical Activity Index included 3 questions which asked the respondents whether they participated in ‘other’ physical activities during the past 3 months, it is not clear how the METs were calculated for these variables. For the purposes of this study, the three categories were re-coded into dichotomous outcomes as ‘active (active/moderately active) / inactive’. All non-responses for this variable were coded as ‘inactive’.

Participation in leisure activity was measured using one question on the CCHS, which asked whether or not respondents participated in leisure activities during the last 3 months. The responses were coded dichotomously as ‘yes/no’. Leisure activities included playing cards or other games, listening to radio or music, doing crafts or other hobbies, visiting with family and friends, and attending events or entertainment. Leisure activities did not include reading a book or watching television.

Perceived health was assessed using the Self-rated Health variable, which is indicative of the respondent’s health status at that point in time based on personal judgment. Self-rated health was assessed using a 5-point ordinal scale (poor, fair, good, very good, excellent), and responses were re-coded as dichotomous outcomes for ‘poor-fair/good-excellent’ for the purposes of study.

### 2.2.5 Independent variables

Sociodemographic (age, sex, marital status, education, income) and health related (body mass index [BMI], tobacco use, alcohol consumption, having a chronic condition) covariates were included for analyses. Age was collected as a continuous variable and sex was coded
dichotomously as ‘male/female’. Marital status was included in this report as a proxy measure of social support. It was originally coded using a 5-point ordinal scale (married, common law, widowed, divorced, single), but for analyses purposes it was collapsed into dichotomous variable (‘married-common law/widowed-divorced-single’). Education level was reflective of whether or not the respondent graduated from high school or not. Household income was originally collected as a continuous variable, but was collapsed and coded dichotomously as ‘CAD<14999/CAD>15000’.

Self-reports of height and weight were used to calculate BMI as a continuous variable. Respondents were asked to indicate their current tobacco use on a 3-point ordinal scale (daily, occasional, never), which was re-coded dichotomously as ‘daily-occasional/never’. Alcohol use was originally coded using a 4-point ordinal scale (regular, occasional, former, never), which was re-coded dichotomously as ‘regular-occasional/former-never’. The existence of one or more chronic conditions was assessed by whether respondents had been diagnosed by a healthcare professional as having a disease or other health condition that had lasted for, or was expected to last for, 6 months or longer. Responses were coded dichotomously as ‘yes/no’.

2.2.6 Statistical analysis

The raw data were obtained from the Statistics Canada Research Data Centre, University of British Columbia, Vancouver, British Columbia.
Proportions for all sociodemographic (age, sex, marital status, education, income) and health related (body mass index [BMI], tobacco use, alcohol consumption, having a chronic condition) variables were estimated. Collinearity was assessed using bivariate Pearson correlations (i.e. multicollinearity = 0.70 or above).

As suggested by Statistics Canada, bootstrapping was used to apply sampling weights to estimate the variance of all point estimates. Bootstrapped estimates were based on 500 replications for each model to correct for unequal probabilities of selection in calculating variances.

2.2.6.1 Primary objectives

1) Prevalence of wheelchair use in adults aged sixty and older was calculated using frequency counts.

2) Participation in physical and leisure activity (Physical Activity Index, participation in leisure activity) were compared between older adults who do and do not use a wheelchair using percent concordances.

3) Wheelchair use as a risk factor for decreased participation in physical activity was assessed using multivariate logistic regression, while controlling for sociodemographic and health-related variables. Odds ratios (OR) and 95% confidence intervals (CI) were estimated for each variable to determine the differences in participation in physical and leisure activities between each group (older wheelchair users, older adults who could walk with support) and to examine the association between wheelchair use and participation in physical and leisure activities.
2.2.6.2 Secondary objectives

1) The perceived health of older wheelchair users was compared to the perceived health of older adults who do not use a wheelchair using percent concordances.

2) The association between participation in physical and leisure activity and poorer perceived health in older wheelchair users was estimated using 2 multivariate logistic regression models. The initial model, which included all sociodemographic and health related variables except physical and leisure activity, produced ORs and 95% CIs for each variable to estimate risk factors of poor perceived health in wheelchair users. The physical and leisure activity variables were then added to the model to examine if participation in physical and leisure activity mediated the relationship between wheelchair use and perceived health. All data were analyzed using SPSS (Version 13.0, Chicago, IL, USA) software.

2.3 Results

Weighted estimates suggested that the population of community-based Canadians aged 60 and older was approximately 5,362,000 and the estimated prevalence of wheelchair use within this population was approximately 100,000. The average (SD) age of the sub-sample of wheelchair users was 76.4 (9.5) years, of which 62% were female. The estimated proportions for the sociodemographic and health related variables are described in Table 2.2.
Table 2.2: Description of Canadian Community Health Survey 3.1 subsample 1 respondents aged 60 and over.

<table>
<thead>
<tr>
<th>Population Estimates</th>
<th>Walk (n= 7217)</th>
<th>Walk with assistance (n=935)</th>
<th>Wheelchair User (n=149)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>4738248 (88.4%)</td>
<td>523577 (11.3%)</td>
<td>99992 (1.9%)</td>
</tr>
</tbody>
</table>

**Sociodemographic Variables**

<table>
<thead>
<tr>
<th></th>
<th>Walk</th>
<th>Walk with assistance</th>
<th>Wheelchair User</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age mean(SD), range</td>
<td>69.6 (7.4), 60-100</td>
<td>76.8 (8.7), 60-98</td>
<td>76.4 (9.5), 60-93</td>
</tr>
<tr>
<td>Sex (%)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Male</td>
<td>47.4</td>
<td>34.9</td>
<td>38</td>
</tr>
<tr>
<td>Female</td>
<td>52.6</td>
<td>65.1</td>
<td>62</td>
</tr>
<tr>
<td>Marital Status (%)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Married/Common law</td>
<td>68.5</td>
<td>45.6</td>
<td>49.2</td>
</tr>
<tr>
<td>Single/Widowed/Divorced</td>
<td>31.5</td>
<td>54.4</td>
<td>50.8</td>
</tr>
<tr>
<td>Graduated High School (%)</td>
<td>51.7</td>
<td>38.3</td>
<td>46.7</td>
</tr>
<tr>
<td>Yes</td>
<td>48.3</td>
<td>61.2</td>
<td>53.3</td>
</tr>
<tr>
<td>No</td>
<td>51.7</td>
<td>38.3</td>
<td>53.3</td>
</tr>
<tr>
<td>Income (%)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CAD&lt;14999</td>
<td>8.3</td>
<td>85</td>
<td>81.4</td>
</tr>
<tr>
<td>CAD&gt;15000</td>
<td>91.7</td>
<td>15</td>
<td>18.6</td>
</tr>
</tbody>
</table>

**Health-related Variables**

<table>
<thead>
<tr>
<th></th>
<th>Walk</th>
<th>Walk with assistance</th>
<th>Wheelchair User</th>
</tr>
</thead>
<tbody>
<tr>
<td>BMI(^*) (m/Kg(^2)), mean(SD)</td>
<td>26.1 (4.3)</td>
<td>27.4 (5.9)</td>
<td>26.6 (5.9)</td>
</tr>
<tr>
<td>Smoker Type (%)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Daily/Occasionally</td>
<td>12.6</td>
<td>12.6</td>
<td>15.1</td>
</tr>
<tr>
<td>Never</td>
<td>87.3</td>
<td>87.4</td>
<td>84.9</td>
</tr>
<tr>
<td>Alcohol Consumption (%)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Regular/Occasional</td>
<td>72.8</td>
<td>56.4</td>
<td>57.4</td>
</tr>
<tr>
<td>Former/Never</td>
<td>27.2</td>
<td>43.6</td>
<td>42.6</td>
</tr>
<tr>
<td>Has a Chronic Condition (%)</td>
<td>88</td>
<td>97.9</td>
<td>100</td>
</tr>
<tr>
<td>Yes</td>
<td>12</td>
<td>2.1</td>
<td></td>
</tr>
<tr>
<td>No</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Dependent Variables**

<table>
<thead>
<tr>
<th></th>
<th>Walk</th>
<th>Walk with assistance</th>
<th>Wheelchair User</th>
</tr>
</thead>
<tbody>
<tr>
<td>Physical Activity Index (%)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Active/Moderately Active</td>
<td>48.4</td>
<td>16.5</td>
<td>8.3</td>
</tr>
<tr>
<td>Inactive</td>
<td>51.6</td>
<td>83.5</td>
<td>91.7</td>
</tr>
<tr>
<td>Participate Leisure Activity (%)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Yes</td>
<td>88.9</td>
<td>64.6</td>
<td>41.3</td>
</tr>
<tr>
<td>No</td>
<td>11.1</td>
<td>35.4</td>
<td>58.7</td>
</tr>
<tr>
<td>Self Rated Health (%)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Poor/Fair</td>
<td>18.1</td>
<td>56.8</td>
<td>74.2</td>
</tr>
<tr>
<td>Good/Very Good/Excellent</td>
<td>81.9</td>
<td>43.2</td>
<td>25.8</td>
</tr>
</tbody>
</table>

Note: Results are weighted to provide proportional representation of the Canadian population.

† Body Mass Index
2.3.1 Physical and leisure activity

Approximately 8.3% of community-based wheelchair users aged 60 and older reported being physically active, compared to 16.5% and 48.8% of older adults who walked with and without assistance respectively. Participation in leisure activity was higher in all groups, with approximately 41.3% of community-based wheelchair users compared to 64.6% and 88.9% of older adults who walked with and without assistance respectively reporting they took part in leisure activities (Table 2.2).

2.3.1.1 Predictors of participation in physical and leisure activity

After controlling for sociodemographic (age, sex, marital status, income) and health related (BMI, tobacco use, alcohol consumption) variables, multivariate logistic regression showed that older adults who walked with assistance (Odds Ratio (OR) = 2.96, 95% CI 2.16, 4.04) were less likely than older adults who walked without assistance to participate in physical activity. Likewise, wheelchair users were even less likely to be participate in physical activity compared to older adults who could walk (OR = 44.71, 95% CI 0.02, 3.31e6).

Tobacco use and higher BMI were significant risk factors for reduced physical activity, while increasing age was a slight risk factor for reduced participation in physical activity. Predictors of being physically active included, being male, graduating from high school, and consuming any alcohol. Marital status, income and having a chronic condition were not significant risk factors for reduced participation in physical activity. See Table 2.3 for detailed information of this model.
Both older wheelchair users (OR = 10.83, 95% CI 5.84, 20.05) and older adults who walked with assistance (OR = 4.24, 95% CI 3.08, 5.84) were less likely than older adults who could walk without assistance to participate in leisure activity, after controlling for sociodemographic and health-related variables. Tobacco use was a significant risk factor for participation in leisure activity, while alcohol consumption had a protective association. Age, sex, marital status, education, income category, BMI and having a chronic condition were not significant predictors of participation in leisure activities. See Table 2.3 for detailed information of this model.

Table 2.3: Association of wheelchair use, sociodemographic and health-related variables with physical activity behaviours in older Canadian adults.

<table>
<thead>
<tr>
<th>Sociodemographic Variables</th>
<th>Physical Activity Index*</th>
<th>Participates in leisure activities</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age (years)</td>
<td>OR 1.03 1.02, 1.05 &lt;0.001</td>
<td>OR 1.02 1.00, 1.04 0.02</td>
</tr>
<tr>
<td>Sex</td>
<td>Male 0.72 0.61, 0.84 &lt;0.001</td>
<td>Male 1.16 0.93, 1.44 0.18</td>
</tr>
<tr>
<td>Marital status</td>
<td>Married/common Law 0.98 0.83, 1.16 0.83</td>
<td>Married/common Law 1.08 0.86, 1.36 0.52</td>
</tr>
<tr>
<td>Education</td>
<td>High school 0.62 0.52, 0.73 &lt;0.001</td>
<td>High school 0.61 0.49, 0.76 &lt;0.001</td>
</tr>
<tr>
<td>Income</td>
<td>CAD&lt;14999 1.05 0.81, 1.34 0.74</td>
<td>CAD&lt;14999 1.14 0.86, 1.51 0.37</td>
</tr>
<tr>
<td>Health Related Variables</td>
<td>BMI (m/Kg2) 1.07 1.05, 1.09 &lt;0.001</td>
<td>BMI (m/Kg2) 1.04 1.01, 1.06 &lt;0.001</td>
</tr>
<tr>
<td>Type of smoker</td>
<td>Regular/occasional 1.95 1.51, 2.52 &lt;0.001</td>
<td>Regular/occasional 1.81 1.33, 2.46 &lt;0.001</td>
</tr>
<tr>
<td>Alcohol use</td>
<td>Regular/occasional 0.74 0.61, 0.89 &lt;0.001</td>
<td>Regular/occasional 0.54 0.43, 0.69 0.001</td>
</tr>
<tr>
<td>Has a chronic condition</td>
<td>Yes 1.12 0.86, 1.46 0.41</td>
<td>Yes 7.60 3.20, 18.03 &lt;0.001</td>
</tr>
<tr>
<td>Wheelchair Use</td>
<td>No (walks with support) 2.96 2.16, 4.04 &lt;0.001</td>
<td>No (walks with support) 4.24 3.08, 5.84 &lt;0.001</td>
</tr>
<tr>
<td></td>
<td>Yes 44.71 0.002, 3.3e6 0.51</td>
<td>Yes 10.83 5.84, 20.05 &lt;0.001</td>
</tr>
</tbody>
</table>

*
2.3.2 Risks factors for poor perceived health

Approximately 74.2% of community-based wheelchair users aged 60 and older reported having poor perceived health, compared to 56.8% and 18.1% of older adults who walked with and without assistance respectively (Table 2.2).

Multivariate logistic regression suggested that using a wheelchair (OR= 10.56, 95% CI 5.90, 18.92, p<0.001) and requiring assistance to walk (OR= 4.18, 95% CI 3.05, 5.75, p<0.001) were significant risk factors for poor perceived health compared to older adults who walked without assistance. Having a chronic condition, smoking and having an income of less than 14,999 CAD were also significant risk factors for poor perceived health, while graduating from high school and consuming alcohol had a protective effect. Age, sex, and BMI were not significant predictors of poor perceived health in older adults. See Table 2.4 for detailed information of this model.
Table 2.4: A Summary of risk factors for predictive models of perceived health in older Canadian adults.

<table>
<thead>
<tr>
<th>Sociodemographic Variables</th>
<th>Perceived Health (Model 1)</th>
<th>Perceived Health (Model 2)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>OR</td>
<td>95% CI</td>
</tr>
<tr>
<td>Age (years)</td>
<td>1.02</td>
<td>1.01, 1.04</td>
</tr>
<tr>
<td>Sex</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Male</td>
<td>1.15</td>
<td>0.92, 1.43</td>
</tr>
<tr>
<td>Marital status</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Married/common Law</td>
<td>1.00</td>
<td>0.80, 1.25</td>
</tr>
<tr>
<td>Education</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Graduated from high school</td>
<td>0.56</td>
<td>0.46, 0.70</td>
</tr>
<tr>
<td>Income</td>
<td>1.13</td>
<td>0.85, 1.50</td>
</tr>
<tr>
<td>Health Related Variables</td>
<td></td>
<td></td>
</tr>
<tr>
<td>BMI (m/Kg2)</td>
<td>1.04</td>
<td>1.01, 1.06</td>
</tr>
<tr>
<td>Type of smoker</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Regular/occasional</td>
<td>1.89</td>
<td>1.38, 2.59</td>
</tr>
<tr>
<td>Alcohol use</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Regular/occasional</td>
<td>0.52</td>
<td>0.41, 0.66</td>
</tr>
<tr>
<td>Has a chronic condition</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Yes</td>
<td>7.60</td>
<td>3.21, 18.07</td>
</tr>
<tr>
<td>Wheelchair Use</td>
<td></td>
<td></td>
</tr>
<tr>
<td>No (walks with support)</td>
<td>4.18</td>
<td>3.05, 5.75</td>
</tr>
<tr>
<td>Yes</td>
<td>10.56</td>
<td>5.90, 18.92</td>
</tr>
<tr>
<td>Physical Activity Index</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Inactive</td>
<td>.</td>
<td>.</td>
</tr>
<tr>
<td>Participates in leisure activities</td>
<td></td>
<td></td>
</tr>
<tr>
<td>No</td>
<td>.</td>
<td>.</td>
</tr>
</tbody>
</table>

Model 1: Impact of wheelchair use on perceived health, controlled for sociodemographic and health related variables.  
Model 2: Impact of wheelchair use on perceived health when after adding physical activity behaviours to the model, controlled for sociodemographic and health related variables.
When participation in physical and leisure activity was added to the model, logistic regression analyses showed that both reduced participation in physical activity (OR= 1.64, 95% CI 1.29, 2.07) and leisure activity (OR= 1.67, 95% CI 1.24, 2.26) were significant risk factors for poor perceived health. Adding participation in physical and leisure activity to the model reduced the Odds Ratio for both older wheelchair users (OR= 6.94, 95% CI 3.81, 12.65, p<0.001) and older adults who could walk with assistance (OR= 3.63, 95% CI 2.64, 4.99, p<0.001). The other sociodemographic and health related variables were not influenced by the addition of participation in physical and leisure activity to the model (Table 2.4).

2.4 Discussion

The prevalence of wheelchair use in adults aged 60 and older adults living in the community was estimated to be approximately 100,000. Although this estimate corresponded with previous estimates of wheelchair users aged 65 and older by Shields (2004) (n=81,300) and Clark and Colantonio (2005) (n=88,300), it is thought to be an underrepresentation of the actual number of Canadian wheelchair users aged 60 and older. Despite efforts to account for unequal sampling probabilities, the small CCHS subsample only includes community living individuals and not those who live in Indian reserves or in institutions.

The overall purpose of this paper was to examine participation in physical and leisure activities in older wheelchair users and to examine the association of wheelchair use, physical and leisure activity on perceived health. As hypothesized, wheelchair users were significantly less likely to participate in leisure activities compared to those who walked with or without support and
wheelchair use seemingly increased the likelihood for reduced participation in physical activity. Wheelchair use was also a significant risk factor for poor perceived health, and participation in physical and leisure activity were shown to have a negative mediating effect on the associations between wheelchair use and perceived health.

Although recent findings suggest the number of physically active older adults is slowly increasing (Woolcott et al., 2010), there is still a large portion of the population who are not active enough to receive health benefits (Ashe et al., 2009). Findings from this study suggest this is particularly true for older adults who use wheelchairs, as only 8.3% of wheelchair users reported participating in physical activity compared to 48.8% of older adults who walked without support. Due to the collapsing of the ‘moderately active’ and ‘active’ variables within the Physical Activity Index, being physically active within this sample represented an energy expenditure of 1.5 to greater than 3 kcal/kg/day. Therefore, the percentage of individuals who meet the recommended 1000 kcal/kg/day (US Department of Health and Human Services, 1996) is likely much smaller than the reported findings in this study values with respect to prevalence of physical activity.

A larger proportion of the population reported participating in leisure activity. Since some of the leisure activities reported on may be active leisure pursuits, it is likely that a portion of the 41.3% of older wheelchair users who reported taking part in leisure activities would be participating in more physical activity than if they were not participating in those leisure activities. It is possible that physical activity levels in older wheelchair users may have been underestimated by the Physical Activity Index alone. However, findings from a recent study suggest that individuals
with disabilities are limited to more passive leisure activities, due to limited mobility, loss of function and fatigue (O’Sullivan & Chard, 2010). Regardless, it is clear that wheelchair users take part in less leisure activity compared to 64.6% of older adults who walk with support and 88.9% of adults who walk without support. This is an important finding as participation in leisure activities have been shown to have similar health benefits as participation in physical activity for older adults, including contributions to successful aging by reducing the risk of premature death (Rodriguez-Laso et al., 2007), and improving overall function (Kono et al., 2007).

Logistic regression analyses suggest that wheelchair use may be a risk factor for reduced participation in physical activity (OR= 44.71) and is a significant risk factor for reduced participation in leisure activity (OR= 2.96). Although the odds ratios suggest that wheelchair use increased the likelihood of not participating in physical activity, the extremely large variance of these estimates suggests these findings must be interpreted with caution. Despite the large variance in this point estimate for the Physical Activity Index, it is clear that a large portion of older wheelchair users are not physically active and are not receiving the benefits of physical activity. Our findings are supported by Ginis et al., 2010, who found that 50% of individuals of individuals of varying age with a spinal cord injury reported no leisure-time physical activity.

Perceived barriers may help to explain the low levels of physical and leisure activity among older wheelchair users. In support of our findings, participants from a recent qualitative study described physical limitations as one of the most common barriers to participation in physical activity in older adults (Bethancourt, et al., 2014). This finding is consistent with many others
studies that indicate that health is a strong predictor of physical activity levels (Macniven et al., 2013; Costello et al., 2011; Baert et al., 2011; Belza et al., 2004; Schutzer & Graves, 2004).

Facilitators to participation in physical activities among older adults have been identified as affordable access to fitness facilities, group-based programs that foster social enjoyment, encouragement and companionship from others, and access to instructors who are specifically trained to work with older adults (Bethancourt, et al., 2014). Self-efficacy has also been identified as an important facilitator, as well as an outcome, of both initiating and maintaining physical and leisure activity (McAuley et al., 2011; Lee et al., 2008; McAuley et al., 2003), but with the onset of physical limitations and disabilities, self-efficacy often declines with age (McAuley et al., 2011; Lee et al., 2008). Specific to wheelchair users, both self-efficacy and wheelchair skills are important factors in predicting leisure-time physical activity (Phang et al., 2012). Improvements in wheelchair skills may facilitate participation in leisure-time physical activity, if improved wheelchair skills help people feel more self-efficacious in their abilities to overcome barriers (Phang et al., 2012). Improvements in wheelchair skills may also help to overcome environmental barriers, which have been shown to impede participation for wheelchair users (Hoenig et al., 2003). Therefore, wheelchair skills training that is focussed on overcoming barriers in the community may facilitate participation in physical and leisure activities.

Wheelchair use (OR=10.56) was also found be significant risk factor for poor perceived health compared to those who did not use a wheelchair. Similar to previous findings, having a chronic condition (Sawatzky et al., 2007; Kaleta et al., 2009), smoking (Lewis & Riegel, 2010) and having a higher BMI were also significant risk factors for poor perceived health, while
graduating from high school and consuming alcohol (Ashe et al., 2009) had a protective effect on perceived health.

Reduced participation in physical activity (OR= 1.64) and leisure activity (OR= 1.67) were also significant risk factors for poor perceived health. Moreover, when physical activity behaviours were added to the model, using a wheelchair (OR= 6.99) was reduced somewhat, but was still a significant factor in predicting poor perceived health. These findings suggest that regardless of sociodemographic and health-related variables, participation in physical activity behaviours can significantly reduce the risk of having poor perceived health in older wheelchair users. This is supported by previous findings which showed that participation in leisure time physical activity had a graded and continuous association with better self-rated health in older adults (Galán et al., 2010). Furthermore, this study also suggested that even small amounts of leisure-time physical activity are related to a better health status, which can be summarized and linked to the clinical and public health recommendations that ‘even a little is good; more is better’ (Lee, 2007).

The health benefits of physical activity (WHO, 2009; Sawatzky et al., 2007; Durstine et al., 2000; Buchner et al., 1992) and leisure activity (Sveen et al., 2004; O'Sullivan & Chard, 2010; Ball et al., 2007; Vanner et al., 2008) are well documented. Findings from this study suggest that participating in physical and leisure activity are associated with improved perceived health, which may also be associated with improved quality of life for older wheelchair users. Furthermore, ratings of perceived health have been shown to be highly predictive of mortality (Kaleta et al., 2009). While the benefits of exercise are well known, it is likely that wheelchair
users who are quite sedentary may benefit from small increases in physical and leisure activities that require more bodily movement than what is normally done.

The results of this study confirm that older wheelchair users are not as physically or leisurely active as those who don’t use a wheelchair. Despite being the most important device for mobility for people with a spinal cord injury, the wheelchair was associated most with barriers to participations that required moving around in the home, going into the community, and using transportation (Chaves et al., 2004). Wheelchair skills training is an important determinant of participation, and may also influence the physical and leisure activity levels of wheelchair users.

There is a need for the development of accessible physical and leisure activity interventions that consider barriers and facilitators to participation for wheelchair users. The promotion of such interventions may lead to increased participation in physical and leisure activity, which is associated with improvements in perceived health for older wheelchair users. Appropriate interventions for older wheelchair users should: 1. focus on providing the skills required for accessing the community and participating in desired activities; 2. consider theoretical strategies for behavioural change; and 3. include a broad range of suitable and accessible activities that are appealing to older adult wheelchair users.

2.4.1 Limitations

The cross-sectional nature of this study imposed inconclusive findings regarding the causality and direction of the relationships of the variables studied. It can only be concluded that there are
associations between wheelchair use and participation in physical and leisure activity and between participation in physical/leisure activity and poorer perceived health.

Also, the pre-defined structure of the questions imposed some uncontrollable limitations to the findings of this study. The study variables (ie. physical and leisure activity) were challenging to define due to the structure of the questions on the CCHS. The broad questions asked about physical and leisure activity left some uncertainty about the activities the respondents participated in. Due to the challenges with defining physical and leisure activity, the results must be interpreted with caution. The types of physical activities asked of the respondents and the uncertainty of the methods used for calculating energy expenditure for the ‘other’ categories of the Physical Activity Index may not have provided an ideal assessment of participation in physical activities for older wheelchair user, which may include wheeling or other physical activities that can be done in a wheelchair. The inclusion of participation in leisure activities in the models must also be interpreted with caution, as there is uncertainty as to which specific leisure activities the respondents took part in. However, since some leisure activities fit the definition of physical activity, and because there are some similar health benefits of both physical and leisure activity, it was felt that the examining the associations between wheelchair use and participation in leisure activity was important for gaining a comprehensive understanding of participatory behaviours of older wheelchair users. It should also be noted that activities of daily living and occupational activities, both of which may include activities that fit our definition of physical activity, were not included in our analyses. Therefore, it is likely that our findings under represent the amount of physical activity that older wheelchair users take part in. Despite the exclusion of activities of daily living and occupational activities, our findings do
suggest that very few older adult wheelchair users participate in enough physical and leisure activities to receive health benefits.

2.5 Conclusion

Wheelchair use is associated with reduced participation in physical and leisure activity, and both wheelchair use and reduced physical and leisure activity are significantly associated with poor perceived health. Perceived health is correlated to objective health measures, both of which may be improved through interventions that target health-related behaviours changes, such as participation in physical and leisure activity.
3 A description of manual wheelchair skills training: Current practices in Canadian rehabilitation centres.

3.1 Introduction

Enabling participation in meaningful activities for individuals is a common focus of many rehabilitation programs. Manual wheelchairs are frequently procured during rehabilitation to provide mobility for people who have trouble walking in effort to reduce the effect of physical disability on daily life (Hoenig et al., 2005) and support functioning and independence in life roles (Arthanat & Lenker, 2004).

Simple procurement of a wheelchair does not guarantee independent, safe and effective wheelchair use. In Canada, more than half of the wheelchair users over 60 years of age rely on others for mobility assistance (Shields, 2004). Reliance on others not only reduces independence, but also limits participation and quality of life for the wheelchair user and the person providing assistance (Mortenson et al., 2012; Carlson & Myklebust, 2002). However, independent use of a wheelchair in an unsafe or ineffective way is also not desirable.

Safe and effective wheelchair use is partially dependent on wheelchair skills capacity (Kilkens et al., 2003), which, described by Phang et al. (2012), may also influence participation in physical and leisure activities. As such, proper training for wheelchair use has been identified as an important component in the wheelchair procurement process (Armstrong et al., 2008; WHO, 2011).
There is a growing body of evidence to support the use of validated wheelchair skills training (www.wheelchairskillsprogram.ca) to improve the wheelchair skills capacity of manual wheelchair users (MacPhee et al., 2004; Best et al., 2005; Ozturk & Ucsular, 2011; Routhier et al., 2012) and their caregivers (Kirby et al., 2004b). Positive associations have also been found between wheelchair skills and independent mobility (Mortenson et al., 2012), functioning (Bourbonniere et al., 2007), and social participation (Kilkens et al., 2005) in manual wheelchair users. Moreover, higher-level wheelchair skills could reduce the number of tips and falls in manual wheelchairs, which is the leading cause of injuries and death associated with wheelchair use (Kirby et al., 1994). A validated wheelchair skills training program has also effectively improved the wheelchair skills of students (Coolen et al., 2004; Smith & Kirby, 2011; Smith et al., 2003), and clinicians (Routhier et al., 2008). Routhier et al. (2008) demonstrated that the 8 hours of training using the Wheelchair Skills Training Program (WSTP) was effective at improving wheelchair skills capacity and safety in healthcare professionals.

Despite the potential benefits, few wheelchair users receive wheelchair skills training (Zanca et al., 2011; Charbonneau et al., 2013). It is suspected that little training is provided as part of the typical manual wheelchair procurement process, especially for advanced wheelchair skills (e.g., gravel and curb-cuts). However, to date, current practices related to wheelchair skills training has not been documented.

Wheelchair procurement, including wheelchair skills training, is most commonly the responsibility of occupational (OT) or physical therapists (PT) in Canada. After obtaining an OT or PT license, clinical practice involves a compilation of existing knowledge, current research
findings, and clinical reasoning for successful implementation of validated interventions (Law et al., 2008). However, the translation of research findings into practice is often a slow and haphazard process that is associated with barriers pertaining to knowledge, attitudes, skills, and habits of knowledge users (Graham et al., 2006; Isle & Davidson, 2006; Dysart & Tomlin, 2002; Bennet et al., 2003). Developing an understanding of current clinical practices may help to identify perceived barriers to using validated wheelchair training programs in practice, which may inform the development of novel approaches for wheelchair skills training that are needed to accommodate the growing number of wheelchair users. Improved strategies for wheelchair training early in the procurement process may help to optimise independent mobility for the user, while decreasing caregiver burden.

The overall purpose of this study was to describe current practices in Canada for manual wheelchair skills training during rehabilitation. Our specific objectives were to explore the: 1) components of manual wheelchair training in general, 2) amount of time spent specifically on mobility skills training for manual wheelchair use, 3) application of validated wheelchair skills training programs into practice, 4) training received by clinicians to teach manual wheelchair skills, and 5) perceived barriers to implementing research into practice.
3.2 Method

3.2.1 Design and sample

A cross-sectional survey was used to collect data from the clinical departments for OT and PT in rehabilitation centres across all 10 Canadian provinces. There are no rehabilitation centres in the two Canadian territories. Rehabilitation centres in each province (except Quebec) were identified from a compendium of Canadian healthcare facilities that specified the provision of rehabilitation services for the following types of care: rehabilitation, geriatric rehabilitation, musculoskeletal, neuroscience, orthopedics, spinal cord, stroke, special rehabilitation, physically handicapped, and community reintegration (Canadian Healthcare Association, 2009). Facilities that had fewer than 10 beds, or that only provided rehabilitation services for extended care, auxiliary care, intermediate care, or continuing care were excluded. Due to possible language barriers that may have influenced the accurate reporting of healthcare facilities in the compendium, rehabilitation centres in Quebec were identified by a study investigator (FR) who is knowledgeable of the rehabilitation services in that province. Eighty-seven rehabilitation centres fit the final inclusion criteria.

General contact information for each facility, and if possible, for the OT and PT departments, was identified through the internet. If more information was required, the facility was contacted by telephone to obtain the contact information for OT and PT departments. A representative from each facility was contacted by telephone and provided general details about the survey, at which time he or she was asked to provide an email address for eligible participants. Potential
participants were contacted by email with a letter of information, which stated that survey responses should come from an individual who held a Canadian license to practice occupational therapy or physiotherapy, and had self-reported knowledge of the current wheelchair provision and training practices within the facility. The email asked the recipient to either respond to the survey or provide contact information for a more appropriate survey respondent.

The Tailored Design Method was used to maximize response rate (Dillman, 2000). Initially, a letter of information about the survey was sent by email. One week later a follow-up email was sent, which summarized the study and included a web-link to the electronic survey. A reminder email was sent 2, 4, and 6 weeks later. Potential respondents were informed that activating the link indicated their consent. Respondents were informed that responses should be reflective of ‘usual’ practice for a ‘typical’ client who uses a manual wheelchair. The study was approved by the Research Ethics Board at the University of British Columbia.

3.2.2 Survey questions

The survey was developed specifically for this study based on our areas of interest and the existing literature. The initial iteration of the survey was sent to 10 wheeled mobility researchers with various backgrounds in OT, kinesiology, and health sciences; who provided feedback to improve the content and clarity of questions. Modifications to the survey questions were made accordingly. The final survey consisted of 34 closed-ended questions, which asked about: 1) demographic information; 2) components of manual wheelchair training; 3) amount of manual wheelchair training provided; 4) use of validated wheelchair training programs in practice; 5)
type of training received by clinicians; 6) perceived barriers to implementing standardized training into clinical practice (Appendix A). The letter of information, survey, and corresponding emails were translated to French by a bilingual research assistant. Translations were reviewed and refined by 2 bilingual researchers and modifications were made when necessary.

Demographic and descriptive information

Demographic information about the respondents was collected to describe the sample, which included profession (i.e., OT, PT, other), province of practice, age of clientele, clinical training location, total years of clinical practice, and years of clinical rehabilitation practice. Descriptive information was collected about manual wheelchair practices in general, including the number of clinicians who provide wheelchair training at the facility. Since we solicited survey responses from a representative of the rehabilitation centres as units, we also asked whether or not respondents consulted with other clinicians when answering the survey questions.

Components of manual wheelchair training

Respondents were asked to best describe the manual wheelchair practices done at their facility, from selecting one or more of the following response options: maintenance and repair; transfers; basic mobility training (e.g., propulsion, manoeuvring around obstacles and over ramps); advanced mobility training (e.g., ascending/descending curbs, wheelies, stairs); activities of daily living (ADLs) (e.g., bathing, grooming, dressing, feeding); and instrumental activities of daily living (IADLs) (e.g., cooking, cleaning, banking, shopping, accessing public transportation). We also asked respondents to estimate the frequency (‘never’, ‘rarely’, ‘sometimes’, ‘frequently’, ‘always’) at which wheelchair training was done.
**Amount of manual wheelchair skills training**

The next set of questions pertained specifically to current practices for wheelchair skills training, which was defined as training an individual the specific skills that are required for the use of a manual wheelchair, including but not limited to: wheelchair propulsion; manoeuvring the wheelchair, transfers (e.g., to and from wheelchair); overcoming environmental obstacles (e.g., doorways, ramps, curbs); and performing wheelies. Respondents were asked to estimate the average number of hours in total that clinicians in their facility spent on manual wheelchair skills training, based on the following categorical variables: ‘none’; ‘less than 1 hour’; ‘1-2 hours’; ‘3-4 hours’; ‘5-6 hours’; ‘7-8 hours’; ‘9-10 hours’; ‘greater than 10 hours’; and ‘not sure’. Respondents were also asked to estimate the average number of wheelchair skills training sessions that clinicians did, with response options including: ‘none’; ‘1-2 sessions’; ‘3-5 sessions’; ‘6-10 sessions’; ‘more than 10 sessions’; and ‘not sure’.

**Validated manual wheelchair skills training programs in practice**

To capture information about the use of validated programs in practice, we asked respondents to indicate which, if any, wheelchair training programs were used. The survey options were based on an extensive search of the literature and online resources, which identified two wheelchair skills training programs: the Wheelchair Skills Training Program (WSTP) (Halifax, Canada) ([www.wheelchairskillsprogram.ca](http://www.wheelchairskillsprogram.ca)); and Whizz-Kidz (London, UK) ([http://www.whizz-kidz.org.uk](http://www.whizz-kidz.org.uk)). Although the WSTP was the only validated wheelchair skills training program documented in the scientific literature, Whizz-Kidz was included in the survey because it is a stand-alone wheelchair training program that it is available on the internet. It should be noted that the Whizz-Kidz program includes components of the WSTP. We asked respondents: ‘How
often do clinicians in your department use the following formal manual wheelchair skills training programs (in whole or in part) to inform clinical practice?” Respondents were asked to select the most appropriate (‘always’, ‘almost always’, ‘sometimes’, ‘rarely’, and ‘never’) for each of the following: ‘Wheelchair Skills Training Program’, ‘Whizzkidz’, ‘other’ (where the respondent could provide free text about other sources), and ‘none’.

**Manual wheelchair skills training received by clinicians**

We asked respondents to describe the type of training that clinicians in their facility receive for teaching manual wheelchair skills to clients. The following response options were provided: ‘presentations’ (e.g., conferences, lunch-and-learn), ‘workshops’, ‘continuing education courses’, ‘clinical education seminars’, ‘self-directed learning’ (e.g., research papers, websites, etc.), and ‘none’. Respondents were also given the option to select ‘other’, where they could provide free text about other types of training available to clinicians at their facility.

**Perceived barriers to using validated training programs in practice**

To explore the perceived barriers to implementing validated wheelchair skills training into practice, we asked respondents to indicate their level agreement (‘strongly agree’, ‘agree’, ‘disagree’, ‘strongly disagree’, and ‘no opinion’) for each of the following options: ‘too expensive’; ‘too much paperwork’; ‘not sure how to implement’; ‘not enough resources’; ‘not enough time’; ‘extra burden on clients’; ‘not important’; ‘not useful’; ‘not supported by department’; and ‘no barriers’. There was also a dichotomous response option for ‘other’ barriers, where respondents could provide free-text about perceived barriers. The response options for perceived barriers were selected based on one of the study investigator’s (KB)
personal communications with clinicians, and the literature (Graham et al., 2006; Isle & Davidson, 2006; Dysart & Tomlin, 2002; Bennet et al., 2003; Kajermo et al., 2010).

3.2.3 Statistical analyses

We used summary statistics (i.e., frequencies, proportions, and cross-tabulations) to address the study questions. Demographic information was examined based on geographical locations, which were defined as Atlantic Provinces (Newfoundland, Nova Scotia, New Brunswick and Prince Edward Island), Quebec, Ontario, and Western provinces (Manitoba, Saskatchewan, Alberta, British Columbia). To account for small cell sizes, response options for ‘rarely’ and ‘frequently’ were collapsed with ‘sometimes’ and ‘always’ respectively for the question on the components of manual wheelchair training. Similarly, response options for the level of agreement with perceived barriers (‘strongly agree’, ‘strongly disagree’) were collapsed into one level of agreement or disagreement.

The survey was created and managed online using Fluid Survey software (http://www.fluidsurveys.com, Ottawa, ON, CA). Survey responses were collected online and raw data were exported into Microsoft Excel 2007 (Microsoft Corporation, USA) and coded. SPSS 19 (SPSS Inc., Chicago, IL, USA) was used for all data analyses.
3.3 Results

Demographic information

Anonymous responses were received from 68 of 87 rehabilitation centres (78%). The majority of respondents were English speaking (52/68) OTs (42/68) with less than 5 years of experience in rehabilitation (32/68). We had representation from all Canadian regions, including 5/8 from the Atlantic Provinces, 16/19 from Quebec, 18/38 from Ontario, and 18/22 from the Western provinces. Eleven of 68 respondents did not indicate the province. Most of the respondents completed their professional degrees in Canada (60/68). The age range of the clientele ranged from children under 12 (15/68) to adults 65 years of age and older (49/68). A summary of demographic information is shown in Table 3.1.
Table 3.1: Summary of descriptive and demographic information.

<table>
<thead>
<tr>
<th>Demographic information</th>
<th>Total</th>
<th>Atlantic</th>
<th>Quebec</th>
<th>Ontario</th>
<th>Western</th>
<th>Unspecified*</th>
</tr>
</thead>
<tbody>
<tr>
<td>n</td>
<td>68</td>
<td>5</td>
<td>16</td>
<td>18</td>
<td>18</td>
<td>11</td>
</tr>
</tbody>
</table>

Practice area
- OT: 42 | 3 | 11 | 12 | 16 | . |
- PT: 7 | 1 | 1 | 3 | 2 | . |
- Other: 5 | 1 | 2 | 2 | . | . |
- unspecified: 14 | . | 2 | 1 | . | 11 |

Professional position
- Clinician: 36 | 1 | 12 | 10 | 13 | . |
- Clinical Practice leader: 14 | 4 | . | 6 | 4 | . |
- Other: 6 | . | 3 | 2 | 1 | . |
- unspecified: 12 | . | 1 | . | . | 11 |

Age of clientele*
- ≤ 12 years: 43 | . | 10 | 17 | 13 | . |
- 13-19 years: 19 | 4 | 6 | 2 | 7 | . |
- 20-64 years: 38 | 5 | 9 | 12 | 12 | . |
- ≥ 65 years: 56 | 4 | 16 | 18 | 18 | . |

Years of clinical practice
- ≤ 5 years: 9 | . | 2 | 1 | 6 | . |
- 6-10 years: 11 | 2 | 4 | 3 | 2 | . |
- 11-15 years: 13 | 1 | 3 | 6 | 3 | . |
- ≥ 16 years: 22 | 2 | 5 | 8 | 7 | . |
- unspecified: 12 | . | 2 | . | . | 10 |

Years experience in rehab
- ≤ 5 years: 20 | 1 | 4 | 4 | 9 | 2 |
- 6-10 years: 12 | 2 | 4 | 5 | 1 | . |
- 11-15 years: 9 | . | 3 | 3 | 3 | . |
- ≥ 16 years: 15 | 2 | 3 | 5 | 5 | . |
- unspecified: 12 | . | 2 | . | . | 10 |

Unspecified* = respondent did not indicate the province from which they were responding from.

Age of clientele* = respondents were asked to ‘check all that apply’.
Components of manual wheelchair training

The most common component of ‘typical’ manual wheelchair training was transfers to and from wheelchair, which were “always” performed by 53/68 respondents. The other components that were “always” included as a part of manual wheelchair training by many rehab centres were basic mobility training (45/68) and ADLs using a wheelchair (37/68). Training for advanced wheelchair skills, maintenance and repair, and IADLs were the least common components of wheelchair training that were done by clinicians in rehabilitation. A summary of the frequency of each manual wheelchair training component is shown in Table 3.2.

Table 3.2: Summary of the frequencies of each component of wheelchair training (n = 68).

<table>
<thead>
<tr>
<th>Component</th>
<th>Never</th>
<th>Sometimes*</th>
<th>Always*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Maintenance &amp; repair</td>
<td>29</td>
<td>31</td>
<td>8</td>
</tr>
<tr>
<td>Transfers</td>
<td>14</td>
<td>1</td>
<td>53</td>
</tr>
<tr>
<td>Basic mobility training</td>
<td>14</td>
<td>9</td>
<td>45</td>
</tr>
<tr>
<td>Advanced mobility training</td>
<td>21</td>
<td>39</td>
<td>8</td>
</tr>
<tr>
<td>ADLs</td>
<td>15</td>
<td>16</td>
<td>37</td>
</tr>
<tr>
<td>IADLs</td>
<td>19</td>
<td>32</td>
<td>17</td>
</tr>
</tbody>
</table>

Sometimes* = collapsed variables for ‘sometimes’ and ‘rarely’.
Always* = collapsed variables for ‘almost always’ and ‘always’.

Amount of manual wheelchair training

On average, manual wheelchair training was included as part of clinical practice for approximately 1-4 hours in total (29/68) and was comprised of 1-5 training sessions (36/68). Twelve of 68 respondents indicated that current practices did not include any manual wheelchair training. Further breakdown of the average time and average number of wheelchair training sessions provided is shown in Figure 3.1 and 3.2.
Figure 3.1: Detailed breakdown of the average time in hours spent on manual wheelchair training in clinical practice.

Figure 3.2: Detailed breakdown of the average number of sessions spent on manual wheelchair training in clinical practice.
Validated wheelchair skills training programs in practice

When asked about the use of existing validated programs for wheelchair skills training, 16/68 reported using the WSTP, 4/68 used Whizz Kidz, and 34/68 did not use any. Of the 16 respondents who indicated use of the WSTP, most used it “rarely” (7/16). Only 1/16 indicated that the WSTP was “always” used. Of the 4 respondents who reported use of the Whizz Kidz, 3/4 reported using it “rarely”. Fifty-nine of 68 reported that no other sources of validated programs were used, while 7/68 others specified additional sources included ‘functional training for propulsion and manoeuvring’.

How clinicians learn to teach manual wheelchair skills

Outside of any training that may have occurred as part of university coursework, clinicians most commonly received wheelchair skills training through presentations (26/68) and self-directed learning (26/68). Few received additional wheelchair skills training after entry into clinical practice (4/68). The type of wheelchair skills training received by clinicians is depicted in Figure 3.3.
Perceived barriers to using validated training programs in practice

The four most common perceived barriers to the implementation of validated wheelchair skills training programs were lack of time (43/68), lack of resources (39/68), uncertainty of how to implement into practice (32/68), and cost (21/68). Although 4/68 respondents felt that that wheelchair skills training was not useful, most disagreed with that statement (46/68). The levels of agreement for each perceived barrier is summarized in Table 3.3.

Twenty-one respondents identified additional barriers to implementing validated programs into practice, which included lack of space, uncertainty of where to obtain specialized training, and inappropriate clinical setting for manual wheelchair skills training.
Table 3.3: Perceived barriers to using validated wheelchair skills training programs in practice.

<table>
<thead>
<tr>
<th>Perceived barriers</th>
<th>Total</th>
<th>Disagree</th>
<th>Neutral</th>
<th>Agree</th>
</tr>
</thead>
<tbody>
<tr>
<td>too expensive</td>
<td>47</td>
<td>20</td>
<td>27</td>
<td>21</td>
</tr>
<tr>
<td>too much paper work</td>
<td>61</td>
<td>36</td>
<td>25</td>
<td>7</td>
</tr>
<tr>
<td>not sure how to implement</td>
<td>37</td>
<td>18</td>
<td>19</td>
<td>31</td>
</tr>
<tr>
<td>not enough resources</td>
<td>29</td>
<td>13</td>
<td>16</td>
<td>39</td>
</tr>
<tr>
<td>not enough time</td>
<td>25</td>
<td>10</td>
<td>15</td>
<td>43</td>
</tr>
<tr>
<td>too much burden on clients</td>
<td>59</td>
<td>38</td>
<td>21</td>
<td>9</td>
</tr>
<tr>
<td>not important</td>
<td>66</td>
<td>48</td>
<td>18</td>
<td>2</td>
</tr>
<tr>
<td>not useful</td>
<td>64</td>
<td>46</td>
<td>18</td>
<td>4</td>
</tr>
<tr>
<td>not supported by department</td>
<td>62</td>
<td>41</td>
<td>21</td>
<td>6</td>
</tr>
<tr>
<td>no barriers</td>
<td>62</td>
<td>38</td>
<td>24</td>
<td>6</td>
</tr>
</tbody>
</table>

3.4 Discussion

Representatives from Canadian rehabilitation centres were survey about the manual wheelchair training that is provided to wheelchair users and a satisfactory response rate of 78% was achieved. The findings demonstrated that the majority of clinicians in rehabilitation centres provide basic mobility training for manual wheelchair users, but few provide training in the advanced skills. Despite a growing body of literature confirming the benefits of wheelchair training, very few clinicians used a validated wheelchair skills training program in practice. The limited use of such programs may be associated with perceived barriers of lack of time and limited resources.

Like riding a bike, learning to use a wheelchair proficiently and safely requires learning.

Providing wheelchair users with training can be considered a critical rehabilitation intervention,
particularly when individuals are returning to the community. It is promising that clinicians are providing some basic training to novice wheelchair users, as wheelchair propulsion and turning in small spaces is important for accessibility. Depending on the ability of the wheelchair user, training in the safe execution of advanced skills (e.g., wheeling down steep ramps and descending curbs), may be beneficial to both wheelchair users and caregivers. Having the capacity for safe and independent wheelchair use in environments that extend beyond the home could lead to increased community participation (Kilkens et al., 2005; Hosseini et al., 2012; Wehman et al., 1999), participation in physical activity (deGroot et al., 2010), and quality of life (Hosseini et al., 2012). The benefits of progressive wheelchair skills training may also extend to caregivers, who are commonly relied upon to assist with mobility and facilitate engagement in social activities for wheelchair users (Shields, 2004; Hanson et al., 2003). Providing wheelchair users with skills and knowledge of associated risks could reduce the risk of injury and possible death associated with unsafe wheelchair use (Kirby et al., 1994). From an economic perspective, wheelchair-related hospitalization costs could also be reduced, which have been reported to range in cost from $10,000 to $75,000 (US) (Gavin-Dreschnack et al., 2005).

The complexity of individual rehabilitation programs makes it challenging for clinicians to implement validated programs. Therefore, the systematic use of validated rehabilitation interventions has been identified as a common problem in clinical practice (Whyte & Hart, 2003). Although clinicians generally have positive attitudes toward the use of research in practice, many clinicians rely heavily on personal experience and clinical reasoning when making clinical decisions (Valdes & von der Heyde, 2012). Similar to other rehabilitation interventions, the most common perceived barriers to implementing a validated wheelchair skills
training program into practice were time, resources, knowledge and associated expenses (Graham et al., 2006; Isle & Davidson, 2006; Dysart & Tomlin, 2002; Bennet et al., 2003; Kajermo et al., 2010). During rehabilitation, clinicians are faced with making decisions regarding an individual who may have many complex needs and competing priorities. Therefore, developing an inclusive rehabilitation program that incorporates all needs is a challenging process. Moreover, rehabilitation stays are relatively short, (i.e., 5 - 6 weeks), thus clinicians have limited time to address all needs fully. Further, the commonly perceived barrier of having the knowledge to implement validated wheelchair skills training program may further reduce the likelihood that validated programs will be used (Gosling et al., 2003). Finally, the perceived expenses associated with using a validated wheelchair training program, such as cost of equipment and clinicians’ time, may contribute to the limited use of validated wheelchair skills training programs.

Knowledge translation efforts of validated wheelchair skills programs may help to overcome some of the commonly perceived barriers. In fact, standardized approaches generated by robust research often provide innovative therapeutic interventions that are time-saving and cost-efficient. For example, a study by Kirby et al. showed that with less than 1-hour of training, caregivers of wheelchair users had statistically significant improvements in their wheelchair handling skills (Kirby et al., 2004b). In addition to being safe and effective in many settings, the cost of setting up and administering the WSTP is relatively low when compared to other rehabilitation interventions. Using existing barriers and physical obstacles that are encountered by wheelchair users in the natural environment can actually reduce equipment costs and reduce the need for additional physical space. Furthermore, clinician time required for training could be
minimized if a systematic approach to training was used. The feasibility of a multi-modal knowledge translation intervention specific to clinician use of the WSTP is currently being investigated (Boronowski & Rushton, 2013).

Comprehensive education and training for teaching wheelchair skills may facilitate successful wheelchair outcomes (DiMarco et al., 2003). Continuing clinical education in wheelchair skills training for clinicians may be warranted, as it is unclear how much education OTs and PT receive during their entry-to-practice education. The findings from this study warrant further investigation into the current amount and type of manual wheelchair skills training provided during entry-to-practice university education (Best et al., 2014b).

There is a dearth of literature to support the use of various approaches to wheelchair skills training, as the WSTP is the only existing program that has been evaluated through robust research. It is possible that the WSTP may not fit within existing clinical practice strategies, which highlights the need for further research on approaches to wheelchair skills training. For example, although a modified version of the WSTP showed improvements in the wheelchair skills of children ages 6-9, it is possible that other methods may be more effective for youth and adolescents. A wheelchair skills training program specifically designed for children, which incorporates some components of the WSTP, has received positive accolades and comments in an online forum (http://www.whizz-kidz.org.uk). Moreover, the WSTP does not specifically acknowledge the influence that wheelchair seating and set-up may have on an individual’s ability to perform certain skills, and does not incorporate such modifications as part of the training. It is
possible that the WSTP may lack other attributes desired by clinicians for a wheelchair training program, but there are no data to support or refute this supposition.

Beyond knowledge translation, novel approaches to teaching wheelchair skills may alleviate clinician burden, especially with regard to progressive training in advanced wheelchair skills. Novel approaches to wheelchair skills training are needed to augment existing training done by clinicians, to ensure that wheelchair users receive the training needed to enable full participation in meaningful activities. New approaches to wheelchair training should focus on strategies to reduce the reliance on clinician resources.

### 3.4.1 Limitations

Although we believe the findings from this study provide useful information about the current practices for manual wheelchair skills training in Canada, this study has limitations. Despite soliciting responses from the most suitable respondent, the anonymity of responses minimizes our ability to ensure there was only one response from each centre. Although we requested the respondent to be directly involved in wheelchair skills training, there was no way to control for this. Further, one respondent was asked to report on behalf of all clinicians in that facility on a subjectively defined ‘typical case’. Therefore, we suspect some variability in responses. Moreover, attempting to capture the type of wheelchair skills training received by clinicians in rehabilitation is limited due to individual responses, as the respondent would only be able to comment on his or her own experience. Survey question comprehension may have also imposed another limitation, and despite our efforts to operationalize survey questions, we believe that
self-reports may be prone to misinterpretation. Finally, we combined data to discuss wheelchair training from a national perspective. This may pose a limitation as clinicians in various Canadian provinces are regulated by different provincial governments.

3.5 Conclusion

In Canada, clinicians in rehabilitation provide some manual wheelchair skills training, but the training most often does not exceed beyond basic skills training and is not based on validated wheelchair training programs. The demands of the increasing number of wheelchair users may be met through knowledge translation activities that help clinicians overcome the perceived barriers, or through novel approaches to wheelchair skills training that may reduce the burden on clinicians.
4 A description of manual wheelchair skills training curriculum in entry-to-practice occupational and physical therapy programs in Canada.

4.1 Introduction

Given the projected increase in wheelchair users in Canada (Statistics Canada, 2005), and advancing wheelchair technologies, a standardized approach to wheelchair skills training for OTs and PTs is becoming increasingly important (Hammel & Angelo, 1996). Without proper training there may be increased risk of injury for wheelchair users (Xiang et al., 2006; Nelson et al., 2010; Akbar et al., 2010), higher likelihood of mobility dependence and reduced social participation (Hoenig et al., 2005; Kilkens et al., 2005; van Zeltzen et al., 2009), and decreased quality of life (Walker et al., 2010; Inkpen et al., 2012).

There is evidence supporting a validated program (www.wheelchairskillsprogram.ca) to improve manual wheelchair skills for wheelchair users (MacPhee et al., 2004; Best et al., 2005; Ozturk & Ucsular, 2011; Routhier et al., 2012), caregivers (Kirby et al., 2004b), students (Coolen et al., 2004; Kirby et al., 2011; Smith et al., 2003), and clinicians (Routhier et al., 2008). In addition, after completion of validated wheelchair skills training, student-clinicians also demonstrated increased knowledge and retention of wheelchair skills, as well as the ability to teach other students 1 year later (Smith et al., 2003).
Despite the availability of a validated wheelchair skills training program, OTs and PTs provide very little wheelchair skills training during rehabilitation, especially in the more advanced wheelchair skills (i.e., curb-climbing) (Best et al., 2014a). The most common barriers to implementing a validated wheelchair skills training program into practice were identified as time and knowledge of how to use existing programs (Best et al., 2014a). A better understanding of education and training for clinicians may provide useful information towards addressing and overcoming these barriers.

All OTs and PTs are required to complete entry-to-practice university programs to obtain certification for practice; however, the program structure is quite variable across the country. Variability among programs may influence inconsistencies across curriculum that is specific to manual wheelchair skills training. Previous studies examining OT curriculum have described the wheelchair related content to be predominantly focussed on seating and positioning (Powell, 1994; Kanny & Anson 1998), suggesting that content for wheelchair skills training may be limited. This may be problematic, as insufficient training of professionals is associated with unsuccessful wheelchair outcomes, including higher client abandonment or non-use, lower levels of comfort, and overall client dissatisfaction with the wheelchair (DiMarco et al., 2003).

Implementing standardized approaches into entry-to-practice clinical curriculum would support the ‘best practice’ principles for which accredited university programs advocate. It has been suggested that evidence-based practices, (i.e., the best available external clinical evidence from systematic research) (Sackett et al., 1996), should replace traditional approaches in health care and this change should be reflected in entry-to-practice curriculum for health professionals,
including OT and PT (Nelson & Baptiste, 2006). To date, there is relatively little systematic understanding of the wheelchair skills training curriculum provided in entry-to-practice OT and PT programs (Coolen et al., 2004; Kirby et al., 2011). Based on the limited use of validated wheelchair skills training programs in practice (Best et al., 2014a) and informal researcher observation, there is reason to believe that clinical preparation specific to wheelchair skills is minimal.

The purpose of this study was to describe the current entry-to-practice manual wheelchair skills training curriculum in OT and PT programs. Specifically, we examined the following objectives across professions and Canadian regions: 1) methods used for integrating manual wheelchair skills training into curriculum; 2) amount of time allocated to manual wheelchair skills training; 3) instructional approaches used for delivering the manual skills training content; and 4) whether validated programs were used in curriculum development.

4.2 Method

4.2.1 Design and sample

A cross-sectional survey was used to collect data from 28 entry-to-practice OT and PT programs in Canada, including 14 OT [9 English; 5 French] and 14 PT [10 English; 4 French]. All programs are accredited by a national association that governs and regulates practice across the country. The head of each OT and PT program, identified through an internet search, was contacted by email with a letter of information, and asked to either respond to the survey or
identify an appropriate faculty who could answer questions about the curriculum related to wheelchair training.

The tailored design method was used to maximize response rate (Dillman, 2000), which began by emailing a letter of information about the survey. One week later a follow-up email was sent, which summarized the study and included a web link to the electronic survey. A reminder email with the web link to the survey was sent to non-responders at 2 and 4 weeks later. The study was approved at the University of British Columbia.

4.2.2 Measurement

The survey was initially developed in English based on our areas of interest and existing literature. We posed closed-ended questions about the type and amount of manual wheelchair skills training provided, the instructional approaches used for delivering wheelchair content, and whether existing evidence was used in the development of the wheelchair skills training curriculum. Initial iterations of the survey were sent to 10 wheeled mobility researchers, 6 of whom were also licensed OTs, who provided feedback to improve the content and clarity of questions. The final survey is shown in Appendix B.

Demographic and descriptive information

Demographic information was collected to describe the sample, including discipline, province, type of degree program, academic position, and location of clinical training. Descriptive information was collected to describe the wheelchair-related curriculum, including education
about wheelchair components, wheelchair seating, maintenance and repair, modifying the environment for wheelchair use, transfers, wheelchair skills training for mobility, and community transportation. Response options for each item were ‘yes’, ‘no’ or ‘not sure’. Respondents were then informed the remainder of the survey would focus on the curriculum specific to wheelchair skills training for mobility.

Integration of manual wheelchair skills training into program curriculum

We asked respondents to indicate whether manual wheelchair skills training was included in the education and evaluation for each of the following components: 1) theory, defined as subjective guiding principles for practice; 2) practical competence, defined as demonstrated ability to perform a specific task; and 3) clinical competence, defined as a standardized evaluation of capability to perform a given task in a clinical setting, such as a structured objective examination. Response options were ‘yes’, ‘no’ or ‘not sure’.

Time allocated for teaching manual wheelchair skills

Respondents were asked to estimate the total number of hours spent on manual wheelchair skills training, based on the following categorical variables: ‘less than 1 hour’; ‘1-2 hours’; ‘3-5 hours’, ‘6-10 hours’, ‘greater than 10 hours’; and ‘not sure’.

Instructional approaches used for manual wheelchair skills training

We then asked which instructional approaches were used for manual wheelchair skills training, from a list which included ‘mandatory or elective courses’, ‘part of a course’, ‘part of a lecture’, or ‘self-directed learning’. To capture the various instructional approaches, we developed a
checklist with 5 commonly used methods, including ‘multiple formal lectures’, ‘single formal lecture’, ‘demonstration’, ‘informal hands-on approach’, and ‘additional education outside of curriculum’. Respondents were asked to indicate the frequency that each method of teaching was used through a dropdown list of items that included ‘never’, ‘rarely’, ‘sometimes’, and ‘always’.

Validated wheelchair skills training programs in curriculum

To capture information about the use of existing validated wheelchair skills training programs in curriculum development, we asked respondents to indicate sources that were used. Response options were based on an extensive search of the literature which identified two validated wheelchair skills programs, the Wheelchair Skills Training Program (Halifax, Canada) and Whizz-Kids (London, UK). We asked respondents to indicate whether either of the validated wheelchair training programs were used in whole or in part in the curriculum development. Respondents were also given the option to select ‘other’, where they could provide free text about other sources, or to select ‘no formal sources were used in the development of the curriculum.’ We also asked respondents to estimate the number of years that wheelchair skills training had been included as part of the standard curriculum.

French Translation

The survey was developed in English and then it and all relevant documentation were translated to French by a bilingual research assistant. Translations were reviewed and refined by two bilingual researchers.
4.2.3 Statistical analyses

We used descriptive statistics (i.e., frequencies, proportions, and cross-tabulations) to address the study questions. Statistical differences between professions and Canadian regions were analyzed using chi-square ($\chi^2$) distributions with statistical significance set at $p < 0.05$. Based on geography and location of universities, Canadian regions were defined as Atlantic provinces/Quebec (Nova Scotia and Quebec), Ontario, and Western provinces (Manitoba, Saskatchewan, Alberta, British Columbia). Due to the small number of responses, the categorical response options for frequency (always, rarely, sometimes, never) were collapsed into 3 categories (always, sometimes, never).

The survey was created and managed online using Fluid Survey software (http://www.fluidsurveys.com, Ottawa, ON, CA). Survey responses were collected online and raw data were exported into Microsoft Excel 2007 (Microsoft Corporation, USA) and coded. SPSS 19 (SPSS Inc., Chicago, IL, USA) was used for all data analyses.

4.3 Results

Demographic and descriptive information

Responses were received from 21/28 (75%) entry-to-practice OT (11, 52.4%) and PT (10, 47.6%) programs. We had representation from all Canadian regions, including 9/21 from Atlantic provinces/Quebec (OT = 5, PT = 4), 7/21 from Ontario (OT = 4, PT = 3) and 5/21 from Western provinces (OT = 2, PT = 3). The respondents were primarily at the professorial level
(8/21) or were Curriculum/Program Coordinators (9/21). Most of the respondents trained in Canada (17/21).

The educational components of the manual wheelchair curriculum included wheelchair skills training, transfers, wheelchair components, wheelchair seating, modifying the environment, maintenance and repair, and ‘other’ (community transportation, loading wheelchair in car, and pressure management). There were no significant differences in educational components between professions or across regions (Table 4.1).

Table 4.1: Manual wheelchair curriculum content in Canada by profession and region.

<table>
<thead>
<tr>
<th>Curriculum content</th>
<th>Atlantic / QC</th>
<th>Ontario</th>
<th>Western</th>
<th>Professional</th>
<th>Regional</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>OT n=5 PT n=4</td>
<td>OT n=4 PT n=3</td>
<td>OT n=2 PT n=3</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Wheelchair skills</td>
<td>3 4</td>
<td>3 2</td>
<td>1 3</td>
<td>2.01 0.16</td>
<td>0.14 0.93</td>
</tr>
<tr>
<td>Seating</td>
<td>3 4</td>
<td>4 2</td>
<td>2 3</td>
<td>0.29 0.59</td>
<td>1.30 0.52</td>
</tr>
<tr>
<td>Components</td>
<td>4 4</td>
<td>4 2</td>
<td>2 3</td>
<td>0.01 0.94</td>
<td>0.74 0.69</td>
</tr>
<tr>
<td>Maintenance/repair</td>
<td>- 1</td>
<td>2 -</td>
<td>1 1</td>
<td>0.15 0.70</td>
<td>1.61 0.45</td>
</tr>
<tr>
<td>Modify environ.</td>
<td>1 4</td>
<td>3 2</td>
<td>2 2</td>
<td>1.53 0.22</td>
<td>0.97 0.62</td>
</tr>
<tr>
<td>Transfers</td>
<td>4 4</td>
<td>4 2</td>
<td>2 3</td>
<td>0.01 0.94</td>
<td>0.74 0.69</td>
</tr>
<tr>
<td>Other</td>
<td>- 1</td>
<td>2 -</td>
<td>1 -</td>
<td>1.01 0.31</td>
<td>0.78 0.68</td>
</tr>
</tbody>
</table>

Integration of manual wheelchair skills training into program curriculum

Manual wheelchair skills training was integrated into program curriculum through the inclusion of theoretical information, the description of practical competencies for wheelchair skills, and the evaluation of clinical competencies. There were no statistically significant differences in how
education on wheelchair skills training was integrated into program curriculum between professions or across regions (Table 4.2).

### Table 4.2: Inclusion of manual wheelchair skills training in theoretical, practical and clinical competencies by profession and region.

<table>
<thead>
<tr>
<th>Competence component</th>
<th>Atlantic / QC</th>
<th>Ontario</th>
<th>Western</th>
<th>Professional</th>
<th>Regional</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>OT  PT</td>
<td>OT  PT</td>
<td>OT  PT</td>
<td>χ²  p</td>
<td>χ²  p</td>
</tr>
<tr>
<td>Theory</td>
<td>n=5  n=4</td>
<td>n=4  n=3</td>
<td>n=2  n=3</td>
<td>0.64 0.80</td>
<td>0.14 0.93</td>
</tr>
<tr>
<td>Practical</td>
<td>n=4  n=3</td>
<td>n=2  n=3</td>
<td></td>
<td>2.01 0.16</td>
<td>0.03 0.99</td>
</tr>
<tr>
<td>Clinical</td>
<td>n=2  n=3</td>
<td>n=2  n=2</td>
<td>n=1  n=1</td>
<td>1.76 0.42</td>
<td>0.14 0.93</td>
</tr>
</tbody>
</table>

**Time allocated for teaching manual wheelchair skills**

While 5/21 respondents indicated that the program had no specific curriculum for manual wheelchair skills training (OT = 4, PT = 1), 8/21 reported delivering more than 6 hours of training (OT = 3, PT = 5). The remaining 8 respondents specified that wheelchair skills training comprised less than 5 hours of the total curriculum (OT = 4, PT = 4). There were no significant differences in the estimated time spent on manual wheelchair skills training between disciplines (χ² = 6.43, p = 0.17) or across regions (χ² = 7.23, p = 0.51).

**Instructional approach to teaching manual wheelchair skills**

Manual wheelchair skills training curriculum was administered through mandatory course content, component of a course, guest lecturers, self-directed studies, and ‘other’ approaches (i.e., field trips to labs where wheelchair skills were demonstrated in a clinical setting). Using guest lecturers was the only instructional approach that was significantly different between
professions ($\chi^2=3.83$, $p=0.05$), with PT using this approach slightly more than OT. There were no significant differences between professions or across regions in other instructional approaches used to teach wheelchair skills (Table 4.3).

Table 4.3: Instructional approaches used to teach manual wheelchair skills content by profession and region.

<table>
<thead>
<tr>
<th>Instructional approach</th>
<th>Atlantic / QC</th>
<th>Ontario</th>
<th>Western</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>OT (n=5) PT (n=4)</td>
<td>OT (n=4) PT (n=3)</td>
<td>OT (n=2) PT (n=3)</td>
</tr>
<tr>
<td>Mandatory course</td>
<td>2</td>
<td>4</td>
<td>2</td>
</tr>
<tr>
<td>Course component</td>
<td>1</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>Guest lecturer</td>
<td>1</td>
<td>3</td>
<td>1</td>
</tr>
<tr>
<td>Self-directed study</td>
<td>-</td>
<td>-</td>
<td>1</td>
</tr>
<tr>
<td>Other</td>
<td>1</td>
<td>1</td>
<td>-</td>
</tr>
</tbody>
</table>

The most common method used by both professions to deliver wheelchair skills training content was informal hands-on instruction. Other methods included demonstration, lectures, and extra-curricular activity, which were described as exposure during clinical placements and spending a day in a wheelchair. There was a significant difference between professions in the use of demonstration to teach wheelchair skills curriculum ($\chi^2 = 7.94$, $p < 0.05$), such that 6 PT programs reported always using this method, while 6 OT programs reported never using it. The only significant difference in teaching methods used across regions was for the use of multiple formal lectures ($\chi^2 = 12.71$, $p < 0.05$), where the Atlantic/Quebec region reported using this method less frequently than the other 2 regions. Teaching methods are summarized in Table 4.4. The majority of programs used a combination of 2 or more methods to teach wheelchair skills (Table 4.5).
Table 4.4: Frequency of use of various delivery methods used to teach manual wheelchair skills content by profession, with professional and regional differences summarized.

<table>
<thead>
<tr>
<th>Teaching method</th>
<th>Always</th>
<th>Rarely</th>
<th>Never</th>
<th>Professional</th>
<th>Regional</th>
</tr>
</thead>
<tbody>
<tr>
<td>Multiple formal lectures</td>
<td>3</td>
<td>2</td>
<td>-</td>
<td>8</td>
<td>5</td>
</tr>
<tr>
<td>Single formal lecture</td>
<td>5</td>
<td>4</td>
<td>-</td>
<td>6</td>
<td>3</td>
</tr>
<tr>
<td>Demonstration</td>
<td>4</td>
<td>6</td>
<td>1</td>
<td>3</td>
<td>6</td>
</tr>
<tr>
<td>Hands-on instruction</td>
<td>6</td>
<td>7</td>
<td>-</td>
<td>5</td>
<td>1</td>
</tr>
<tr>
<td>Extra-curricular</td>
<td>1</td>
<td>3</td>
<td>2</td>
<td>2</td>
<td>8</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Teaching method</th>
<th>OT (n=11); PT (n=10)</th>
<th>OT</th>
<th>PT</th>
<th>OT</th>
<th>PT</th>
<th>χ²</th>
<th>p</th>
<th>χ²</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>Multiple formal lectures</td>
<td></td>
<td>3</td>
<td>2</td>
<td>-</td>
<td>3</td>
<td>8</td>
<td>5</td>
<td>3.85</td>
<td>0.28</td>
</tr>
<tr>
<td>Single formal lecture</td>
<td></td>
<td>5</td>
<td>4</td>
<td>-</td>
<td>3</td>
<td>6</td>
<td>3</td>
<td>4.07</td>
<td>0.25</td>
</tr>
<tr>
<td>Demonstration</td>
<td></td>
<td>4</td>
<td>6</td>
<td>1</td>
<td>3</td>
<td>6</td>
<td>1</td>
<td>7.94</td>
<td>&lt;0.05</td>
</tr>
<tr>
<td>Hands-on instruction</td>
<td></td>
<td>6</td>
<td>7</td>
<td>-</td>
<td>2</td>
<td>5</td>
<td>1</td>
<td>4.71</td>
<td>0.95</td>
</tr>
<tr>
<td>Extra-curricular</td>
<td></td>
<td>1</td>
<td>3</td>
<td>2</td>
<td>2</td>
<td>8</td>
<td>5</td>
<td>1.65</td>
<td>0.65</td>
</tr>
</tbody>
</table>

Table 4.5: Frequency of use of various combinations of teaching methods used to teach manual wheelchair skills training content by discipline.

<table>
<thead>
<tr>
<th>Combined teaching methods</th>
<th>OT</th>
<th>PT</th>
</tr>
</thead>
<tbody>
<tr>
<td>0 methods</td>
<td>5</td>
<td>1</td>
</tr>
<tr>
<td>1 method</td>
<td>1</td>
<td>-</td>
</tr>
<tr>
<td>2-3 methods</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>4-5 methods</td>
<td>3</td>
<td>7</td>
</tr>
</tbody>
</table>

Validated wheelchair skills training programs in curriculum

The following results pertain to the 16 respondents who reported the inclusion of wheelchair skills training in curriculum. When asked about the length of time that wheelchair skills training was included in the curriculum, 5/16 respondents indicated 1 to 4 years (OT = 3, PT = 2), 4/16 replied 5 to10 years (OT = 1, PT = 3), and 7/16 reported more than 10 years (OT = 4, PT = 3). Only 8/16 reported using a validated wheelchair skills training program, in whole or in part, in the development of the curriculum (OT = 2, PT = 6).
4.4 Discussion

We surveyed representatives from the entry-to-practice programs who provide training for future OTs and PTs in Canada and achieved a 75% response rate. Our results demonstrated that the majority of OT and PT programs in Canada included specific curriculum for manual wheelchair skills training, but less than half used validated programs when implementing wheelchair training content into curriculum.

Without the use of validated wheelchair skills training programs, it is speculated that the curriculum specific to wheelchair skills training does not exceed beyond fundamental skills, such as transfers, propulsion and basic manoeuvring (Coolen et al., 2004). While the fundamental skills may address some accessibility and safety issues, being trained in intermediate and advanced wheelchair skills is important for enabling wheelchair mobility and increasing community participation (Kilkens et al., 2005; Hosseini et al., 2012). Improved independent wheelchair skills capacity may also alleviate some of the burden that is often placed on caregivers to provide mobility and to facilitate engagement in social activities for wheelchair users (Kirby et al., 2004b).

Optimal wheelchair skills training may also have economic influence. For example, wheelchair skills training could reduce the risk of wheelchair accidents associated with tips and falls, which is the leading cause of wheelchair related injuries and deaths (Kirby et al., 1994). Reducing the number of wheelchair-related accidents could alleviate some of the burden on the healthcare system, which was estimated to be 100K in 2006 in the United States due to emergency room
admittances alone (Xiang et al., 2006). Basic training on weight shifting combined with proper seating may also reduce the healthcare costs associated with the treatment of pressure ulcers, which can cost over $9000 per month to treat (Allen & Houghton, 2004).

There are currently no compulsory curricular standards for manual wheelchair skills for OT and PT students. While it is promising that half of the programs reported six or more hours of manual wheelchair skills training in curriculum, it is speculated that the most commonly used informal hands-on approach would be inconsistent and variable. Previous findings suggest that wheelchair skills training according to a validated wheelchair skills training program may offer guidelines for curricular standards. When 1 hour of a validated and standardized Wheelchair Skills Training Program (WSTP) (www.wheelchairskillstrainingprogram.ca) was added to existing unstandardized curriculum, students in an entry-to-practice OT program improved their manual wheelchair skills by 25%, retained the skills for 1 year, and were able to teach other students (Coolen et al., 2004; Smith et al., 2003). Kirby et al. demonstrated similar findings in a group of medical students, whose wheelchair skills and wheelchair knowledge significantly improved after a 4-hour workshop that included the WSTP (Kirby et al., 2011). This suggests that a validated manual wheelchair skills training program could be effectively implemented into existing OT and PT curriculum using minimal time.

Albeit important for effective wheelchair use, wheelchair skills training is a single factor within the wheelchair provision process. Since clinician expertise influences every component of wheelchair service delivery (Eggers et al., 2009), it is imperative that curriculum provides a broad understanding of all factors. Although our results show that curriculum included education
on the wheelchair, seating and fit, and environmental considerations for wheelchair use, we did not examine these components in detail. Nor did we investigate curriculum on the other key components of wheelchair provision. It is critical that wheelchair-related curriculum be scrutinized to ensure quality wheelchair service delivery. For example, curriculum should also include education on standardized methods for wheelchair service provision (Elsaesser et al., 2011), including key intervention approaches to optimize function of individuals with disabilities (Smith, 2005). This supports the need for the acceptance of a standardized approach for wheelchair provision (Greer et al., 2012), which may also assist with consistent education and training across disciplines and geographical regions. Furthermore, a universal approach could help to establish clearly defined roles and responsibilities for clinicians and wheelchair suppliers.

Continuing education is critical for obtaining advanced training in specialized fields, such as wheelchair provision, which requires an understanding of the dynamic interface between the wheelchair and the user, in addition to an appreciation of the user’s needs, abilities, preferences, available technologies and environmental demands (DiMarco et al., 2003). The knowledge and skills required to successfully provide wheelchairs range included the application of biomechanics and ergonomics for specialty seating, and the integration of advancing technologies with environmental considerations and personal characteristics (Trefler & Taylor, 1991; Samuelsson et al., 2001). Even the selection of the best seat cushion requires considerable knowledge (Ferguson-Pell, 1990). Some organizations provide continuing education certifications to recognize expertise in specialized skill sets, such as Assistive Technology Professional and Seating Mobility Specialist (RESNA, 2013). However, there are no requirements to obtain specialized wheelchair training certifications for national or provincial
practice in Canada, thus little incentive for Canadian OTs and PTs. Interestingly, clinicians in Quebec are encouraged to not develop their knowledge outside of what is practiced in their clinical milieus, possibly because post-professional certifications are rarely, if ever, offered in French (Routhier F, personal communication, March 2013). However, the WSTP may also provide an evidence-based framework for the development of continuing education modules in French, as healthcare professionals who completed the WSTP-French version significantly improved their wheelchair skills capacity and their perception of their actual skill level. One participant commented that the WSTP could lead to changes in professional practice (Routhier et al., 2008).

Although we would not necessarily advocate for creating a new category of a wheelchair training specialist, we would encourage the use of standardized basic training for students in entry-to-practice programs, as well as standardized continuing education modules. The WSTP may provide an evidence based approach for teaching students and professionals, which would fit within the educational philosophies of both the Canadian Association of Occupational Therapy (CAOT) and the Canadian Physiotherapy Association (CPA).

Future studies could examine the time and financial efficiencies of basic standardized training according to the WSTP in entry-to-practice programs to ensure all clinicians enter the field with the same education. The WSTP could be further explored as a framework for the development of intermediate and advanced wheelchair skills training modules for post-graduate OTs and PTs who practice specifically in rehabilitation. The findings from this study combined with the description of current clinical practices for manual wheelchair skills training in rehabilitation
may provide insight into the use of evidence-based research by practicing professionals, which may provide suggestions for future knowledge translation efforts. Future studies could examine how wheelchair skills training could be extended into the community, either through knowledge translation efforts that target community-based clinicians or vendors who provide wheelchairs outside of formal rehabilitation.

4.4.1 Limitations

Despite a 75% response rate, we were pleased to have representation from all Canadian regions. Since responses came from all levels and respondents may or may not have been responsible for teaching the content we surveyed about, we suspect that there may be some variability in the knowledge of the respondents with regard to the specific content about manual wheelchairs. It is also possible that specificity of wheelchair skills taught may have been missed, as the survey questions did not ask for specific details about particular skills. Survey question comprehension may have imposed another limitation and despite our efforts to operationalize survey questions, self-reports are prone to misinterpretation (Dillman, 2000). Finally, we discussed accreditation and post-professional training from a national perspective, which is not applicable for clinicians in the province of Quebec where clinical practice is regulated by provincial associations. However, a validated program for teaching manual wheelchair skills is available and effective in French and may also be used for curriculum and post-professional training in Quebec.
4.5 Conclusion

The findings from our study suggest wheelchair curriculum is consistently included in OT and PT programs, but the content and teaching methods specific to wheelchair skills training are not standardized and limited in time. Program curriculum may benefit by the integration of validated wheelchair skills training programs. The use of validated programs may also provide a structure for the development of intermediate and advanced wheelchair skills training and certification after graduation.
5 Systematic review and meta-analysis of the effect of peer-led self-management programs on physical activity and self-efficacy.

5.1 Introduction

Wheelchair users are at particularly high risk of physical and leisure inactivity (Best & Miller, 2011), making them prone to several risk factors including heart disease, diabetes, obesity, sarcopenia, arthritis, further physical disability, and psychological disorders (Katzmarzyk et al., 2003; Warburton et al. 2006). From an economic standpoint, physical inactivity adds considerable cost to healthcare systems. In fact, the 2009 cost of physical inactivity for Canadians was estimated to be $6.8 billion dollars (Janssen, 2012).

Physical inactivity is modifiable (Snell & Mitchell, 1999), and for wheelchair users, merely increasing the amount of time spent using the manual wheelchair may elicit some of the benefits of physical activity (e.g., the primary and secondary prevention of cardiovascular disease, diabetes, hypertension, cancer, osteoporosis, depression, stress, anxiety and dementia (Warburton et al., 2010). Wheelchair skills are critical for mobility and participation, (Kilkens et al., 2005; Phang et al., 2012), but there is limited training beyond basic wheelchair skills (Best et al., 2014). Time and knowledge have been identified as the primary barriers to implementing a validated wheelchair skills program in education and practice (Best et al., 2014a; 2014b, Chapters 3 & 4). During entry-to-practice programs, educators are constrained by the demands of incorporating a broad spectrum of curricular content. Similarly, during relatively short rehabilitation periods (i.e., ~ 6 weeks), clinicians are faced with the demands of prioritizing many competing aspect of care. Since curricular demands in universities and case-loads in
practice continually expand, alternative wheelchair training strategies are worth considering. New approaches to wheelchair training should focus on skill development that enables participation, especially in activities that have health benefits such as physical and leisure activity (Best et al., 2011).

Peer-approaches to modifying health behaviours have become a common trend in the peer-reviewed literature. A peer is defined as someone who has experiential knowledge of a specific behaviour and similar characteristics as the target population (Dennis, 2003). A peer can impart a connection through a sharing of common culture, knowledge and understanding about particular situations that are experienced within their communities (Szilagyi, 2002). Watching peers persevere through challenges to achieve success reinforces the likelihood that the observer will do the same when faced with similar situations (Bandura, 1997).

A peer-trainer is a nonprofessional individual who is trained in a specific area to teach a group of learners who share similar characteristics, health conditions or situations (Medvene et al., 1992). Compared to professionally trained individuals, peer-trainers have been described as being more empathic and respectful, especially among older adults (Bratter & Freeman, 1990). With appropriate training, peer-trainers are able to teach unique skills to learners in a non-threatening environment and from an economic viewpoint, peer-training may offer a unique and cost-effective strategy for extended health care that minimizes burden on health care professionals.

Peer-led interventions are often grounded in Social Cognitive Theory, which posits that self-efficacy is a strong predictor of behaviour (Bandura, 1997). According to Social Cognitive
Theory, self-efficacy is informed by enactive mastery (i.e., skill), vicarious observation (i.e., observation of others), verbal persuasion (i.e., positive verbal encouragement); and physiological response (i.e., reinterpretation of physiological responses) (Bandura, 1997). Peer-led interventions facilitate vicarious experience, thus can positively influence self-efficacy. Self-efficacy is situation specific, and has recently been shown to be important for wheelchair use (Sakakibara et al., 2013a; 2014a; 2014b). Peers can effectively apply vicarious learning to improve self-efficacy in various situations, while increasing the skills needed to accomplish the desired behaviour. Various systematic reviews have established that peer-led self-management programs improve functional status, health behaviours (including physical activity), self-efficacy, and health-related quality of life in various clinical settings, including arthritis (Lorig et al., 1993; Nunez et al., 2009), and diabetes (Dale, 2012). Jonker et al., (2009) reported similar findings in a review of chronic disease self-management programs for older adults. Improvements in health behaviours, including physical activity, smoking and condom use were also confirmed in a recent systematic review on the effectiveness of peer-led programs on general health behaviours (Webel et al., 2010).

Chapter 2 established the low levels of physical and leisure activity in older wheelchair users (Best & Miller, 2011). Although it is speculated that higher wheelchair skills could positively influence physical activity participation, wheelchair skills done by clinicians is limited (Best et al., 2014a). The need for alternative wheelchair training approaches has been identified, and peer-led approaches to wheelchair training offer one potential strategy. To inform the development of a peer-led wheelchair skills training approach that may potentially influence physical activity, a systematic appraisal of the current social cognitive literature is needed.
The primary objective of this systematic review was to synthesize the effects of peer-led self-management programs on physical activity compared to no intervention or expert-led interventions in various clinical and non-clinical populations. Since self-efficacy is a strong theoretical predictor of behaviour change, the secondary objective was to examine the effect of peer-led self-management programs on self-efficacy for behaviour change compared to no intervention or expert-led interventions in various clinical and non-clinical populations.

5.2 Method

5.2.1 Protocol

The systematic review was written in accordance with the guidelines of the Preferred Reporting Items for Systematic reviews and Meta-analyses (PRISMA) statement (http://www.prisma-statement.org) (Liberati et al., 2009; Moher et al., 2009). The systematic review protocol and study eligibility criteria were defined apriori and are described in Appendix C.

5.2.2 Information sources and search

The original searches were conducted by two independent reviewers and included articles published between 1978 and April 30, 2014 in electronic databases (Pubmed, MEDLINE, PsycINFO, EMBASE, CINAHL, and Cochrane Database of Systematic Reviews). The reference lists from previous systematic reviews were hand searched. The search terms are summarized in Table 5.1 and an example of a search from Embase (OvidSP) is shown in Appendix D.
Table 5.1: Summary of keywords included in systematic search according to PICO.
*Note: no comparison terms were included in the search. Rather, the search was limited to randomized controlled and quasi-experimental trials that made comparisons between intervention and control groups.

<table>
<thead>
<tr>
<th>Participants</th>
<th>Intervention type</th>
<th>Intervention (Peer)</th>
<th>Outcomes</th>
</tr>
</thead>
<tbody>
<tr>
<td>diabetes</td>
<td>social cognitive theory</td>
<td>peer trainer</td>
<td>self-efficacy</td>
</tr>
<tr>
<td>chronic disease</td>
<td>social learning theory</td>
<td>peer leader</td>
<td>confidence</td>
</tr>
<tr>
<td>arthritis</td>
<td>self-efficacy theory</td>
<td>peer teacher</td>
<td>pain</td>
</tr>
<tr>
<td>asthma</td>
<td>self-management theory</td>
<td>peer counselling</td>
<td>participation</td>
</tr>
<tr>
<td>stroke</td>
<td>program/intervention</td>
<td>peer group</td>
<td>mobility</td>
</tr>
<tr>
<td>amputation</td>
<td>self-care program/intervention</td>
<td>peer mentor*</td>
<td>exercise</td>
</tr>
<tr>
<td></td>
<td></td>
<td>peer support</td>
<td>physical activity</td>
</tr>
<tr>
<td></td>
<td></td>
<td>lay-led expert patient</td>
<td>walking</td>
</tr>
<tr>
<td></td>
<td></td>
<td>expert peer group</td>
<td>falls</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>fear of falling</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>balance confidence</td>
</tr>
</tbody>
</table>

5.2.3 Study selection

A search was conducted for peer-reviewed randomized controlled (RCTs) and quasi-experimental trials published in English between 1989 and April 2014. Quasi-experimental that included experimental studies (i.e., an intervention and a control group), but that lacked random allocation of participants were also included in this review. To be included in this review, the study sample must have consisted of community-living participants who were 19 years of age or older.

Additional inclusion criteria were that trials must have evaluated a peer-led (or co-peer-led) self-management program that was grounded in Social Cognitive Theory (Bandura, 1997) compared to a control group. Self-management programs were defined as interventions that included any of the following content: teaching skills required to self-manage specific behaviours (i.e., exercise, cognitive symptoms, pain and fatigue, depression, nutrition, relaxation techniques,
communication, and problem solving), goal setting, individualized programming based on participant goals, and tracking and monitoring participant progress throughout the intervention.

The control group may have consisted of no intervention, usual care, or another intervention (e.g., a program led by a professional). In attempt to isolate vicarious learning through peer-interaction as the active ingredient of interest in this study, peer-led interventions that applied other theoretical frameworks or that were delivered by a peer solely through telephone or internet were excluded. However, if another theory was applied alongside Social Cognitive Theory, or if the peer-led intervention combined face-to-face with telephone or internet, the study was included.

Finally, to be included in the review, studies must have included at least one (primary or secondary) continuous endpoint of physical activity. Self-efficacy outcomes were extracted as a secondary objective of this study, but were not required for inclusion. Since physical activity and self-efficacy were often secondary outcomes, the mean and standard deviation (SD) at both baseline and post-intervention were often not reported. In these cases, the corresponding author was contacted via email and asked to provide summary statistics (i.e., mean (SD)) or effect sizes for physical activity outcomes (and self-efficacy if applicable).

To be included in the meta-analyses, physical activity and self-efficacy outcomes must have contained the data required to calculate effect size. If the required data were not included, a request to obtain the data was made to the corresponding author of the paper.
5.2.4 Data extraction

Two individuals independently rated the titles and abstracts, and then reviewed full-text articles (KB, JT). If consensus could not be reached regarding inclusion criteria, a third individual was consulted. Upon completion of the final article list, information related to study design, participants, interventions, comparisons, and outcomes was extracted by one individual (KB). Data were extracted for both physical activity and self-efficacy outcomes by one individual (KB), and then verified by a separate individual (JT). For primary comparison purposes, baseline scores were compared with the first assessment after completion of the intervention. Final retention measures were also extracted and examined in secondary analyses. If the study included three or more intervention arms, data were extracted for each arm of the study for comparison to the peer-led intervention arm.

5.2.5 Methodological quality

The methodological quality of RCTs was evaluated using the Physical Therapy Evidence Database (PEDro) (Sherrington et al., 2005). Quasi-experimental trials were not assessed for methodological quality and were not included in meta-analyses procedures. The PEDro scale includes 11 statements that describe internal and external validity of the study. One point is awarded to each of the criterion that is met by the study, except the first item is not included in the total score. Study quality is quantified on a scale ranging from 0 to 10 points. Excellent study quality was defined as scores ranging from 9 to 10 points; good quality RCTs had scores ranging from 6 to 8 points; scores ranging from 4 to 5 points indicated fair quality; and poor studies were
defined as those having scores of 3 points or less (Foley et al., 2003). PEDro scores were obtained from the website when possible (http://search.pedro.org.au/pedro/basic_findrecords.php). When PEDro scores were not available on the website, two independent raters who were not blinded to authors’ names or institutions calculated the scores (KB, JT). Scoring discrepancies were resolved via consensus or consultation with a third rater.

5.2.6 Summary measures and data synthesis

Since post-intervention scores or change scores were not reported for all studies, a quantitative synthesis of all data was not possible. In this case, these studies remained in descriptive review of the literature based, but were excluded from the meta-analyses.

To address the primary objective, an exploratory meta-analysis was performed on physical activity outcomes from all studies that provided appropriate statistics for extracting or calculating the Standardized Mean Difference (SMD). Given the variation in methods used to assess physical activity among studies, an exploratory meta-analysis of all studies that provided SMD was performed. Since there was heterogeneity of physical activity outcomes among studies, the trials were categorized according to type of physical activity variable (i.e., subjective; objective) for further analyses. Within the subjective physical activity outcomes, the trials were further sub-categorized into three groups, consisting of: 1. Self-reported physical activity duration in minutes per week; 2. Frequency of physical activity according to the mean score calculated from pre-defined likert scales (e.g., ‘How frequently do you take part in moderate physical activities?’)
varying from never (0) to routinely (4)); and 3. Other types of subjective physical activity outcomes, such as dichotomous (‘yes/no’) responses to a list of physical activities, physical activity recall, and metabolic equivalent [MET] based on estimated frequency of physical activity per week. Objective physical activity outcomes included the use of pedometers to measure the number of steps per day. Three independent meta-analyses were performed for each category of physical activity outcomes if there were at least four studies that provided SMDs (Fu et al., 2011). Final retention measures for all physical activity and outcomes were also examined when reported.

Finally, the secondary objective was achieved through meta-analysis of trials that provided appropriate statistics for calculating the Standardized Mean Difference (SMD) of self-efficacy outcomes. Final retention of self-efficacy outcomes were also examined when applicable.

### 5.2.7 Data management and statistical analysis

The mean difference (SD) between pre and post intervention for the experimental and control groups for physical activity and self-efficacy outcomes were extracted. The SMD with 95% confidence intervals (CI) was used to calculate the treatment effect size (Cohen’s $d$). The effect size of multiple studies was calculated with Comprehensive Meta-Analysis (Englewood, NJ, USA) using the weighted effect size. Cohen’s $d$ conventions were used to define the strength of the effect size, such that an effect size of 0.8 and above was considered large, a medium effect size was around 0.50, and a small effect size was 0.2 (Cohen, 1998). Forest plots were used to illustrate the consistency of the results across studies and the cumulative effect of the
interventions for both primary (physical activity outcomes) and secondary (self-efficacy outcomes) objectives.

Heterogeneity attributable to differences across studies in populations, interventions, outcomes, or design was expected (Glasziou & Sanders, 2002). Therefore, heterogeneity statistic ($I^2$) was calculated to determine the percentage of variation attributable to heterogeneity, with $p<0.05$ indicative of similarity between the studies. Although there is no explicit rule for when heterogeneity becomes important, Higgins et al. (2003) suggests $I^2 <25\%$ equates to low heterogeneity, moderate heterogeneity ranges from $25 - 75\%$ and $I^2 >75\%$ is high. If $I^2$ was low ($\leq 25\%$), a fixed-effect model was used for evaluation of the pooled intervention effect. However, if $I^2$ was moderate to high ($>25\%$), a random-effects model was selected to reduce heterogeneity between studies (Sutton & Higgins, 2008; Borenstein et al., 2009). Sensitivity analyses were performed to assess robustness of findings according to methods suggested by the Cochrane Collaboration (2002). Replications of meta-analyses were done with consideration given to: whether physical activity and self-efficacy were primary or secondary outcomes; intervention dosage; study quality; sample size; and variability. Possible publication bias was evaluated through observation of funnel plots when there were 10 or more studies included in the meta-analysis (Sterne et al., 2011).

5.3 Results

The initial search strategy identified 3385 citations. Following duplicate removal (Figure 5.2) and screening of titles and abstracts, 114 full-text articles were assessed for eligibility. In
addition, nine systematic reviews were identified and the reference lists were hand searched. Assessment resulted in exclusion of 80 references, for which the reasons for exclusion are described in Appendix E. Of the 25 studies that were included in this systematic review, 17 studies provided enough data to be included in an exploratory meta-analysis. After grouping the studies according to type of physical activity outcomes, two additional meta-analyses were conducted. The first included nine studies that reported on self-reported physical activity duration in minutes per week and the second included four studies that estimated physical activity frequency according to similar likert scales. The study flow diagram is presented according to PRISMA guidelines in Figure 5.1.
Figure 5.1: Study flow diagram illustrating the search and selection of the studies. Of the 17 RCTs, 13 were included in the meta-analysis of physical activity (duration = 9; frequency = 4) and 15 provided data for a meta-analysis on self-efficacy.

**Abbreviations:** RCT = Randomized Controlled Trial; Qexp = Quasi-experimental trial; PA = physical activity
5.3.1 Study characteristics

The study characteristics of the 25 studies (RCT = 21; quasi-experimental = 4) are presented in Table 5.2. Eight studies included participants with non-specific chronic conditions, while 6 were specific to diabetes and 2 to arthritis. Additionally, populations sampled included older adults, African Americans, individuals with multiple sclerosis (MS), and individuals with mental illness. All interventions were defined as self-management programs that applied social cognitive approaches under the premise that improving self-efficacy may facilitate behaviour change, including physical activity.

Twelve studies assessed physical activity using self-reports of physical activity duration, 9 of which provided sufficient data to calculate SMD. Pre-defined likert scales estimating frequency of physical activity were used in 6 studies and 4 provided data to obtain SMD. One study used an objective physical activity outcome, and the remaining 6 studies assessed physical activity using various subjective outcomes that could not be combined for meta-analysis (Table 5.2).

Self-efficacy outcomes were reported for 23 of 25 studies, 20 of which provided information for obtaining SMDs. Eighteen studies reported on self-efficacy for managing a specific chronic condition, while the remaining 4 studies reported on self-efficacy for physical activity participation in physical activity or general self-efficacy (Table 5.2).
## Table 5.2: Study characteristics of the 25 studies included in systematic review (RCT = 21; quasi-experimental = 4).

<table>
<thead>
<tr>
<th>Study</th>
<th>Design</th>
<th>Total n; mean (SD)/range age (y); subjects, male (%)</th>
<th>PEDro score (/10)</th>
<th>Intervention; duration; summary of intervention.</th>
<th>Comparison group</th>
<th>Outcomes (1/2)*</th>
<th>Results, + / 0b</th>
<th>Retention, + / 0 / -b</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Subjective PA -duration</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
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<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>†Barlow et al., 2009</td>
<td>RCT</td>
<td>216; I= 48 (10), C= 51 (12); multiple sclerosis, male (29).</td>
<td>6</td>
<td>6, 2.5 h/week, group-based chronic disease SMP specific to multiple sclerosis. Co-led by a peer and professional.</td>
<td>usual care</td>
<td>PAS 2</td>
<td>0</td>
<td>12 months</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>CDSE 1</td>
<td>+</td>
<td></td>
</tr>
<tr>
<td>Buman et al., 2011</td>
<td>RCT</td>
<td>81; 63 (9); inactive; male (17).</td>
<td>6</td>
<td>16, 1 h/session, group-based peer-led SMP to increase PA behaviour.</td>
<td>gym membership and basic education</td>
<td>LTEQ 1</td>
<td>0</td>
<td>18 months</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>ESE 2</td>
<td>+</td>
<td></td>
</tr>
<tr>
<td>Chan et al., 2011</td>
<td>Q-exp</td>
<td>772; I = 73 (9), C =76 (8), chronic disease; male (20)</td>
<td>-</td>
<td>6, 2.5 h/week, group-based chronic disease SMP, co-led by peer and professional.</td>
<td>usual care</td>
<td>PAS 1</td>
<td>+</td>
<td>6 months</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>ESE 2</td>
<td>+</td>
<td></td>
</tr>
<tr>
<td>††Druss et al., 2010</td>
<td>RCT</td>
<td>65; I = 48 (10), C = 48 (10); chronic disease; male (30).</td>
<td>5</td>
<td>6, 2 h/week, group-based chronic disease SMP, led by 2 peer-leaders. Adapted for mental health consumers</td>
<td>usual care</td>
<td>BRFSS 2</td>
<td>0</td>
<td></td>
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<tr>
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<td></td>
<td></td>
<td></td>
<td>PAM 1</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>††Fu et al., 2003</td>
<td>RCT</td>
<td>954; I = 64 (10); C = 64 (10); chronic disease, male (29)</td>
<td>5</td>
<td>7, 2-2.5 h/week, group based chronic disease SMP, co-led by a peer and health professional.</td>
<td>usual care</td>
<td>PAS 1</td>
<td>+</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>CDSE 2</td>
<td>+</td>
<td></td>
</tr>
<tr>
<td>Goeppinger et al., 2007</td>
<td>RCT</td>
<td>416; 64 (13); arthritis; male (18)</td>
<td>2</td>
<td>6, 2-2.5 h/ week, group-based peer-led arthritis SMP.</td>
<td>6, 2-2.5 h/week of group-based peer-led chronic disease SMP.</td>
<td>PAS 2</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>ASE 1</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>Study</td>
<td>Design</td>
<td>Total n; mean (SD)/range age (y); subjects, male (%)</td>
<td>PEDro score (/10)</td>
<td>Intervention; duration; summary of intervention.</td>
<td>Comparison group</td>
<td>Outcomes (1/2)*</td>
<td>Results, + / 0b</td>
<td>Retention, + / 0 / - b</td>
</tr>
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</tr>
<tr>
<td>Lorig et al., 1999a</td>
<td>RCT</td>
<td>331; age; chronic disease; male (17).</td>
<td>4</td>
<td>6, 2h/week, group-based, peer-led chronic disease SMP. Cultural adaptations for Spanish people.</td>
<td>usual care</td>
<td>PAS 2</td>
<td>+</td>
<td>-</td>
</tr>
<tr>
<td>Lorig et al., 2005</td>
<td>RCT</td>
<td>374; I = 66 (14), C = 65 (14); arthritis; male (20).</td>
<td>6</td>
<td>6, 2 h/week, group-based, co-led arthritis SMP.</td>
<td>usual care</td>
<td>PAS 2</td>
<td>+</td>
<td>-</td>
</tr>
<tr>
<td>Lorig et al., 2008</td>
<td>RCT</td>
<td>567; I = 53 (13), C= 53 (13); chronic disease, male (38).</td>
<td>4</td>
<td>6, 2h/week, group-based, peer-led chronic disease SMP.</td>
<td>usual care</td>
<td>PAS 2</td>
<td>0</td>
<td>-</td>
</tr>
<tr>
<td>Lorig et al., 2009</td>
<td>RCT</td>
<td>345; I = 68 (12); C = 65 (11); diabetes; male (31).</td>
<td>6</td>
<td>6, 2.5 h/week, peer-led, group-based, diabetes SMP.</td>
<td>usual care</td>
<td>PAS 2</td>
<td>+</td>
<td>-</td>
</tr>
<tr>
<td>Lorig et al., 2003</td>
<td>RCT</td>
<td>551; I = 57 (13), C = 56 (15); chronic disease; male (20.5).</td>
<td>6</td>
<td>6, 2.5 h/week, co-led, group-based, chronic disease SMP, adapted for Spanish culture.</td>
<td>usual care</td>
<td>PAS 2</td>
<td>+</td>
<td>-</td>
</tr>
<tr>
<td>Lorig et al., 1999b</td>
<td>RCT</td>
<td>952; (40 – 90), chronic disease; male (35).</td>
<td>5</td>
<td>7, 2.5h/week, peer-led, group-based, chronic disease SMP.</td>
<td>usual care</td>
<td>PAS 2</td>
<td>+</td>
<td>-</td>
</tr>
</tbody>
</table>

**Subjective PA – frequency**

<table>
<thead>
<tr>
<th>Study</th>
<th>Design</th>
<th>Total n; mean (SD)/range age (y); subjects, male (%)</th>
<th>PEDro score (/10)</th>
<th>Intervention; duration; summary of intervention.</th>
<th>Comparison group</th>
<th>Outcomes (1/2)*</th>
<th>Results, + / 0b</th>
<th>Retention, + / 0 / - b</th>
</tr>
</thead>
<tbody>
<tr>
<td>Garrett et al., 2005</td>
<td>RCT</td>
<td>629; age 18+, diabetes; male (43).</td>
<td>3</td>
<td>1.3 h session of a group-based participatory SMP, co-led by a peer and health professional.</td>
<td>Education booklet</td>
<td>LS (1-10) 2</td>
<td>+</td>
<td>-</td>
</tr>
<tr>
<td>Study</td>
<td>Design</td>
<td>Total n; mean (SD)/range age (y); subjects, male (%)</td>
<td>PEDro score (/10)</td>
<td>Intervention; duration; summary of intervention.</td>
<td>Comparison group</td>
<td>Outcomes (1/2)*</td>
<td>Results, + / 0b</td>
<td>Retention, + / 0 / - b</td>
</tr>
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<td>-----------------------------</td>
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</tr>
<tr>
<td>*^Goldberg et al., 2013</td>
<td>RCT</td>
<td>63; I = 47 (7), C = 49 (11); mental illness; male (48)</td>
<td>8</td>
<td>13, 60-75 m/week, group-based SMP, co-led by a peer and professional.</td>
<td>usual care</td>
<td>LS (1-5) 2</td>
<td>+</td>
<td>2 months</td>
</tr>
<tr>
<td>*^Robinson-Whelen et al., 2006</td>
<td>RCT</td>
<td>137; 59 (9); physical limitation; male (0).</td>
<td>8</td>
<td>8, 1 h/week, group-based health promotion program, led by 2 peers.</td>
<td>no intervention</td>
<td>HPLP (1-4) 2</td>
<td>+</td>
<td>3 months</td>
</tr>
<tr>
<td>Siu et al., 2007</td>
<td>Q-exp</td>
<td>160; ≥18y; chronic disease; male (25).</td>
<td>-</td>
<td>6, 2.5 h/week, group-based, chronic disease SMP co-led by a peer and a health professional.</td>
<td></td>
<td>LS (0-4) 1</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>*^Swerissen et al., 2006</td>
<td>RCT</td>
<td>474; 18+; 66 (9.52); chronic disease; male (24).</td>
<td>2</td>
<td>6, 2.5 h/week, group-based, peer-led, chronic disease SMP.</td>
<td>usual care</td>
<td>LS (0-4) 2</td>
<td>+</td>
<td></td>
</tr>
<tr>
<td>*^Williams et al., 2013</td>
<td>RCT</td>
<td>250; (45-75); chronic disease; male (35).</td>
<td>6</td>
<td>7, 3h/week, group-based chronic disease SMP, co-led by a peer and professional.</td>
<td></td>
<td>LS (0-4) 2</td>
<td>+</td>
<td></td>
</tr>
<tr>
<td><strong>Subjective PA -other</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>*^Barlow et al., 2000</td>
<td>RCT</td>
<td>544; I = 57 (13); C = 59(12); arthritis; male (16).</td>
<td>5</td>
<td>6, 2.5 h/week, group-based arthritis SMP, co-led by peer and health professional.</td>
<td>usual care</td>
<td>Yes/No 2</td>
<td>+</td>
<td>12 months</td>
</tr>
<tr>
<td>*^Campbell et al., 2004</td>
<td>RCT</td>
<td>587; 52; African American; male (26).</td>
<td>5</td>
<td>i. 7 monthly meetings (~16 h), group-based SMP co-led by peer and professional + 3 events.</td>
<td>no intervention</td>
<td>MET 1</td>
<td>i. +</td>
<td></td>
</tr>
</tbody>
</table>

*^Robinson-Whelen et al., 2006

*^Swerissen et al., 2006

*^Williams et al., 2013

**Subjective PA -other**

*^Barlow et al., 2000

*^Campbell et al., 2004
<table>
<thead>
<tr>
<th>Study</th>
<th>Design</th>
<th>Total n; mean (SD)/range age (y); subjects, male (%)</th>
<th>PEDro score (/10)</th>
<th>Intervention; duration; summary of intervention.</th>
<th>Comparison group</th>
<th>Outcomes (1/2)*</th>
<th>Results, + / 0b</th>
<th>Retention, + / 0 / - b</th>
</tr>
</thead>
<tbody>
<tr>
<td>Elbel et al., 2003</td>
<td>Q-exp</td>
<td>148; I = 48 (6), C = 42 (11); skilled labor employees; male (99)</td>
<td>-</td>
<td>7, 20-45 min 2x/ week, peer-led, group-based SMP.</td>
<td>i. 7, 20-45 min, pro-led, group-based SMP. ii. no intervention</td>
<td>7d recall 1 ESE 2</td>
<td>i. 0 + ii. 0 +</td>
<td>1 month</td>
</tr>
<tr>
<td>*†Rosal et al., 2011</td>
<td>RCT</td>
<td>252; 18+; diabetes; male (23)</td>
<td>8</td>
<td>12, 2.5 h/week followed by 8, 2.5 h/month, group-based diabetes SMP, co-led by a peer and health professional.</td>
<td>enhanced usual care</td>
<td>24h recall 2 DSE 2</td>
<td>+ +</td>
<td>12 months</td>
</tr>
<tr>
<td>*†van der Wulp et al., 2012</td>
<td>RCT</td>
<td>133; 61 (54); diabetes; male (55).</td>
<td>7</td>
<td>3 individual diabetes SMP sessions deliver in the home by a peer.</td>
<td>usual care</td>
<td>PASE 2 DSE 2</td>
<td>0 0</td>
<td>6 months</td>
</tr>
<tr>
<td>*†Vincent et al., 2007</td>
<td>RCT</td>
<td>20; 56 (9); diabetes; male (29).</td>
<td>5</td>
<td>8, 2 h/ week, group-based, peer-led, chronic disease SMP.</td>
<td>usual care + education</td>
<td>SDSCA 2 DSE 1</td>
<td>0 -</td>
<td></td>
</tr>
<tr>
<td><strong>Objective PA</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Tudor-Locke et al., 2009</td>
<td>Q-exp</td>
<td>347; 56 (7); diabetes; male (37).</td>
<td>-</td>
<td>16 week, group-based, peer-led social cognitive intervention to improve PA.</td>
<td>16 week, group-based, pro-led social cognitive intervention to improve PA</td>
<td>steps/day pedometer 1</td>
<td>0 -</td>
<td></td>
</tr>
</tbody>
</table>
Table Descriptions:
SMP = For the purposes of this study, self-management programs are defined as interventions based on Social Cognitive Theory or Self-Efficacy Theory (Bandura, 1977; Bandura, 1997).

\(^a\) Indicates whether outcome was primary (1) or secondary (2)

\(^b\) Statistical significance in between-group comparisons: p < 0.05 (+); p > 0.05 (0); not applicable (-)

* Included in physical activity meta-analysis
† Included in self-efficacy meta-analysis

Table Abbreviations: ASE = self-efficacy to manage arthritis (Lorig et al., 1996); ASMP = arthritis SMP; BRFSS = Behavioural Risk Factor Surveillance System (Remington et al., 1988); CDSE = self-efficacy to manage chronic disease (Lorig et al., 1996); CDSMP = chronic disease SMP; DSE = self-efficacy to manage diabetes (Lorig et al., 1996); DSMP = diabetes SMP; ESE = Exercise self-efficacy scale (McAuley, 1993); GSE = general self-efficacy (Schwarzer & Jerusalem, 1995); HPLP = Health Promoting Lifestyle Profile (Walker et al., 1987); LS = Likert Scale; LTEQ = Leisure Time Exercise Questionnaire (Godin & Shephard, 1985); MET = Metabolic Equivalent; PA = physical activity, SE = self-efficacy; PAM = Patient Activation Measure (Hibbard et al., 2004); PAS = PA scale (Lorig et al., 1996); PASE = PA scale for the elderly (Washburn et al., 1993); Q-exp = quasi-experimental; SDSCA = Summary of Diabetes Self-care Activities measure (Toobert et al., 2000).

5.3.2 Methodological quality

The PEDro scores ranged from 2 to 7, with a median score of 5. Of the 21 RCTs, 10 (48 %) were of good quality, 8 (38 %) demonstrated fair quality, and 3 (14 %) had poor quality. Four studies (16 %) were quasi-experimental trials, defined as using non-randomization of participants to an experimental or control group. The item by item scoring of each of the 11 criterion for all RCTs is shown in Appendix F.

5.3.3 Summary of findings

Fifteen of 25 studies reported statistically significant improvements in physical activity (p < 0.05). Twelve of these 15 studies compared the intervention group to usual care or no
intervention, while the other 3 made comparison between an intervention group and an attention control group. Of the 9 studies that provided results after a retention period, 5 had statistically significant improvements in physical activity from baseline. One study that reported non-significant changes in physical activity post-intervention reported statistically significant changes 18 months later, while the 4 studies that reported statistically significant p-values post-intervention remained unchanged at follow-up after the retention period. Only 1 study reported a statistically significant decrease in physical activity at the 3-month retention time point.

Of the 23 studies that included measures of self-efficacy, 16 reported statistically significant improvements (p < 0.05). Four of the 16 studies that reported statistically significant improvements in self-efficacy made comparison to an attention control group. Eight studies included final retention measures, 4 of which reported significant p-values 1 to 6 months post-intervention.

5.3.4 Quantitative data synthesis

Physical activity - All studies

Effect sizes could be calculated for physical activity outcomes in 17 of 21 RCTs. A random effects model of 17 studies (n = 6106) participants showed a small statistically significant effect of peer-led interventions on physical activity, (SMD = 0.4, 95% CI = 0.22, 0.51, p < 0.001) (Figure 5.2). However, $I^2$ was high (84 %, p < 0.001), indicating a large amount of heterogeneity between the study outcomes for physical activity. In addition, observation of a funnel plot suggested presence of publication bias among the studies [Appendix G].
When one study with a low PEDro score and one study with a small sample size (n = 20) was removed from the meta-analysis, the effect size increased slightly (SMD = 0.4, 95% CI = 0.23, 0.54, p < 0.001) and the heterogeneity remained significantly high ($I^2 = 85\%$, p < 0.001). Only 3 of 17 studies defined physical activity as the primary outcome. When these 3 studies were removed, the effect size decreased slightly (SMD = 0.3, 95% CI = 0.19, 0.36, p < 0.001) and heterogeneity was reduced ($I^2 = 40\%$) and no longer of statistical significance (p=0.06).

![Image](image.png)

**Figure 5.2:** Meta-analysis of the overall effect of peer-led self-management programs on physical activity (n = 6106).

**Subjective physical activity - duration**

A meta-analysis was performed for the pooled effects of 9 studies that used subjective estimates of physical activity duration in minutes per week. Figure 5.3 summarizes the fixed-effects model.
for a total of 4220 participants, which showed a statistically significant small effect (SMD = 0.2, 95% CI = 0.17, 0.29, p < 0.001) and similarity between all nine studies ($I^2 = 0\%$, p = 0.79). The methodological quality of all nine studies ranged from fair to good. However, all but 2 studies compared the intervention group to a ‘usual care’ control group that received no intervention. All nine studies had comparable intervention dosages (12-16 h), but one study used 16, 1 h sessions compared to the others that used 6-7, 2-2.5 h sessions. A sensitivity analysis showed that removal of this one study did not change the effect (SMD = 0.2, 95% CI = 0.16, 0.30, p < 0.001) or similarity between the studies ($I^2 = 0\%$, p = 0.72). Two studies had a large amount of variance in SMD estimates (Buman et al., 2011; Druss et al., 2010), and both of these studies had relatively small sample sizes (n = 81, 65 respectively) compared to the other 7 studies that had n>300. When these two studies were removed from the meta-analysis, there was little change (SMD = 0.2, 95% CI = 0.17, 0.30) and the model remained significant (p < 0.001). Among the nine studies, Buman et al., 2011 was the only study that evaluated physical activity as the primary objective.
Figure 5.3: Meta-analysis of the effect of peer-led self-management programs on subjective reports of weekly physical activity (minutes/week) (n = 4220).

Subjective physical activity - frequency

A random effects model of 4 studies (n = 913) that estimated frequency of physical activity using ordinal scales (e.g., likert scales) showed a moderate statistically significant effect (SMD = 0.4, 95% CI = 0.04, 0.71, p < 0.03). However, the heterogeneity was large and statistically significant ($I^2 = 80\%$, p = 0.002). Due to a small number of studies, sensitivity analyses were not performed.

Self-efficacy

A meta-analysis of 15 studies that evaluated similar self-efficacy outcomes for managing chronic disease, diabetes, or arthritis (n= 5139) produced a small statistically significant effect (SMD = 0.3, 95% CI = 0.21, 0.37, p < 0.001) with moderate heterogeneity that just reached statistical significance ($I^2 = 42\%$, p = 0.05) as shown in Figure 5.4. Two sensitivity analyses were
performed depending on whether self-management self-efficacy was a primary or secondary outcome. The 6 studies that evaluated self-management self-efficacy as a primary outcome had statistically significant heterogeneity ($I^2 = 60\%, p = 0.04$), and a small pooled effect (SMD = 0.3, 95% CI = 0.13, 0.38, $p< 0.001$), while the 9 studies that evaluated self-efficacy as a secondary outcome had a small effect (SMD = 0.3, 95% CI = 0.22, 0.41, $p< 0.001$) with moderate heterogeneity that was not statistically significant ($I^2 = 39\%, p = 0.10$). Three studies had relatively small samples sizes compared to the other studies and demonstrated a large amount of variability in the meta-analysis. Removal of these 3 studies did not change the effect size or the heterogeneity. Finally, a sensitivity analysis combining studies with similar intervention dosage produced a similar pooled effect (SMD = 0.3, 95% CI = 0.22, 0.39, $p < 0.001$) with slightly reduced heterogeneity that was not statistically significant ($I^2 = 37\%, p = 0.12$).

Figure 5.4: Meta-analysis of effect of peer-led self-management program on self-efficacy for self-management of chronic disease, diabetes and arthritis (n = 5139).
5.4 Discussion

Twenty-one randomized controlled trials, 86% of which were of fair or good quality, and 4 quasi-experimental trials, provided information about the effect of peer-led self-management programs on physical activity and self-efficacy. Compared to a control group, the intervention group had statistically significant increases in physical activity and self-efficacy for more than half of the trials, 56% and 70% respectively.

Effect size estimates were obtained from 17 of 25 studies. An exploratory meta-analysis suggested that peer-led self-management programs had an aggregate small to moderate effect (SMD = 0.4) on increasing physical activity. However, heterogeneity and publication bias were evident among the 17 studies, which was possibly due to the variability in physical activity outcomes. Better precision for determining effect of self-management interventions for improving physical activity may be achieved by using similar outcomes that report in similar units (Prince et al., 2008). Therefore, studies were sub-categorized according to the type of physical activity variable assessed (i.e., subjection duration, subjective frequency, objective, other), and separate meta-analyses were conducted.

Physical activity outcomes

The majority of studies (16 of 17) in this systematic review used self-reported measures of physical activity. Although self-reports are commonly used to limit costs associated with objective measures and to reduce participant burden, subjective evaluations may be prone to recall and social desirability bias that can contribute to over- or under reporting (Podsakoff et al., 2003). A meta-analysis provided supported for the use of self-report measures, suggesting that
issues may be more problematic when attempting to capture higher levels of performance (Prince et al., 2008). Patient reported outcomes are becoming more widely used in research and practice (William et al., 2012). In addition to reduced cost and burden to administer compared to objective measures of physical activity, self-reported outcomes capture responses directly from the individual and do not require interpretation from anyone else. Moreover, self-reports have the potential for capturing idiosyncrasies and limitations that are specific to the individual (Williams et al., 2012).

*Subjective physical activity - duration*

The pooled effect of n=4220 participants from 9 studies that measured subjective physical activity duration in minutes per week showed a small, but statistically significant effect of self-management interventions (SMD = 0.2). All 9 studies administered peer-led self-management interventions with a similar dosage and intensity of approximately 2 to 2.5 hours x 6 or 7 weekly sessions. The exception was the study by Buman et al., 2009, in which the intervention was administered for 1 hour a week for 16 weeks. All of the interventions were self-management program, of which physical activity was only one component. The interventions were aimed at improving various health related behaviours, thus were not designed solely to improve physical activity.

All 9 studies had fair to good methodological quality and relatively large sample sizes, which reinforced the internal validity of the findings. Additionally, all studies measured physical activity duration using tools with validated measurement properties (Lorig et al., 1996, Godin, 1985. Furthermore, half of the studies allowed participants to report higher level details of
activity types (e.g., aerobic, strengthening and flexibility activities), which may have reduced some of the measurement error that can be associated with self-reports (Kline et al., 2000). However, since physical activity was not the primary outcome in 8 of 9 studies, it is possible that the studies were not powered to detect changes in secondary outcomes and thus it is plausible that effect sizes for physical activity outcomes may be under-estimated.

Although there were not enough trials in our systematic review to evaluate longer-term retention (Fu et al., 2011), observation of statistical testing in 2 of 3 studies that evaluated physical activity at follow-up suggest that the effect of the intervention on physical activity may be maintained over time (Buman et al., 2011; Chan et al., 2011). Changes to physical activity behaviour may take some time after intervention to actually show change. Therefore, future studies on physical activity interventions should include follow-up retention periods as part of the study design.

Subjective physical activity - frequency

The meta-analysis on the effects of peer-led self-management programs on subjective physical activity frequency was not conclusive. There was a statistically significant moderate effect (SMD = 0.4), but the heterogeneity among the studies was high and statistically significant. Although all studies estimated physical activity frequency using a mean score that was calculated from predefined ordinal scales, the heterogeneity may be explained by the variability between the responses options used. For example, Goldberg et al. (2013) used a 4-point scale to estimate frequency of physical activity, ranging from never (1) to routinely (5). In comparison, Robinson-Whelen et al. (2006) used the Health Promoting Lifestyle Profile that measured the frequency of many health-promoting behaviours, including physical activity, on a scale ranging from never (0)
to routinely (4). Despite all studies using likert scales to evaluate frequency of physical activity, the inconclusive results of this meta-analysis further highlight the importance of homogenous physical activity outcomes (Prince et al., 2008).

Another factor that may have influenced heterogeneity in the meta-analysis was the differences in intervention dosage between the trials. For example, 2 of the studies evaluated interventions that consisted of 6 or 7, 2.5 hour weekly sessions, and the other 2 studies administered 1 hour sessions over 8 and 13 weeks. Although the results of the meta-analysis were inconclusive, the intervention groups in 5 of 6 studies had statistically significant improvements in physical activity compared to the control groups. This suggests that peer-led self-management programs may have a positive influence on the frequency of physical activity participation, but further evaluation is needed.

Self-efficacy and peer-training

According to Bandura, self-efficacy is a stronger predictor of behaviour than skill itself (Bandura, 1997). Therefore, the likelihood of a specific behaviour change is highly dependent on one’s self-efficacy related to that behaviour. Peer-trainers in self-management programs are incorporated as a method of vicarious learning, which is one of the four sources of self-efficacy. Although the exact mechanism of vicarious experience within peer-led interventions is unknown, Social Cognitive Theory posits that observation of successful performances by others who are perceived to be peers can have a positive influence self-efficacy.
Due to the potential influence of self-efficacy on behaviour, many behavioural interventions also examine self-efficacy to understand behaviour change (Bandura, 1997). Of the 25 studies included in the systematic review, 23 of them evaluated self-efficacy. Sixteen of 23 studies reported statistically significant improvements in self-efficacy for changing behaviour that were inclusive of increased physical activity. A meta-analysis of 15 studies established that peer-led self-management programs had a small statistically significant effect on self-efficacy specific to the management of various chronic diseases.

Although improvements in self-efficacy have been shown to influence desired behaviour changes (Webel et al., 2010), it is not possible to determine the exact influence of the peer-trainer (i.e., vicarious experience) on self-efficacy in our systematic review. Self-efficacy is also informed by enactive mastery, verbal persuasion, and reinterpretation of physiological symptoms, with enactive mastery being the most influential source (Bandura, 1997). While all interventions in this review included vicarious experience from a peer-trainer, the interventions also included at least one or more of the other sources. For example, participants were taught self-management skills (i.e., enactive mastery) and all interventions enhanced self-efficacy through verbal persuasion. Re-interpretation of physiological symptoms is less tangible than the others sources, thus it was not always clear if and how this source of self-efficacy was included or manipulated within the studies.

Vicarious learning and physical activity

Although we were not able to isolate the individual influences of vicarious experience within each intervention, findings from a previous systematic review reported statistically significant
larger effect sizes on self-efficacy for physical activity in interventions that included vicarious experience compared to those that did not (Ashford et al., 2010). When the independent effects of enactive mastery and verbal persuasion on self-efficacy were evaluated, negative associations were found. Although few studies in the Ashford et al. review included vicarious experience, the authors suggest that future interventions targeting physical activity modification should include vicarious experience.

It is noteworthy that 12 of 17 studies in this review evaluated a co-led intervention, which consisted of a health care professional and a peer-trainer. Therefore, the influence of each trainer (i.e., the individual influence of the peer-trainer) on study outcomes cannot be determined. Regardless, using peers to facilitate self-management programs seemed to improve physical activity in various adult populations that ranged in age from 19 to 90 years. Furthermore, studies included in this review included various clinical and non-clinical populations, suggesting that peer-led approaches may be suitable for a large portion of the population. Our inferences are supported by a recent systematic review in adolescents, which reported that social cognitive theory explained 33% of the variance for predicting physical activity behaviour and 48% of the variance for predicting physical activity intention (Plotnikoff et al., 2013).

Since peer-trainers are accessible for various populations and can be systematically trained, exploration of peer-led strategies for enhancing wheelchair use self-efficacy is justifiable. For safety reasons, professional trainers may need to be part of pilot clinical trials, but peer-trainers may provide a relatively inexpensive approach to self-efficacy enhanced wheelchair training and may help to reduce clinician burden. Peer-led self-management programs have been shown to be
cost-effective compared to usual care for other clinical populations with chronic conditions, as self-management programs lead to better health outcomes at lower costs (Armstrong et al., 2008; Richardson et al., 2008; Kennedy et al., 2007). Moreover, peer-trainers can provide psychological and social benefits for participants (Bratter, 1990; Szilagyi, 2002; Webel, 2010), which may be of particular importance for wheelchair users (Kitchin, 2012; Standal & Jespersen, 2008). For example, in Standal and Jespersen’s qualitative study, they describe peers to be useful models for imitation who can discuss situations to find mutual solutions to common challenges. Furthermore, they describe peers as measuring sticks for novice users that may be indicative of future potential.

### 5.4.1 Limitations

Despite an attempt to categorize physical activity outcomes according to type of measurement (i.e., subjective duration, subjective frequency, objective), the findings must be interpreted with caution. Explanations of the strengths and limitations of this review may aid in the interpretation of the findings.

A publication bias between all studies suggests that overall results should be interpreted with caution. However, meta-analysis of 9 studies that reported on similar subjective physical activity duration outcomes provided evidence of a small statistically significant effect of peer-led self-management programs on physical activity. These findings highlight the importance of reporting on homogenous interventions and outcomes, and the need for future experimental trials.
All studies in this review evaluated self-management programs that were based on Social Cognitive Theory, most of which were according to the Stanford model (http://patienteducation.stanford.edu/programs) or a modification of this program (e.g., adapted for a Spanish culture). Recognizing that five studies by the same author (Lorig et al.) may have provoked bias in this review, the findings for physical activity duration meta-analysis should be interpreted with caution. However, since all five studies used separate patient groups, each study contributed individual results. Moreover, since all of the other studies included in the meta-analysis for physical activity duration followed the same standardized self-management program, the deliveries of the interventions are presumably consistent.

It should be acknowledged that only 3 of the studies in this review compared the intervention group to an attention control group, while the remaining 14 studies used a usual care or no intervention control group. Therefore, the possibility of attention bias from the research was not controlled for and may have influenced the findings. The use of active control groups or equivalency trials in the future may help to determine whether changes in physical activity and self-efficacy are due to the content of the self-management program, or simply time with a peer.

Physical activity and self-efficacy were often secondary outcomes, thus accuracy of effect size estimates is questionable. However, large sample were present in many of the studies, which may have accounted for the application of statistical procedures to multiple outcomes. The studies examined various ages of clinical and non-clinical populations that may have influenced the appropriateness for pooling of effect sizes. However, since a wide range of clinical populations and ages were included, the findings may be generalizable to broad populations.
While it is promising that peers can effectively facilitate self-management interventions for various clinical and non-clinical groups, the findings from this review are generalizable to individuals who can ambulate. Application and evaluations of a social cognitive approach to improving health behaviours and self-efficacy in wheelchair users might be worth investigating as a novel approach to augmenting existing wheelchair interventions.

Finally, since pooled effect sizes could only be analysed immediately post-intervention, it is not possible to draw conclusions on the long term effects of peer-led self-management programs on physical activity and self-efficacy. Due to the health benefits associated with physical activity, future investigation into the long-term effects of peer-led self-management programs on physical activity and self-efficacy is warranted.

**5.5 Conclusion**

There is evidence to support the use of peer-led self-management programs for increasing weekly duration of physical activity in various populations, but the effect size seems to be small. Training peers to facilitate self-efficacy enhancing interventions to increase physical activity levels may provide an effective method for reaching various clinical and non-clinical populations. Although the results of this review are based on an ambulatory population, the evaluation of peer-trainers in other clinical populations (i.e. wheelchair users) is justifiable. In order to adequately evaluate the effect of physical activity interventions, there is a need for reliable and valid measurement of physical activity and consistent reporting among studies.
6 Pilot study of a peer-led wheelchair training program to improve wheelchair use self-efficacy: A randomized controlled trial.

6.1 Introduction

The ultimate goal of rehabilitation for wheelchair users includes safe and independent functioning in the wheelchair and participation in meaningful activities (WHO, 2001). Training is recognized as an important component of wheelchair service provision (WHO, 2011), as procurement of a wheelchair alone does not guarantee safe and independent wheelchair use (e.g., wheelchair mobility) or meaningful social participation (e.g., physical activity). More than half of experienced, community-dwelling wheelchair users reported one wheelchair-related accident in the previous 3 years and 17% experienced 2 or more (Chen et al., 2011). Although provided with the intent to improve independence, more than 40% of adults aged 12 to 64 years require mobility assistance (Shields, 2004). Moreover, wheelchair use has been identified as a risk factor for physical and leisure inactivity (Best & Miller, 2011). Acknowledging that wheelchair training is a single factor in the procurement process, it may be deemed as one of the most important for maximizing the capacity for individuals to participate in meaningful activities in challenging environments (Kilkens et al., 2005).

An effective validated wheelchair skills training program exists, but it is rarely used as part of regular clinical practice and are not consistently used in entry-to-practice curriculum (Best et al., 2014a; Best et al., 2014b). One of the reasons may be the reliance on clinicians to deliver 1:1 training for new wheelchair users, which has two downsides. First, our recent survey shows the
primary barriers to applying a validated wheelchair skills training program in practice were ‘time’ (62%) and ‘knowledge’ (54%), suggesting that training likely occurs sporadically during rehabilitation based on availability and immediate need of the individual. Second, the survey found that only 8% taught beyond the basic skills (e.g., propulsion, manoeuvring) (Best et al., 2014a). While fundamental wheelchair skills may address some accessibility and safety issues, preliminary findings suggest that training in the intermediate and advanced wheelchair skills is important for enabling wheelchair mobility and increasing community participation (Kilkens et al., 2005; Hosseini et al., 2012).

Wheelchair skills training in practice may be influenced partially by the entry-to-practice education received in university, as described in our recent survey as unstandardized across the Canada and not based on validated wheelchair training programs (Best et al., 2014b). Knowledge translation and integration of existing wheelchair training programs into clinical curriculum may provide some solutions. However, alternative approaches to augment existing training programs may reduce clinician burden while providing options for continued training in the advanced wheelchair skills after rehabilitation. Community-based programs that provide ongoing wheelchair training would also be accessible to many individuals who receive their wheelchair in the community without receiving any rehabilitation services.

**Importance of self-efficacy for wheelchair skill development**

Self-efficacy influences behaviour change and how an individual uses their wheelchair (Sakakibara et al., 2013; Sakakibara et al., 2014). While controlling for age and sex, wheelchair use self-efficacy was found to be more important than wheelchair skills in predicting mobility
and participation in daily and social activities (Sakakibara et al., 2012). From a sample of 96 older community-living wheelchair users, Miller et al., (2012) reported that 40% experienced low self-efficacy. Even more surprising was that nearly 30% of the sample had an imbalance between wheelchair skills and self-efficacy (i.e., high skill, but low self-efficacy and vice versa), suggesting that high skill does not necessarily mean high self-efficacy. Therefore, wheelchair training interventions should focus on both the skills and self-efficacy needed to facilitate mobility and participation.

Bandura’s Social Cognitive Theory provides a theoretical framework for the enhancement of self-efficacy through 4 influential sources (i.e., enactive mastery, vicarious experience, verbal persuasion, and reinterpretation of physiological responses) (Bandura, 1997). Although skill accomplishment (i.e., enactive mastery) is the most powerful source of self-efficacy (Bandura, 1997), the use of peer-trainers to enhance vicarious experience has become a common approach in behaviour modification interventions. A systematic review confirmed a small but statistically significant effect of peer-led social cognitive approaches on participation in physical activity and self-efficacy (Best et al., Chapter 5).

Peer-trainers may be especially influential for wheelchair users, as individuals may be able to use other’s experiences related to using a wheelchair as a resource. Qualitative findings from an institution-based wheelchair intervention described that peers who used wheelchairs had more credibility than able-bodied, non-wheelchair users for showing different techniques in a wheelchair (May, Day, & Warren, 2006). Even when a professional had suitable wheelchair skills to demonstrate technique, participants felt their wheelchair-using peers had more
credibility because peers understand what they deal with (Standal & Jespersen, 2008). Peer-led programs can also be administered in dyads or a group, which not only lends to efficient use of time, but also fosters a sense of community among the participants and increases the likelihood for sustaining the proposed behaviour (Webel et al., 2010). Moreover, from an economic standpoint, peer-training can be cost-effective and may reduce some of the burden on health care professionals (Armstrong et al., 2008; Richardson et al., 2008; Kennedy et al., 2007).

Based on a review of Social Cognitive Theory (Best et al., Chapter 5), and the self-efficacy, rehabilitation, and wheelchair training literature, a peer-led Wheelchair Self-efficacy enhanced training program, called WheelSee, was created. A pilot study of WheelSee with 2 older manual wheelchair users showed individual improvements in wheelchair use self-efficacy, wheelchair skills, and life-space mobility (Best et al., 2012). The overall aim of this pilot study was to evaluate the potential of WheelSee as an approach to improving manual wheelchair use. The primary objective was to test the hypothesis that the WheelSee intervention group would have higher wheelchair use self-efficacy compared to a control group in a sample of adult wheelchair users. Secondary objectives were to test the hypotheses that compared to a control group, adult wheelchair users in the intervention group would have higher wheelchair skills capacity and performance, life-space mobility, and satisfaction with participation. Due to the novelty of the intervention, a tertiary objective was to solicit participant feedback about WheelSee through a post-intervention survey to describe participants’ reflections of the WheelSee program.

Information obtained through primary, secondary and tertiary objectives was useful for refining WheelSee and for the design of a sub-sequent multi-site clinical trial.
6.2 Method

6.2.1 Study design

A single-blind (Data Collector) randomized controlled trial was used to evaluate the primary and secondary objectives. The study received ethics approval from local ethics review boards and all participants provided informed consent.

6.2.2 Participants

Individuals were eligible to participate in this study if they: 1) were 19 years of age or older; 2) lived in the community; 3) used their own manual wheelchair for mobility (at least 2 hours/day); 4) were able to independently propel a manual wheelchair a distance of 10 meters (using any propulsion method); 5) had self-identified wheelchair mobility goals; and 6) were cognitively able to engage in the program (score of 24 or higher on the Mini Mental State Examination (MMSE)) [Appendix H]. Individuals were excluded from the study they: 1) could not communicate or complete study questionnaires in English; 2) anticipated a health condition or procedure that may have contraindicated training (e.g., surgery scheduled which may impair physical activity); 3) had a degenerative condition that was expected to worsen or progress quickly (e.g., Amyotrophic lateral sclerosis (ALS)); or 4) had previously or were planning to receive wheelchair mobility training during the period of study.
6.2.3 Recruitment

A variety of non-probability sampling methods were employed to recruit participants. Initially, participants were recruited on a volunteer basis from GF Strong Rehabilitation Centre (Vancouver, BC) and the community, through occupational therapists and physiotherapists, wheelchair vendors, special interest groups, and using word of mouth and posters. Snowball sampling methods were also used, such that participants who enrolled in the study were asked to recruit people they know who sit the study criteria. Finally, convenience sampling methods were employed in two ways. First, a hospital data base containing names and addresses of previous inpatients who were discharged using wheelchair was obtained. A letter of information was mailed to eligible individuals. Finally, previous research participants at GF Strong who indicated interest to participate in future studies were contacted by the researcher by phone or email.

6.2.4 Randomization

Subjects were randomly assigned to the experimental or control group in pairs using a 1:1 allocation ratio between groups by a research assistant who worked off-site and was independent of the study. To support balance between groups a central computerized randomization process was designed with a randomly selected and variable block size of 4 or 8. To address bias, subjects were instructed not to discuss their training period with the study Data Collector, who was blinded to group allocation.
6.2.5 Procedure

Upon screening for eligibility criteria and enrollment, the Data Collector completed baseline (T1) measures and entered data into a secure database. The Data Collector scheduled post-intervention (T2) evaluation 6 weeks later. The study Coordinator contacted the data manager via email to obtain group allocation, then contacted the participant to inform them of group allocation and to schedule WheelSee sessions if required. Participants in the intervention group (WheelSee) attended 6, 1.5 hour training sessions at a frequency of 1 to 2 sessions per week. All training occurred in pairs throughout the duration of training. Appendix I summarizes the study procedures. WheelSee was co-administered by a peer-Trainer and a support-Trainer. Participants in the control group did not receive any wheelchair training. The Data Collector called participants in both the intervention and control group to remind them about the scheduled T2 evaluations.

6.2.5.1 Intervention

WheelSee was co-administered by a peer-Trainer and a support-Trainer. The peer-Trainer had more than 15 years of experience using a manual wheelchair and had a background in teaching and coaching team sports. The support-Trainer was a kinesiologist with more than 10 years experience in manual wheelchair skills training. The primary investigator (and support-Trainer) provided a 2-day comprehensive orientation and training program to the peer-Trainer, which included details about each session, an overview of the Specific, Measurable, Attainable, Relevant and Time-based (SMART) goal framework (Scobie et al., 2009), training in how to
teach wheelchair skills (www.wheelchairskillsprogram.ca), and education on social cognitive approaches to teaching wheelchair skills (enactive mastery, vicarious learning, verbal persuasion, re-interpretation of physiological symptoms).

To facilitate enactive mastery, the peer-Trainer was taught to use goal setting strategies, select applicable skills required to achieve goals, teach wheelchair skills, and set manageable objectives for the study participants according to the WheelSee Facilitator Manual [Appendix J]. The peer-trainer used the Wheelchair Skills Training Program as a guide for teaching specific wheelchair skills when possible (www.wheelchairskillsprogram.ca). Vicarious learning was integrated into the intervention in two ways. First, the peer-trainer was a role-model for the participants, who could demonstrate how to accomplish skills and speak firsthand about overcoming challenges. Second, by administering the intervention in pairs, participants had the chance to learn by watching other participants practice. Participants were encouraged not to compare their progress to the other participant, but instead, if one participant was more experienced, they too could assist the learning process. These two approaches to vicarious learning allowed for the application of verbal persuasion, such that participants could receive positive verbal support from both the peer-Trainer and the other participant. The peer-Trainer was also taught to present situational vignettes using role-play, description, imagery, and his own personal experiences to explain how physiological reactions related to low self-efficacy can be understood and reinterpreted. The role of the support-Trainer was to observe the training sessions to reinforce safety during practice of wheelchair skills and when needed, assist the peer-Trainer in identifying necessary skills required to achieve a particular goal and identifying objectives. Participants were also encouraged to bring a family member or friend (i.e., caregiver) to WheelSee, who was
encouraged to reinforce verbal persuasion by providing positive support during practice. Caregivers could also be taught how to spot for safety issues. Although involvement of a caregiver was encouraged, this was not a requirement for the intervention. Appendix K summarizes the development of WheelSee and explains how the four sources of self-efficacy were applied within the intervention.

WheelSee was tailored to the individual’s goals, as identified at the start of each session. Since a learner may not initially recognize the benefits of some skills, the peer-trainer suggested goals when appropriate. During the first four WheelSee sessions, participants were encouraged to select goals related to performing activities and negotiating the environment around the home and outside the home. Acknowledging that all principles of motor learning were not included in this intervention, whenever possible, motor learning principles for skill acquisition were applied (Magill, 2011, www.wheelchairskillsprogram.ca). First, no more than 2 goals were practiced during each session. The peer-trainer facilitated the learning process in two ways, including encouraging participants to try what they think might work (i.e., implicit learning), coupled with indentifying the specific skills needed to accomplish the goal (i.e., explicit learning). When possible, the peer-trainer provided demonstration of how to perform the tasks needed to accomplish the goal with minimal instruction. Simplification and progression strategies were applied, such that easier ways to perform a skill were initially taught, then, as participants progressed, more instruction was provided on how to perform the skill more proficiently. To help the participants understand the task, the peer-trainer often used memory aids (e.g., reference to a clock when talking about hand placement on the pushrim). To help with understanding positioning and proprioception, the peer-trainer provided specific instructions about body
position in relation to the wheelchair (e.g., reminder that casters are approximately under the knees to help with timing of transient tips). The peer-trainer provided knowledge of performance, specifically using prescriptive feedback when possible. The schedule of feedback was largely dependent on the participants’ preference and stage of learning. Skill retention and transfer of skills was attained by practicing previously learned skills on subsequent sessions, and by practicing the skill in the natural environment. Usually the 2 sessions took place in a controlled indoor setting (i.e., GF Strong wheelchair mobility lab), then progressed to natural environment (i.e., malls, publics gardens) to incorporate contextual interference into the training.

The participant manual provided some examples of specific activities performed in the wheelchair, including ‘making a hot meal and carrying it to the table’, ‘getting the wheelchair up a step ramp’, or ‘taking part in leisure or physical activities’. The participants were encouraged to pick goals that were meaningful for them. Tasks included specific wheelchair skills, knowledge in skill sequencing, knowledge of potential physical and subjective barriers, and methods to overcome challenging situations. For example, a goal may consist of ‘cross the street at a busy crosswalk with 6 lanes of traffic’. The peer-Trainer then helped to break that goal into objectives, such as: ‘maneuver wheelchair close enough to push walk light, descend a curb cut, propel the wheelchair across the street using big pushes, ascend a curb cut’. The peer-Trainer also addressed issues of anxiety or fear that may be related to each objective, based on personal feelings and experiences, and then asked each of the participants how they felt about attempting the task. If one participant was more skilled in a particular task, the peer-Trainer encouraged them to share their solutions in overcoming anxiety and fear as well. The peer-
Trainer then provided skills training for each objective that was required to achieve the overall goal with assistance from the support-Trainer when necessary.

The final two WheelSee sessions focused on reinforcing less tangible skills for using a wheelchair, such as knowledge and problem-solving in challenging situations, advocacy, managing social situations, and controlling emotions. Goals were identified using the same methods as above, but practice of these more abstract skills occurred through discussion and role-playing of situational scenarios. For example, if the goal was to ‘overcome feelings of embarrassment when entering a friend’s house with wet or snowy tires’, the peer-Trainer relied on various approaches, including role-playing, discussion of feelings, symptom interpretation, and anxiety management techniques that have worked for him in the past. Applying the four sources of self-efficacy, the peer-Trainer had participants role-play to achieve enactive mastery (e.g., practice asking for a towel to clean the tires). Vicarious experience, verbal persuasion and re-interpretation of symptoms were addressed by the peer-Trainer and other participants discussing what they would do, and how they may deal with their feelings. The sharing of feelings was intended to foster a sense of understanding among participants, which is something that non-wheelchair users would not be able to relate to or understand (Kitchin, 2012). If time permitted, participants were also encouraged to further practice the objective skills that were identified in previous sessions.

**Structure of a WheelSee session**

1) The first WheelSee session began with introductions of the peer-Trainer, support-Trainer and each participant, followed by a power point presentation that was delivered by the peer-Trainer
and support trainer. The presentation described the program content, established expectations, and defined roles (~30 minutes). Participants then took part in an ice-breaker activity before setting goals for the first session (~20 minutes).

The remaining 5 sessions started with a review of the previous session, discussion of any practice that occurred outside of training, overview of goals or setting new goals, and expectations of the current session (~30 minutes).

2) The participants took turns working on his or her individual goals during each session, while watching and encouraging the others (~ 40 minutes). Graded learning strategies were applied, such that the skill fundamentals were learned inside without distraction, then practiced in more challenging environments with minimal contextual interference, then progressed to the ‘real’ environment. Depending on participants’ goals, various community locations were visited for as part of training. For example, one participant’s goal was to access a local garden, which included navigating a rocky path with inclines and declines. Once gravel was mastered in the controlled setting of the lab, we visited the local community gardens to continue practice. The amount of time spent inside or outside was dependent on participants’ progression of skills and weather. Performance feedback was given by the peer-Trainer, the support-Trainer and the other participant throughout the practice period.

3) After each practice period, the peer-Trainer facilitated a reflection and discussion, where the peer-Trainer challenged participants to talk about what they were feeling during practice, and how they planned to manage their emotions when performing the skills outside of WheelSee.
Each session ended with a brief summary of progress and how the skills can be applied until the next session (~20 minutes).

*WheelSee scheduling and equipment:* Sessions were held at GF Strong Rehabilitation Centre, Blusson Spinal Cord Centre, and in various community locations (i.e., public gardens, shopping malls, libraries, and city streets), at a convenient time for participants. Each participant received a manual, which included an overview of the WheelSee program, including details about each session, goal setting and monitoring worksheets, and a log to track questions that may arise outside of training [Appendix L]. Participants used their own wheelchair for all training sessions.

### 6.2.5.2 Control group

Typically when initially evaluating (i.e., piloting) an intervention, the researcher attempts to determine if the treatment is better than nothing at all. Often, a pragmatic approach to the design applied, such that a ‘usual care’ or no contact control is used for comparison (Hotopf, 2002). Although ‘active’ control groups are designed to minimize threat to internal validity by controlling for the non-active components of the intervention (e.g., attention, schedule, travel to sessions), pragmatic trials often compare the intervention group to a ‘usual care’ or ‘no contact’ control group (i.e., the wide range of care that is provided in a community), whether it is adequate or not’ (NIH, 2005). This allows for the retention of rigour that is associated with randomisation, while retaining the characteristics and heterogeneity of normal clinical practice (Thorpe et al., 2009).
A ‘no contact’ control was used in this study. Although some participants may have received ‘usual care’ as part of their ongoing occupational or physiotherapy, no additional education or training was provided to participants in the control group during the study period. Participants involved in any wheelchair skills training were excluded. To maintain equipoise, standardized wheelchair skills training was offered to participants upon study completion.

6.2.5.3 Safety

To reinforce participant safety, WheelSee employed safety equipment (i.e. wheelchair spotter strap) and the training of safe techniques. The support-Trainer was trained in wheelchair spotting and proper use of a spotter strap, and took responsibility for demonstrating, instructing and monitoring wheelchair spotting by caregivers. Awareness of potentially unsafe situations is important for wheelchair users; therefore, an aim of WheelSee was to provide education and training to minimize risks that are inherent to manual wheelchair use in the community. When a potentially unsafe situation arose, the peer-Trainer and support-Trainer acknowledged and discussed the unsafe behaviour, then provided education and training on how to avoid future situations. If required, a protocol was in place to record adverse events (e.g., falling out of the wheelchair) and to report any incidents to the ethics review board.
6.2.6 Study outcomes

6.2.6.1 Personal characteristics and sociodemographic information

A Participation Information Form was created to collect demographic and personal information to describe the sample, including: age; sex; marital status; education level; primary diagnosis for using a wheelchair; secondary diagnoses; months of wheelchair experience; method of wheelchair propulsion; daily wheelchair use; previous accidents related to using a wheelchair; and previous wheelchair training received [Appendix M]. Information about the wheelchair, including model, weight and size were collected using the Wheelchair Specification Form [Appendix N].

The level of anxiety and depression and social support were also collected, as these factors could confound the primary and secondary hypotheses. Depression is associated with self-efficacy (Bandura, 1997) and has been shown to be a determinant of life-space mobility and participation frequency (Mortenson et al., 2012). The Hospital Anxiety and Depression Score [HADS], a 14-item, self-report scale, was used to assess both 7-item subscales for depression and anxiety. Responses are on a 4-point scale (0=not at all; 3=very often indeed) and based on reflections of the previous week. Total scores for each subscale range from 0 to 21, with higher scores indicative of greater severity of symptoms (Zigmund & Snaith, 1983). The HADS has evidence in support of its reliability and validity (Bjelland et al., 2002). [Appendix O]. Social support can influence physical and psychological well-being (Heitzmann & Kaplan, 1988) and the social environment may also influence wheelchair-use self-efficacy (Rushton et al., 2013). Therefore,
perceived social support was assessed using the 6-item Interpersonal Support Evaluation List [ISEL] (Cohen & Hoberman, 1983). Reliability and validity of the ISEL has been established (Cohen et al., 1985). [Appendix P].

6.2.6.2 Outcome measurement

All outcome measures were collected at baseline (pre-randomization) and post-intervention by Data Collectors (n=2) who were trained in the administration and scoring of all assessments by the study investigator (KB). The measurement properties for all clinical outcomes assessed in this study are summarized in Appendix Q.

Primary outcome measure

Self-efficacy for wheelchair use was measured by the Wheelchair Use Confidence Scale for Manual Wheelchair Users (WheelCon-M 3.0) [Appendix R]. The WheelCon was selected as the primary clinical outcome measure because self-efficacy has been shown to predict both life-space mobility (Sakakibara et al., 2014b) and participation frequency (Sakakibara et al., 2013a, 2014b) in wheelchair users. The WheelCon is a 65-item, self-report scale, which assesses self-efficacy in 6 conceptual areas of wheelchair use, including manoeuvring around the physical environment, performing activities in a wheelchair, knowledge and problem solving, advocating for needs, managing social situations, and managing emotions (Rushton et al., 2011). Items are rated on a scale ranging from 0 to 100, and a mean percentage scores is calculated with higher scores indicating more self-efficacy (Rushton et al., 2011). In a recent study of community-dwelling, experienced, manual wheelchair users who were 19 years of age and older, the internal
consistency (Cronbach alpha) of the WheelCon was reported to be 0.92, and the 1-week-retest intraclass correlation coefficient (ICC) was 0.84 (Rushton et al., 2013). The study also provides evidence in support of the measure’s validity through hypothesizing associations with relevant outcomes including wheelchair skills (Spearman correlation ($rs=0.52$), activities of daily living ($rs=0.32$), depression ($rs=-0.43$), and life-space mobility ($rs=0.38$) (Rushton et al., 2013). In the same study, Rushton et al., (2013) determined the Standard Error of Measurement (SEM) to be 5.9% and the Smallest Real Difference (SRD) to be 16.4%.

**Secondary outcome measures**

Secondary outcome measures, including wheelchair skills capacity and performance, life-space mobility, and satisfaction with performance were measured to help explain the variability in the primary outcome. The measurement properties of the secondary outcomes are provided in Appendix Q.

**WST – Questionnaire [WST-Q] 4.1.** [Appendix S].

Self-efficacy is situation specific, and performance mastery (i.e., skill level) is the most influential source of self-efficacy. The WST-Q was selected as a secondary measure because perceived wheelchair skills was shown to account for 91% of the influence of self-efficacy on life-space mobility (Sakakibara et al., 2014b). Additionally, wheelchair skills was shown to mediate the relationship between wheelchair self-efficacy and participation frequency (Sakakibara et al., 2014b). Since an individual’s perceived capacity to perform wheelchair skills may not necessarily be indicative of his or her perception of ability or what he or she actually does (Inkpen et al., 2012), both perceived capacity and performance outcomes were evaluated.
The WST-Q captures subjective evaluation of an individual’s perceived ability to execute 32 manual wheelchair skills (yes/no) [capacity], and whether or not the skill was successfully performed in the past month (yes/no) [performance]. The total number of the 32 skills performed are summed and a total percent score (0-100%) is calculated for both perceived capacity and performance. The WST-Q is highly correlated with the objective WST (Spearman’s $\rho = 0.89$, $p<0.001$), and measurement properties of the WST have been established (Hosseini et al., 2012; Lemay et al., 2012; Phang et al., 2012; Lindquist et al., 2010; Kirby et al., 2004a; Kirby et al., 2002).

Life-Space Assessment (LSA). [Appendix T].

The Life-Space Assessment (LSA) was selected because it can provide information about the life-space mobility habits of wheelchair users (Auger et al., 2009; Auger et al., 2010) and has been shown to mediate the relationship between wheelchair self-efficacy and participation frequency (Sakakibara et al., 2014). The LSA is a 20-item questionnaire that captures the life-space mobility of individuals in a continuum of environmental contexts: 1. home, 2. around the home, 3. in the neighbourhood, 4. in town, and 5. outside of town (May, 1985). The concept of life-space mobility was proposed to capture the extent of spatial latitude experienced by older adults (May, 1985), and is being applied to a sample of wheelchair users of varying age in the current study. Participants were asked to report their attainment of each life-space during the past 4 weeks, frequency of attainment, and any assistance required. A composite score was calculated that ranged from 0 to 120, such that higher score were indicative of achieving greater spatial latitudes more frequently with less assistance. The LSA has been used to assess life-space mobility in middle-aged and older manual wheelchair users (Sakakibara et al., 2013a, 2014a,
The measurement properties of the LSA have been documented for community dwelling older adults (Baker et al., 2003, Curcio et al., 2013), and middle-aged and older power wheelchair users (Auger et al., 2009; Auger et al., 2010). The LSA has been validated as a good measure of mobility that reflects the interplay of physical functioning with the social and physical environment in older adults (Curcio et al., 2013).

The Wheelchair Outcome Measure (WhOM). [Appendix U]

The Wheelchair Outcome Measure (WhOM) is a client-specific tool that measures the impact of wheelchair interventions on user’s self-selected meaningful participation goals (Miller et al., 2011). The WhOM was used to explore how WheelSee influences perceived satisfaction with participation, as well as to help identify intervention goals. Participants were asked to identify participation goals related to using their wheelchair and to rank the importance of each one (0 – 10) and their current level of satisfaction with performance of that goal (0 – 10). The product of the mean of the importance scores x the mean of satisfaction was calculated, then divided by the number of goals to obtain a total score that ranged from 0 – 100. The measurement properties of the WhOM have been documented (Rushton et al., 2010; Miller et al., 2011).

Tertiary outcome measure

Post-WheelSee intervention Survey [Appendix V]

Participant feedback is important for the development and modification of new interventions. A post-WheelSee survey was designed specifically for participants of WheelSee, to obtain information of interest to the researcher to inform program refinement. Immediately upon
completion of last the WheelSee session, the peer-Trainer administered a self-reported post-WheelSee survey that asked for written feedback about participant’s perceptions of the program. The survey consisted of 9 open-ended items and took approximately 10 minutes to complete. To enhance understanding for participants and to agree with the terminology used on the WheelCon, for the purpose of this survey, self-efficacy was referred to as confidence.

6.2.7 Data management

All raw data were entered by the Data Collector and managed by the primary study investigator (KB) in Microsoft Excel 2007 (Redmond, WA). The raw data were screened for spurious entries and errors were corrected.

6.2.8 Statistical analyses

Primary and secondary outcomes

One-way Analysis of Variance (ANOVA) was used to test the primary and secondary hypotheses that compared to the control group, participants in intervention group would have higher wheelchair use self-efficacy, wheelchair skills capacity and performance, life-space mobility, and satisfaction with participation post-intervention. Assumptions of ANOVA were tested.

Since data for the primary outcome (WheelCon) and one secondary outcome (WST-Q capacity) did not meet the homogeneity of variance assumption of ANOVA, $\log_{10}$ transformations were
performed for these two variables. Significance testing ($p$) was performed on reflected Log$_{10}$ transformed data, and back transformations were done to estimate the 95% confidence interval (Howell, 2007). Effect sizes were calculated as a ratio of the effect and total sums of squares (partial $\eta^2$), then Cohen’s d effect sizes were estimated from the partial $\eta^2$ according to methods described by Fritz et al. (2012).

**Tertiary objective**

The written responses from the Post-WheelSee survey were documented and descriptive information was summarized. Frequency counts of responses were recorded when applicable.

Distributions of scores were assessed for normality (Kolmogrov-Smirnov statistic), outliers (histogram, normal probability plot, and boxplot), and homogeneity of variances (Levene’s statistic) [Appendix W]. Since WheelCon and WST capacity data did not meet homogeneity of variance assumption, various transformation methods were explored. Reflected Log$_{10}$ transformations were performed to enable parametric statistical evaluation (Portney & Watkins, 2009; Tabachnick & Fidell, 2007) [Appendix X]. Means and standard deviations for continuous variables (including the Log transformed WheelCon and WST capacity data) and frequencies and proportions for categorical variables were calculated for each group. Parameter estimates for the WheelCon and WST-Q were derived from back transformations (Howell, 2007).

Senn & Bretz (2007), state that power can be reasonably preserved or even increased by measuring many outcomes in clinical trials, despite maintaining strict control of the type I error rate. Therefore, due to the pilot and exploratory nature of this study, no adjustments were made...
for evaluation of multiple comparisons. Instead, we have identified the primary outcome of interest and will explore the effects on the secondary outcomes. Cohen’s d effect size estimates were defined as small (0.2), medium (0.5) and large (0.8) (Cohen, 1998). Statistical Package for the Social Sciences (SPSS) Version 19 (Chicago, IL) was used for all data analysis with a statistical significance level $p < 0.05$.

**Sample size calculation**

Documented variability data of WheelCon in experimental trials is limited. Therefore, according to methods described by Chow et al., (2008) for analysis of variance (ANOVA), sample size estimation was based on the variability WheelCon data from an experimental study using a sample of non-wheelchair users (Sakakibara et al., 2012). To achieve a significance level of 0.05 and 80% power, it was estimated that a total of 24 participants, 12 in each group, was required to achieve a large effect size ($\eta^2 = 0.39$). Previous wheelchair intervention studies have reported drop-out rates varying from 9 – 18%; therefore, the sample size was conservatively adjusted by 20% for a total of 28. [Appendix Y].

Intention-to-treat was used for the primary analysis, with missing data treated using multiple imputation method. Sensitivity analyses were performed on 10 imputations and statistical inferences were made on the pooled effects (Rubin, 1987; Sterne et al., 2009). Since the primary objective of this pilot study was to obtain the first estimate of a potential treatment effect of a novel intervention, a secondary analysis on a per-protocol basis (i.e., subjects who adhere to treatment) was also performed for comparison (Moncur & Larmer, 2009; Sheiner et al., 2005). [Appendix Z].
6.3 Results

As per the Consolidated Standards for Reporting Trials (CONSORT), the flow of participants from enrollment throughout the study is depicted in Figure 6.1. Of the 29 individuals who gave consent, 28 met the inclusion criteria, completed baseline assessment and were randomized into the intervention (n=16) or control group (n=12). Twenty-seven of 28 completed assessments at both time points. Of the 16 participants who were allocated to the intervention group, 12 completed the study according to protocol, 2 completed the intervention with some modification to the protocol, and 2 did not adhere to the intervention.

Figure 6.1: CONSORT flow of participants through the WheelSee study.
The mean (sd) age of the subjects was 48.8 (17.0) years, with age ranging from 20 to 84 years. The majority of the participants were unmarried (19 of 28), males (22 of 28), with secondary education (22 of 28), who primarily spoke English as a first language (25 of 28). Spinal cord injury was the most common primary diagnosis requiring the use of a manual wheelchair (19 of 28), and most participants used their wheelchair for more than 5 hours daily (21 of 28). The mean (sd) time in months of previous wheelchair use was 157.3 (151.3), varying from 2 to 492 months, and 10 participants reported having one or more accident in the past year. A complete summary of descriptive and demographic information is shown in Table 6.1.
Table 6.1: Baseline characteristics of demographic and personal information, wheelchair related variables and clinical variables.

<table>
<thead>
<tr>
<th>Participant Characteristics</th>
<th>WheelSee (n=16)</th>
<th>Control (n=12)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Demographic and personal information</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Age, y, mean (SD); range</td>
<td>49.1 (18.7); 20-84</td>
<td>48.5 (15.2); 25-71</td>
</tr>
<tr>
<td>Sex, no. (%)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Male</td>
<td>14 (87.5)</td>
<td>8 (66.7)</td>
</tr>
<tr>
<td>Marital status, no. (%)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Married or common law</td>
<td>6 (37.5)</td>
<td>3 (25)</td>
</tr>
<tr>
<td>Education, no. (%)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>College or university</td>
<td>13 (81.3)</td>
<td>9 (75)</td>
</tr>
<tr>
<td>Income CAD, no. (%)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>&lt;$ 15,000</td>
<td>5 (31.3)</td>
<td>5 (41.7)</td>
</tr>
<tr>
<td>15,000 - 50,000</td>
<td>4 (25)</td>
<td>3 (25)</td>
</tr>
<tr>
<td>Primary language, no. (%)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>English</td>
<td>14 (87.5)</td>
<td>11 (91.7)</td>
</tr>
<tr>
<td>Primary Diagnosis, no. (%)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>SCI</td>
<td>10 (62.5)</td>
<td>9 (75)</td>
</tr>
<tr>
<td><strong>Wheelchair related variables</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Previous wheelchair use, m, mean (SD); range</td>
<td>113.3 (125.3); 2-432</td>
<td>215.9 (168.0); 11-492</td>
</tr>
<tr>
<td>Use in current wheelchair, m, mean (SD); range</td>
<td>36.3 (36.8); 0-120</td>
<td>44.6 (51.2); 2-168</td>
</tr>
<tr>
<td>Type of wheelchair</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Rigid frame</td>
<td>6 (37.5)</td>
<td>7 (58.3)</td>
</tr>
<tr>
<td>Propulsion method, no. (%)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2 hands only</td>
<td>15 (93.8)</td>
<td>11 (91.7)</td>
</tr>
<tr>
<td>Hours per day wheelchair is used no. (%)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>&gt;8</td>
<td>9 (56.3)</td>
<td>7 (58.3)</td>
</tr>
<tr>
<td>5 – 8</td>
<td>3 (18.8)</td>
<td>2 (16.7)</td>
</tr>
<tr>
<td>Wheelchair related accident in past year, no. (%)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Yes</td>
<td>4 (25)</td>
<td>6 (50)</td>
</tr>
<tr>
<td>No. of accidents in past year, mean (SD)</td>
<td>1.8 (1.0)</td>
<td>2.3 (0.5)</td>
</tr>
<tr>
<td><strong>Clinical variables at baseline</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>MMSE score (/30)</td>
<td>27.0 (2.4)</td>
<td>26.9 (3.3)</td>
</tr>
<tr>
<td>ISEL Score (/18)</td>
<td>13.7 (2.5)</td>
<td>14.4 (2.7)</td>
</tr>
<tr>
<td>HADS anxiety (/21)</td>
<td>4.7 (3.2)</td>
<td>5.3 (4.4)</td>
</tr>
<tr>
<td>HADS depression (/21)</td>
<td>3.6 (2.5)</td>
<td>2.8 (2.9)</td>
</tr>
<tr>
<td>WheelCon (/100)</td>
<td>69.1 (18.7)</td>
<td>78.9 (15.3)</td>
</tr>
<tr>
<td>WST capacity (/100)</td>
<td>82.2 (13.1)</td>
<td>78.4 (18.2)</td>
</tr>
<tr>
<td>WST performance (/100)</td>
<td>55.5 (21.0)</td>
<td>64.3 (20.0)</td>
</tr>
<tr>
<td>LSA (/120)</td>
<td>40.5 (19.5)</td>
<td>49.2 (16.3)</td>
</tr>
<tr>
<td>WhOM (/100)</td>
<td>45.7 (30.4)</td>
<td>39.4 (30.1)</td>
</tr>
</tbody>
</table>
For the 27 participants who completed assessments at both time points, the mean (SD) time between baseline (T1) and post-intervention (T2) assessments was 44.7 (9.5) days. Their study administration time was 44.3±7.6 days for the intervention group and 45.2±11.8 days for the control group. On average (SD), the intervention group completed 8.4 (2.3) hours of WheelSee training. Two participants in the intervention group had a family member attend all six training sessions, while 2 others brought a family member or friend to one session.

There were no adverse events during evaluation or training.

Primary objective: Wheelchair use self-efficacy

Average WheelCon scores in the intervention group improved from 69 to 88%, while the control group average scores decreased slightly from 79 to 76%. A sensitivity analysis of 10 multiple imputations showed minimal variation in support of a moderate effect size (Cohen’s d = 0.7) \( (F_{1,26} = 3.50; \text{mean difference} = -12; 95\% \text{ CI} = -18.1, 4.0; p = 0.07; \log_{10} \text{transformation}) \) (Table 6.2).

Secondary objective: Wheelchair skills capacity and performance

The intervention group demonstrated increased wheelchair skills capacity (81 to 88%) and wheelchair skills performance (56 to 71%). The control group showed a little change in both wheelchair skills capacity performance (Table 6.2). WheelSee had a large effect on wheelchair skills capacity (Cohen’s d = 0.8), as the intervention group had statistically significant higher post-intervention WST-Q capacity scores than the control group \( (F_{1,26} = 4.72; \text{mean difference} = -13.2; 95\% \text{ CI} = -22.2, 1.8; p = 0.04, \log_{10} \text{transformation}) \). However, the post-intervention
differences between group in WST-Q performance scores were not of statistical significance and the effect size was small (F$_{1,26}$ = 0.14; mean difference = -13.9; 95% CI = -41.3, 13.7; p = 0.34) (Table 6.2).

Secondary objective: Life-space mobility

Both the intervention and control groups showed small increases over time in life-space mobility scores (Table 6.2). However, there was not a statistically significant difference in LSA scores between groups after WheelSee (F$_{1,26}$ = 0.89; mean difference = 7.8; 95% CI = -9.8, 22.3; p = 0.43) and the effect size was small (Table 6.2).

Secondary objective: Satisfaction with participation

The majority of participants (22/28) identified 3 to 5 wheelchair mobility goals on the WhOM, while the remaining 6 participants identified 1 or 2 goals. Goals included learning specific wheelchair skills, improving community access, and increasing participation in physical or leisure activities (Table 6.3). The intervention group had larger increases in WhOM scores over time (mean change = 15%) compared to the control group (mean change = 2%). A moderate effect size (Cohen’s d = 0.7) was observed and between group differences approached statistical significance post-intervention (F$_{1,26}$ = 3.49; mean difference = -17.3; 95% CI = -36.4, 1.8; p = 0.07) (Table 6.2).
Table 6.2: Mean (SD)^ changes from baseline to post-intervention and estimated effect sizes for primary and secondary clinical outcomes based on intention-to-treat analyses.

<table>
<thead>
<tr>
<th></th>
<th>Intervention group</th>
<th>Control group</th>
<th>F_{1,26}</th>
<th>Effect</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>T1</td>
<td>T2</td>
<td>T1</td>
<td>T2</td>
</tr>
<tr>
<td><strong>Primary</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>WheelCon</td>
<td>69.1 (18.7)</td>
<td>87.8 (81.2, 95.0^\text{\textsuperscript{\textdagger}})</td>
<td>78.9 (15.3)</td>
<td>75.6 (63.0, 91.0^\text{\textdagger})</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Secondary</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>WST-Q capacity</td>
<td>82.2 (13.1)</td>
<td>87.7 (84.9,92.6^\text{\textdagger})</td>
<td>78.4 (18.2)</td>
<td>75.5 (62.7, 92.6^\text{\textdagger})</td>
</tr>
<tr>
<td>WST-Q performance</td>
<td>55.5 (21.0)</td>
<td>79.6 (46.2)</td>
<td>64.3 (20.0)</td>
<td>66.4 (19.4)</td>
</tr>
<tr>
<td>LSA</td>
<td>40.5 (19.5)</td>
<td>47.6 (24.6)</td>
<td>49.2 (16.3)</td>
<td>53.7 (13.8)</td>
</tr>
<tr>
<td>WhOM</td>
<td>45.7 (30.4)</td>
<td>61.2 (18.1)</td>
<td>39.4 (30.1)</td>
<td>45.5 (28.9)</td>
</tr>
</tbody>
</table>

^§ Cohen’s d effect size estimates from partial \(\eta^2\) (Fritz et al., 2012).

^\text{\textdagger} 95% Confidence Intervals are presented for back transformations of non-normally distributed data (Howell, 2007).

^*p < 0.10

^†p < 0.05

Abbreviations: T1 = baseline, T2 = post-intervention, SD = standard deviation, WheelCon = Wheelchair Use Confidence Scale, WST-Q = Wheelchair Skills Test-Questionnaire, LSA = Life-space Assessment, WhOM = Wheelchair Outcome Measure.
Table 6.3: Participant identified goals during baseline assessments preceding WheelSee.

<table>
<thead>
<tr>
<th>Specific wheelchair skills</th>
<th>Community</th>
<th>Physical Activity</th>
<th>Leisure Activity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wheelie</td>
<td>Shopping</td>
<td>Exercise</td>
<td>Travel</td>
</tr>
<tr>
<td>Escalators</td>
<td>- at market</td>
<td>Wheeling (streets/trails)</td>
<td>Meet with friends</td>
</tr>
<tr>
<td>Up / down stairs</td>
<td>- at the mall</td>
<td>- with a dog</td>
<td>Events</td>
</tr>
<tr>
<td>Up / down curbs</td>
<td>- window shopping</td>
<td>Endurance/flexibility</td>
<td>- concerts</td>
</tr>
<tr>
<td>Uneven terrain</td>
<td>- curbside shopping</td>
<td>Community centres</td>
<td>- sports</td>
</tr>
<tr>
<td>Up steep hills or ramps</td>
<td>- grocery shopping</td>
<td>Sports</td>
<td>Restaurants</td>
</tr>
<tr>
<td>Crossing streets</td>
<td>Employment/Volunteer</td>
<td></td>
<td>Parks, beaches, etc.</td>
</tr>
<tr>
<td>Transportation</td>
<td>Getting gas</td>
<td></td>
<td>Hobbies</td>
</tr>
<tr>
<td>Transfer</td>
<td>Mailing parcels</td>
<td></td>
<td>- carpentry</td>
</tr>
<tr>
<td>Manoeuvring efficiently</td>
<td>Cooking</td>
<td></td>
<td>- fishing</td>
</tr>
<tr>
<td>Get from ground to</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>wheelchair</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Wheelchair set-up</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Tertiary objective: Participant feedback about WheelSee

All participants (n=16), felt that both how the wheelchair was used and the ability to complete daily activities were influenced by the level of confidence to use a wheelchair. One participant commented that “the more experience I get, the more I trust my skill. [I’m] also willing to try harder skills as I get more confident”. Similarly, another participant commented that “I will avoid [activities] I am not comfortable with”.

All 16 participants also felt that their personal level of confidence to use their wheelchair was improved by participating in WheelSee. When asked to describe how, one participant wrote that their confidence improved by having the “chance to practice skills with a teacher to help”, as well as “watching others in class, both success and failure”.

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The components of WheelSee that worked best were described as: “[having an] obstacle course was good to practice skills” [n=2]; “positive reinforcement from facilitators” [n=3], “trying new skills” [n=8]; “having a peer-trainer who had experience using a wheelchair” [n=4], and “watching other participants” [n=4]. The component that worked the least was practicing skills that could already be done [n=4], and two participants felt that the set-up of the wheelchair may have impeded confidence enhancement and skills development. Two participants provided suggestions for improvements, which included, “to be more outside in the community” and “use the inside training room more”. The components of WheelSee that were particularly liked by participants included: “going outdoors, especially to the mall and doing the escalator”; “trying the skills that I didn’t think were possible and having help to do them”; and “learning to do new things and knowing I can go beyond status quo”. The only thing that one participant didn’t like about the program was expressed as, “could have had twice as many sessions”. Two participants provided suggestions for additional activities for WheelSee, which included “being placed in social situations, such as ordering food or making conversation” and having a session on “floor to chair transfers”.

6.4 Discussion

This pilot RCT suggests there may be potential benefits of peer-led wheelchair training, as WheelSee had a large effect on wheelchair use-self-efficacy, wheelchair skills and satisfaction with participation. Additionally, all participants in the intervention groups believed that wheelchair use self-efficacy influenced how the wheelchair was used and the ability to complete daily activities, and all participants felt that their personal level of self-efficacy for using a
wheelchair improved from participating in WheelSee. There were no differences between the intervention and control group for wheelchair skills performance and life-space mobility. Finding from this pilot RCT are preliminary and must be interpreted with caution.

Wheelchair use self-efficacy

A recent study by Miller et al., (2012) defines low self-efficacy as a score of less than 80% on the WheelCon. Low self-efficacy can have a negative influence on wheelchair use and participation (Sakakibara et al., 2014), which can have an unfavourable impact on quality of life for wheelchair users. In the total sample, 16 of 28 individuals had wheelchair-use self-efficacy less than 80%. Before WheelSee, 9 of 16 participants in the intervention group had less than 80% wheelchair use-self-efficacy. Upon completion of WheelSee, this number was reduced to 2. The lack of change in wheelchair self-efficacy observed in the control group was expected and is comparable to other peer-led intervention studies that used non-active controls groups (Best et al., Chapter 5).

Although a minimally important clinical difference (MCID) has not been yet determined for the WheelCon, the smallest real difference (SRD) is an acceptable representation of a clinically imp change (Schuck & Zwingmann, 2003). It is promising that 50% (8 of 16) of the participants who completed WheelSee obtained a change in WheelCon score that was above the SRD (16%). (Rushton et al., 2013). Also promising is the finding of a moderate effect size (Cohen’s $d = 0.7$) that approached statistical significance. Therefore, the WheelSee approach may have potential for contributing to important clinical changes regarding wheelchair use self-efficacy.
Differences in the amount of previous wheelchair use experience at baseline may have influenced the differences in wheelchair use self-efficacy observed between groups and should not be overlooked. The intervention group had approximately 9 years of previous experience, ranging from 2 months to 36 years, while the control group had 18 years experience ranging from 11 months to 41 years. Although sub-group analyses were not an intended purpose of this study, 6 of 16 individuals in the intervention group who had over 3 years experience using a manual wheelchair experienced an overall 20% increase in wheelchair use self-efficacy. This suggests that self-efficacy enhancing wheelchair interventions, such as WheelSee, may have benefits for varying amounts of previous wheelchair user use. Future studies should stratify based on previous wheelchair experience to determine how training can be facilitated at various stages in the rehabilitation process and after return to community-living. Additionally, studies should address the issue of timing, that is, when is the best time to teach people how to use their wheelchair, and what should training interventions look like during initial rehabilitation versus after living in the community for some time?

A validated Wheelchair Skills Training Program (WSTP) (Ref) has been previously shown to improve wheelchair use self-efficacy, with slightly higher effects than the current study (Sakakibara et al., 2012). However, Sakakibara et al., (2012) examined able-bodied older adults who had never used a manual wheelchair before. Since self-efficacy is informed by previous experiences (Bandura, 1997) it is highly likely that responses on the WheelCon lacked a meaningful interpretation for these participants. Moreover, individuals with physical disabilities have to consider how their functional limitations may influence performance abilities, in addition to the consequences of an unsuccessful performance (e.g., tipping the wheelchair).
From a theoretical perspective, it is not possible to determine the specific influence of WheelSee or WSTP on each of the individual sources of self-efficacy. However, the WSTP is principally designed as a motor learning intervention for improving wheelchair skill that focuses on wheelchair specific skill acquisition. Since the WSTP effectively improves wheelchair skill (Best et al., 2005; Routhier et al., 2012; Osturk & Ucsular, 2011), and enactive mastery (i.e., successful performance of the skill) is the most influential source of self-efficacy (Bandura, 1997), there is likely a synergy between increased wheelchair skills that relates to improved wheelchair use self-efficacy. Although we do not know the precise contribution of wheelchair skill for improving self-efficacy, we know that self-efficacy may be enhanced by additional sources of self-efficacy (i.e., vicarious experience, verbal persuasion, and reiteration of physiological symptoms).

In addition to enactive mastery, it is possible that the WSTP also includes additional sources of self-efficacy. However, these are not explicitly stated. Social Cognitive Theory implies that vicarious experience may be enhanced using a peer-trainer and training in dyads to teach wheelchair skills, with addition self-efficacy enhancement through verbal persuasion from peers (and caregiver when applicable), and discussion of bodily reactions associated with low-self-efficacy. Further investigation is required to determine the independent contribution of each source of self-efficacy and how each can be successfully implemented into wheelchair training. However, it is likely that whole is greater than the sum of its parts, such that self-efficacy depends on adequate amounts and optimal interaction of all four sources.
Wheelchair skills capacity and performance

WheelSee had a large and statistically significant effect on wheelchair skills capacity (Cohen’s $d = 0.8$). There was a statistically significant difference in post-intervention WST capacity scores between the intervention (89%) and control group (78%). In our study, wheelchair skills capacity improved by 9% in the intervention group and regressed by 1% in the control group. Although within-subject changes were lower compared to previous studies using the WSTP (absolute change of 6% in our study compared to ~15% in previous studies), the post-intervention wheelchair capacity was about 10% higher (88% in our study compared to 78% in previous studies)(Best et al., 2005; Öztürk and Ucsular, 2011; Routhier et al., 2012).

There are some possible reasons that may help to explain differences between the studies. First, our study used the questionnaire version of the WST-Q, while the other studies used an objective assessment of wheelchair skill. Rushton et al., (2012) demonstrated a high correlation between the WST-Q and objective version measures ($r = 0.98$), but reported that individuals tend to overestimate their ability by about 4%. It is possible that some participants in this study may have overestimated their ability at baseline due to previous performance of the skill with assistance from a therapist. For example, upon the start of WheelSee training, one participant felt confident to perform a wheelie. However, trainer observation revealed that the participant actually used a rear anti-tip device to assist with support and balance to accomplish the skill, suggesting a false sense of performance mastery. Therefore the true change in scores may not be accurately reflected. Such issues can be addresses during training, but may have influenced within-subject changes in this study. It is also possible that variation in the amount of previous
wheelchair experience may have influenced the smaller within-subject change scores in our study.

The intervention group had higher post-intervention performance (71%) than the control group (66%), but the effect size was small and not statistically significant. Again, the WST-Q is a subjective evaluation of wheelchair skills that may be prone to overestimation of approximately 4% (Rushton et al., 2012). Wheelchair skills performance is indicative of the skills that have been performed in the past month. From a rehabilitation outlook, it is the skills that are actually performed that indicate how the wheelchair is being used to achieve participation in meaningful activities. It is possible that changes were not detected between groups because participants did not have enough time to perform new skills before post-intervention assessment, or that the amount of wheelchair experience may have influenced wheelchair performance outcomes. It is also conceivable that outside of the controlled study environment, participants were not confident enough in their skill level to perform some skills.

Regarding both wheelchair skills capacity and performance from a clinical perspective, an improvement of 3% is approximately equivalent to improvement in 1 wheelchair skill (Giesbrecht et al., 2014). Therefore, learning and using just 1 wheelchair skill may have a profound clinical impact. For example, learning to climb a small curb may make the difference in accessing a building or not. Participants in the intervention group had approximately 10% higher wheelchair skills capacity than the control group, which is approximately equivalent to 3 additional wheelchair skills. Additionally, the intervention group reported about 5% higher wheelchair skills performance than the control group, or performance of 2 more skills in the past
months. Although each specific skill does not have the same clinical implication, an improvement in 1 or 2 intermediate or advanced skills may enable mobility and participation in meaningful activities. Moreover, increased performance of just 1 or 2 skills suggests that the wheelchair user may be using their wheelchair more, thus may be gaining some health benefits associated with mobilizing in their wheelchair.

**Life-space mobility**

Wheelchair self-efficacy has recently been reported to be associated with life-space mobility, and this relationship is mediated by wheelchair skills (Sakakibara et al., 2014b). WheelSee had a small effect size on life-space mobility that was not statistically significant. A look at within-subject changes over time shows that both groups reported increases in life-spaces. Although the possibility of measurement error cannot be excluded, it is possible that engaging in a research study alone may have influenced changes observed in the control group. Since all participants identified meaningful goals related to using a wheelchair at baseline, it is possible that motivation gained through perceived social pressure (Ajzen & Fishbein 1975), intrinsic sources (Deci & Ryan, 2000), or contemplation (Prochaska & DiClemente, 1983) may have stimulated a behavioural change response that encouraged more frequent travel in a greater variety of life-spaces.

Long term follow-up is needed to truly understand the how self-efficacy and wheelchair skills can influence the life-space mobility of wheelchair users over the long-term. The Life-space mobility assessment accounts for places traveled on a continuum that ranges from the inside the home to outside of the community, such as travelling to another city. It is plausible that
participants in this study did not have enough time to plan for and achieve desired travel during the study period.

**Satisfaction with participation**

WheelSee had a large effect size (0.7) on satisfaction with participation that approached statistical significance. Compared to the control group (45%), the intervention group had higher satisfaction with participation (61%) in self-identified goals post-intervention. This change just reaches the Minimal Detectable Difference (15%) as reported by Miller et al., 2011. Therefore, we cannot be sure of the clinical significance of this change. However, it is likely that achievement in just one goal can have profound improvements on an individual’s quality of life. For example, if the goal was to become more physically active, and this goal was achieved, in addition to perceived satisfaction with accomplishing the goal, the individual would also start to receive the health benefits of participating in physical activity.

Participation outcomes in both the intervention and control groups may be influenced by simply by engaging in a research study alone. For example, a recent systematic review reported that nearly 30% of inactive control groups reported improvements in physical activity. The changes in the control groups were attributed to behavioural measurements combined with participant characteristics (Waters et al., 2012). Since all participants selected meaningful goals related to using a wheelchair at baseline, similar to life-space mobility, it is possible that social pressure, intrinsic motivation and contemplation may have influenced participation outcomes in both groups (Ajzen and Fishbein 1975; Deci & Ryan, 2000; Prochaska & DiClemente, 1983).
Increased participation in physical activity was a commonly reported goal. Changes in physical activity behaviour may require more than 6 weeks to accomplish and to perceive success. For example, at the end of a 16 week physical activity intervention, Buman et al., (2011) reported no statistically significant differences in physical activity between the intervention and control groups. However, at 18 months follow-up, the intervention group reported significantly higher levels of physical activity. Therefore, although the intervention group had some improvements in satisfaction with participation, follow-up is needed to determine whether or not the behaviours are retained or changed.

*Post-WheelSee survey*

Participants in this study confirmed that their level of perceived self-efficacy for using their wheelchair influenced their personal wheelchair use. It is promising that upon completion of WheelSee, all 16 participants felt that their personal level of wheelchair use self-efficacy improved. Particularly promising is the fact that the use of a peer-trainer was identified by 4 of 16 individuals as one of the components of the interventions that worked best. Additionally, 4 of 16 participants liked that they could watch other wheelchair users (i.e., peer or participant) performing a skills. Perceived benefits of WheelSee from a participant perspective add support to the future evaluation of peer-led approaches. Descriptive findings about what participants liked and did not like can provide useful insight into the participants’ values and experiences. According to Wiart & Burwash, 2007, understanding participants’ preferences regarding an intervention is just as important as the efficacy.
Prevention of drop-outs and compliance

Retention is both groups was high, as only one participant did not complete post-intervention assessments. Prevention of drop-outs was established using various approaches. One approach was recruiting a volunteer sample who may have been more motivated to participate. Use of the wheelchair user community to engage subjects in this project may have reinforced retention. This process of engaging community partners to recruit has been shown to facilitate recruitment and retention (Mfutso-Bengo et al., 2008). According to Schaefer et al. (2009), another reason may be a perceived moral obligation to take in research for the good of the public.

This study also had very high compliance in the intervention group. The more compliant participants are, the more benefits they may receive from the intervention. Since wheelchair users experience considerable barriers to research participation, such as complex health problems (Kosma et al, 2004), cognitive impairments, financial stress (Bell et al., 2008), and limited transportation (Cardenas & Yilmaz, 2006), it is promising that the majority of participants completed WheelSee as intended. Being lead by a peer trainer may have helped to achieve a cultural competence that is particularly meaningful for individuals with disabilities (Kosma et al., 2004). Cultural competency involves elements of personal identification, language, actions, values and communications specific to a cultural group (e.g., wheelchair users), which influence health beliefs and behaviours. The National Institutes of Health recognize cultural competency as an effective strategy to delivering health services (NIH, 2014). Additionally, establishing collaborations between researchers and wheelchair users may have added credibility to the research, as wheelchair users were partners and consultants, not just subjects (Kitchin, 2012).
6.4.1 Limitations

Although generalizability of the results is limited to manual wheelchair users who live in Vancouver, we included a wide range of age and previous wheelchair experience in the sample. The small convenience sample and insufficient power for sub-group analyses for potentially important variables (i.e., age, previous wheelchair experience) represent considerable limitations of this pilot RCT, and may also account for lack of statistical significance in the secondary objectives. Although the difference in previous wheelchair experience between the intervention and control group at baseline may have influenced the results, large effects sized were obtained for wheelchair use self-efficacy, wheelchair skills capacity, and satisfaction with participation. Future may consider power calculations that allow for stratification of potentially confounding factors.

Establishing a tradition alpha = 0.05 to indicate statistical significance may have also posed a limitation to our study. Current exploratory research is often more liberal when establishing statistical cut-points, and it is becoming common to see alpha set at 0.10 to be sure that potentially effective interventions are not dismissed to early. Although wheelchair our secondary outcome (wheelchair skills capacity) achieved statistical significance, the primary outcome (WheelCon) did not. However, large effect sizes combined with perceived participant benefits support continued evaluation of WheelSee.

Although the primary outcome has documented reliability and validity, responsiveness and the minimal clinically important change of the WheelCon has yet to be established. Sakakibara et al.,
(2013b) estimated that a change of 10% could be meaningful for inexperienced wheelchair users. However, it was not clear how change in WheelCon scores was clinically important to experienced wheelchair users. Although a reasonable estimate of the clinical significance (Smallest Real Difference, Rushton et al., 2012) was considered in this pilot study, establishing the minimal clinical important difference for wheelchair use-self efficacy would help with evaluations of clinical significance in future studies. Until responsiveness and expected change of the WheelCon can be established, future trials may want to consider a primary outcome that has consistently been able to document change after intervention, such as the Wheelchair Skills Test.

We attempted to blind the data collectors to group allocation. However, despite asking subjects not to talk about the training with the Data Collectors, some participants occasionally made training-related comments. However, since all outcomes were subjective self-reports, and some self-administered, it is unlikely that a potential data collector bias would influence the participants responses.

Finally, our study was limited by comparisons between an intervention group and a ‘usual care’ control group. Although justification of a ‘usual care’ control group was provided for this pragmatic pilot study, it is not possible to eliminate the possibility of attention bias as a possible effect. However, findings from this study have informed the design of larger randomized controlled trials, including the development of an active control group. Additionally, the potential influences of the pairing of participants were not addressed in our sample size calculation. Though participants were randomly allocated in pairs, the data were treated as
individual units of measure. Future designs should consider nesting design that account for random allocation of pairs.

Clinical applications and future directions

Further investigation is needed to fully understand the influence of wheelchair-use self-efficacy on wheelchair skills. Previously identified conceptual areas, including knowledge and problem solving, self-advocacy, and managing emotions and social situations (Rushton et al., 2012), demonstrate that wheelchair use self-efficacy is larger than wheelchair skills. Although WheelSee attempted to include these non-tangible constructs, more research is needed on how to effectively integrate these components to modify self-efficacy. Such an understanding may help to understand how wheelchair-use self-efficacy and skills can influence social participation, quality of life and overall health of wheelchair users.

Since WheelSee uses both a peer-trainer and a support-trainer, it may be considered labor intensive. However, the intervention does not require specialized equipment (i.e., all obstacles can be found in the natural environment), and family members could be trained as spotters. The future intent of WheelSee is that a peer-trainer could administer WheelSee training independently in the community, thus reducing the necessity of clinician involvement to teach advanced wheelchair skills. Similar types of peer-led self-management programs have been documented as a cost-effective solution for providing health care (Kennedy et al., 2007; Richardson et al., 2008). Additionally, it is possible that WheelSee could accommodate larger groups, which may have some reduced health-service costs. Direct applications of reduced
health-service costs associated training in pairs or larger groups should be assessed in future studies.

It is possible that WheelSee could be offered through special interest groups in the community, such as those for SCI or MS, or at recreation facilities that offer other group programs. In that way, peer-led training may be a useful approach to augment existing wheelchair training programs. For example, clinicians may begin wheelchair training upon provision of the wheelchair, but peers could continue with ongoing training in the community on a per-needs basis to ensure continued training in intermediate and advanced skills. Community-based wheelchair training may also provide opportunities for ‘booster’ sessions for experienced wheelchair users who run into situations that they would like to receive advice about. Thus studies evaluating ecological validity would be beneficial.

Another aspect for future research that should be considered is the measurement of physical activity outcomes, with follow-up retention measures. If WheelSee is able to improve physical activity, there may be additional associated health benefits. Additionally, longer term behaviour changes may be influenced by progression of disability, exacerbations of existing health conditions, or change in health status, which are variable that could be addressed by future studies.

Finally, WheelSee should be compared with existing wheelchair skills training programs (i.e., equivalency trials), to determine the most effective approaches for wheelchair training. It is
possible that peer-led programs like WheelSee could augment clinician training, but this needs to be evaluated in future studies.

6.5 Conclusion

This was the first study to investigate a peer-led approach to wheelchair training to improve wheelchair use self-efficacy and associated wheelchair outcomes. WheelSee is a novel approach to a health service dilemma that had a positive influence on wheelchair use self-efficacy, wheelchair skills capacity, and satisfaction with participation. Findings from this pilot study support continued research to evaluate the effect of peer-led approaches to wheelchair training for both novice and experienced manual wheelchair users of varying age. In conclusion, a peer-led, goal-oriented approach to wheelchair training shows promise and is worthy of further study through design of multi-site RCTs to evaluate effectiveness.
7 Overall discussion, synthesis and future directions

Mobility and participation are important factors of quality of life and should be considered as part of wheelchair interventions (WHO, 2001). Supporting participation in physical activities is particularly important for achieving health benefits, especially for wheelchair users (Rimmer, 2006). Wheelchair mobility and wheelchair skills support participation in meaningful activities for wheelchair users, such as leisure time physical activity (Routhier et al., 2003; Oyster et al., 2011; Phang et al., 2012). However, wheelchair skills training is needed to ensure adequate skills development (WHO, 2009). Low self-efficacy with wheelchair use is prevalent, (Miller et al., 2012) and may pose an invisible barrier to wheelchair mobility and participation (Sakakibara et al., 2013; Sakakibara et al., 2014). Enhancing self-efficacy during wheelchair training has been identified to support mobility and participation outcomes for wheelchair users (Sakakibara et al., 2014; Geyh et al., 2012).

The ICF provided a functional framework for categorizing and organizing the variables of interest related to wheelchair mobility and participation in this dissertation. The ICF was applied in effort to conceptualize the relationships between many of the variables. However, there were issues of overlap with some of the variables and uncertainty about where some constructs best fit. For example, there is an ongoing debate about the appropriate classification of wheelchair use self-efficacy as a body function or personal factor. Although the ICF is not perfect in any clinical research context, its application in this dissertation was useful.
Over the course of my dissertation, we first established that risk of physical and leisure inactivity was associated with wheelchair use, and that there was an association between wheelchair use and self-rated health in Chapter 2 (Best et al., 2011). Evidence describing the limited use of validated wheelchair skills training programs in Chapters 3 and 4 provided rationale to determine if there are alternative ways that may help to overcome existing limitations and barriers to clinician-led wheelchair skills training (Best et al., 2014a; 2014b. The development of a novel complimentary approach would not replace clinician training efforts, but instead may augment existing practice. Community-based training interventions may also allow for the evaluation of training after initial rehabilitation, which would provide some insight into optimal timing for administering wheelchair training interventions.

With the recent identification of self-efficacy as important factor for wheelchair use, we conducted a systematic review of existing self-efficacy enhancing interventions in Chapter 5 to determine if a Social Cognitive approach to training was worthy of consideration. Accordingly, we developed a self-efficacy enhanced wheelchair training intervention, which was subsequently evaluated in a pilot experimental study in Chapter 6. The results from each of the studies contribute to a greater understanding of wheelchair use training, and how self-efficacy enhancing approaches can be applied for wheelchair users with the hopes that these strategies will enhance participation in daily and social physical activities.
7.1 Wheelchair use is a risk factor for physical inactivity

Wheelchairs are provided to enable mobility and participation in efforts to optimize quality of life for those with mobility disabilities. Despite intended benefits, wheelchair use has been confirmed as a risk factor for physical and leisure inactivity and poor perceived health in adults over the age of 60 (Best et al., 2011). Wheelchair users were significantly less likely to participate in leisure activities compared to those who walked with or without support and wheelchair use seemingly increased the likelihood for reduced participation in physical activity. Wheelchair use was also a risk factor for poor perceived health, and participation in physical and leisure activity were shown to have a negative mediating effect on the associations between wheelchair use and perceived health (Best et al., 2011). These results are in line with those of Chaves et al., (2004), who reported the wheelchair was the main perceived cause of limited participation inside and outside of the home and during transportation.

Participation in physical activity is particularly important for wheelchair users in the prevention of secondary health conditions (Rimmer, 1999). However, findings from our study show that only 8% of older wheelchair users participate in regular physical activity compared to 49% of older adults who walked without support. This estimate is lower than that of Martin-Ginis et al., (2010), who reported that 50% of individuals of individuals of varying age with a spinal cord injury reported no leisure-time physical activity. The difference is likely attributable to the age groups within the two studies, as physical inactivity is even more common among older adults (Ashe et al., 2009). Older individuals, who represent the largest proportion of wheelchair users, may tend to participate more in leisurely pursuits than physical activity. In Chapter 1 older
community-living wheelchair users reported higher levels of participation in leisure activities (41%) compared to physical activities (Best & Miller, 2011). Although passive leisure activities (e.g., relaxation, meditation, reading) require little energy expenditure (O'Sullivan & Chard, 2010), leisure is comprised of both passive and active activities. Many active leisure activities (e.g., socializing with family and friends, playing games, preferred hobbies) require moving from one place to another; therefore, some energy expenditure may be required. However, leisure pursuits alone may not be enough to achieve the health benefits associated with adequate amounts of physical activity.

Education and training have been recognized as important facilitators to participation in physical activities for wheelchair users (Buffart et al., 2009; Rimmer et al., 2004). Additional facilitators were identified as affordability, accessible physical environments and equipment, social contact and perceived fun (Buffart et al., 2009; Rimmer et al., 2004). Some of the barriers to participation in physical activity for wheelchair users include, knowledge, the physical environment, attitude and motivation, fear of injury, and accessible facilities (Buffart et al., 2009; Froehlich et al., 2002; Kirchner et al., 2008; Rimmer et al., 2004). Specific to individuals with spinal cord injury, preparation during rehabilitation and stimulation to be physically active were identified as the top two facilitators of physical activity (Vissers et al., 2008). For wheelchair users having the skill to use their wheelchair is a key fundamental component of becoming more physically active. Social Cognitive Theory suggests that having the skill alone is not enough to promote changes in behaviour (Bandura, 1997), thus wheelchair training interventions should consider how skills plus self-efficacy may provide a synergy to achieve desired participation outcomes.
Adequate wheelchair skills may help to overcome the participation barriers associated with the wheelchair and the physical environment (Hoenig et al., 2003). More recently it has been shown that optimizing the levels of wheelchair skills and wheelchair use self-efficacy may have a positive influence on the frequency of participation (Sakakibara et al., 2014). Both wheelchair skills and wheelchair use self-efficacy have been associated with leisure-time physical activity (Phang et al., 2012). Improvements in wheelchair skills may facilitate participation in leisure-time physical activity, if improved wheelchair skills help people feel more self-efficacious in their abilities to overcome barriers (Phang et al., 2012).

Self-efficacy for wheelchair use seems to play a similar role in enabling participation for wheelchair users as self-efficacy for exercise plays in the initiation and maintenance of physical and leisure activity in the general population (McAuley et al., 2011; Lee et al., 2008; McAuley et al., 2003). Therefore, interventions that include wheelchair mobility training and self-efficacy enhancing strategies may be a useful approach to improving the physical activity levels of wheelchair users. Further research is needed to develop effective strategies that enable wheelchair mobility while promoting increased physical activity among wheelchair users.

**Implication:** Participation in physical activity has numerous health benefits, but wheelchair use is a risk factor for physical and leisure inactivity and poor perceived health. Since mobility is a requirement of physical activity participation, physical activity interventions for wheelchair users should focus on wheelchair skills and self-efficacy for wheelchair use.
7.2 Current wheelchair training education and practice

As hypothesized, wheelchair skills training provided in rehabilitation is limited (Best et al., 2014a). Although many clinicians teach basic wheelchair skills, very few teach the advanced skills that are needed to optimize mobility and participation. Moreover, most training does not use a validated wheelchair skills training program, with the most common perceived barriers to the use of such programs reported to be time and knowledge (Best et al., 2014a).

While it is promising that clinicians are providing some basic training (e.g., turning in small spaces) to novice wheelchair users, training in the safe execution of advanced skills (e.g., wheeling down steep ramps and descending curbs) may provide benefits to wheelchair users and caregivers. In addition to increased safety (Ozturk & Ucsular, 2010), advanced wheelchair skills may facilitate community participation (Kilkens et al., 2005; Hosseini et al., 2012; Wehman et al., 1999), including participation in physical activities (deGroot et al., 2010; Phang et al., 2012), and quality of life (Hosseini et al., 2012). Increased independent wheelchair use may also lessen the reliance on caregivers to assist with mobility and engagement in social activities (Shields, 2004; Hanson et al., 2003).

The perceived barriers of time and knowledge to wheelchair skills training program must be addressed. A study of wheelchair skills in occupational therapy studies suggested many clinicians likely do not receive specific training regarding wheelchair skills, speculating that only a small number of therapy training programs dedicated more than a few hours to wheelchair skills training (Coolen et al. 2004). Findings in Chapter 4 confirm this hypothesis, as the majority of entry-to-practice OT and PT programs in Canada included just a few hours of specific curriculum for manual wheelchair skills training. Additionally, this survey found that of those
who do wheelchair skills training, less than half used validated programs for implementing wheelchair content into curriculum (Best et al., 2014b).

Effective wheelchair skills training, including training in intermediate and advanced wheelchair skills, may be achieved with as little as three hours of training according to a validated wheelchair skills program (Best et al., 2005). Although successful knowledge translation of a validated wheelchair skills training program is possible (Coolen et al., 2004; Kirby et al., 2011; Routhier et al., 2008), learning to use the program in its entirety takes time and continued commitment to implement in practice. With clinicians facing many complex needs and competing priorities that have to be addressed in an increasingly shorter periods of time, rehabilitation may not be the ideal place for advanced wheelchair skills training. Moreover, rehabilitation is a time of considerable adjustments for many individuals, thus may not be the best time for learning new skills. Instead, knowledge translation efforts could focus on providing clinicians a foundation for basic wheelchair skills training, which could be later augmented with community-based training in the intermediate and advanced skills.

Community-based wheelchair training may provide an opportunity for ‘just in time’ progressive wheelchair training to augment basic training received in rehabilitation. This may provide an avenue for on-going training and booster sessions in the advanced skills for wheelchair users as they gain experience using a wheelchair and better understand the demands associated with wheelchair use.
7.3 Self-efficacy enhancing strategies for physical activity participation

Chapters 2 through 4 establish a need for novel wheelchair skills training programs that may promote participation in physical activities while reducing clinician burden. The recent discovery of the influence of wheelchair use self-efficacy on wheelchair skills and participation has suggested that interventions should consider self-efficacy enhancing strategies. As such, a review of the Social Cognitive and self-efficacy literature was conducted to inform the development of a new wheelchair training program. Social Cognitive Theory posits that self-efficacy predicts behaviour (Bandura, 1997). Self-efficacy is informed by enactive mastery, vicarious experience, verbal persuasion, and reinterpretation of physiological symptoms, and optimal influence from all four sources of self-efficacy provides the best outcomes (Bandura, 1997). One common approach used to apply self-efficacy enhancing strategies to intervention is the use of peer-trainers. Therefore, a systematic review was conducted to determine the effect of peer-led interventions on physical activity and self-efficacy outcomes.

Implication: Novel approaches to wheelchair skills may assist to optimize wheelchair provision services. Community-based training may augment existing clinical practices to help ensure optimal timing for the training of specific skills that are needed for mobility and participation in meaningful activities. Strategies should be inclusive of all wheelchair users and should aim to reduce reliance on clinician resources.
Peer-led interventions show support for improving physical activity duration and self-efficacy in various clinical and non-clinical populations of varying age (Chapter 5). Although the effect size was low, the results of our current systematic review are in line with a recent review in adolescents, which reported that social cognitive theory explained 33% of the variance for predicting physical activity behaviour and 48% of the variance for predicting physical activity intention (Plotinikoff et al., 2013). Although many interventions in the meta-analysis targeted more than just physical activity behaviour, it is promising that multi-component interventions could influence physical activity outcomes.

There are numerous benefits associated with peer-led interventions. Peer-trainers are accessible from various populations and can be trained using standardized protocols. Peer-led self-management programs have been documented as cost-effective compared to usual care in the treatment of chronic conditions, as they lead to better health outcomes at lower costs (Armstrong et al., 2008; Richardson et al., 2008; Kennedy et al., 2007). Moreover, peer-trainers can provide psychological and social support participants (Bratter, 1990; Szilagyi, 2002; Webel, 2010), which may be of particular importance for wheelchair users (Kitchen, 2012; Standal & Jespersen, 2008). Therefore peer-led wheelchair training according to Social Cognitive Theory may offer a novel approach to wheelchair skills training that enhances self-efficacy, promotes participation, and minimizes clinician burden.
7.4 Peer-led wheelchair training has potential

Guided by Social Cognitive Theory and consideration of the sources of self-efficacy (i.e., enactive mastery, vicarious learning, verbal persuasion, and reinterpretation of physiological symptoms), a peer-led, **Wheelchair ‘Self-efficacy enhanced’** training program was developed, called **WheelSee**. A pilot RCT showed that WheelSee has potential to improve wheelchair use self-efficacy, wheelchair skills and satisfaction with participation. Although statistical significance was only reached for wheelchair skills capacity, this pilot study demonstrated that WheelSee had a large effect size on wheelchair use self-efficacy (0.7), wheelchair skills capacity (0.8), and satisfaction with participation (0.7). Maybe most meaningful is the fact that all participants who completed WheelSee believed that wheelchair use self-efficacy influenced how they used their wheelchair, and all individuals felt that their personal level of self-efficacy improved with participation in WheelSee.

Low self-efficacy can negatively influence wheelchair mobility and participation (Sakakibara et al., 2014), and can have an unfavourable impact on quality of life for wheelchair users (Hoessini et al., 2012). With less than 9 hours of peer-led training, potentially clinically meaningful differences were documented in wheelchair use self-efficacy and wheelchair skills. There were
also notable improvements in perceived satisfaction of participation in meaningful goals, many of which included participation in physical activity.

High compliance rates (96%) were observed with the WheelSee intervention, as only one participant did not complete the study. Compliance is particularly concerning for research in wheelchair users who often experience considerable physical and social barriers to research participation, such as the physical environment, transportation and attitudes (Kosma et al, 2004, Bell et al., 2008; Cardenas & Yilmaz, 2006). Furthermore, Kitchin, 2012 identified that collaborations between academics and wheelchair may increase the credibility of the research among potential participants (Kitchin, 2012). WheelSee endeavoured to accomplish this by gathering and applying feedback from the peer-Trainer, a study co-investigator who was a community-living wheelchair user, and participants. In addition to providing wheelchair skills training, it is also possible that a peer may be able to address some of the perceived barriers to participation experienced by many wheelchair users. Due to first-hand experiences with overcoming barriers in a wheelchair, a collaborative approach that includes a peer-trainer may have an even stronger influence than a health professional alone (Kitchin et al., 2012).

Although WheelSee allowed and encouraged participation of family members or friends in the training, very few individuals took advantage of this opportunity. The intent of including caregivers in WheelSee was to make training inclusive and to make use of the caregivers as spotters for the practice of skills where tips and falls were possible. Involvement of a caregiver in future studies may not only provide a form of social support for the wheelchair user, but may also provide insight about the importance of social support in wheelchair interventions. For
example, caregiver may provide a useful source or verbal feedback (i.e., verbal persuasion) that could be extended back to the home and community. Appropriate methods and timing of verbal feedback from family members may be evaluated, and the caregiver may attain perspective about what it’s like to use a wheelchair.

The future intent of WheelSee is that a peer-trainer could administer WheelSee independently in the community, thus reducing the reliance on clinicians to teach advanced wheelchair skills. Community-based wheelchair training may also provide progressive wheelchair training opportunities for all wheelchair users. WheelSee could be administered in larger groups, which may have cost-efficiencies such as those documented with other peer-led interventions (Kennedy et al., 2007, Richardson et al., 2008). However, this was the first study to apply Social Cognitive Theory to wheelchair skills training and the first study to implement and evaluate peer-led wheelchair training program. Although a peer-led self-efficacy enhanced approach shows potential for improving wheelchair skills and satisfaction with participation, much more research is needed into self-efficacy enhancing interventions for wheelchair users.

**Implication:** A peer-led wheelchair training program may improve wheelchair use self-efficacy and wheelchair skills. Moreover, participants reported subjective perceived benefits to peer-training. More research is needed to determine the effect of peer-led wheelchair training on self-efficacy for wheelchair use, and how such programs may promote increased wheelchair use and participation in meaningful activities. Additionally, research is needed to understand how peer-led programs can be sustained in the community as an augment to existing clinical practice.
7.5 **Strengths and limitations**

This dissertation has generated some rationale for the development of novel approaches to wheelchair training, and provides preliminary evidence suggesting that peer-led, self-efficacy enhanced wheelchair training is worth exploring further. The findings provide a report of the current physical activity levels of wheelchair users, which may be partially explained through the description of current wheelchair skills education and training.

The use of a population survey to explore the physical and leisure activities represents both strength and a weakness. Although the results are representative of the older Canadian population, the research questions were limited to pre-obtained survey variables. There is also a population of wheelchair users who live in long-term care facilities who are often excluded from population surveys. Therefore, the results pertain only to community-living wheelchair users. Since many wheelchair users live in institutionalized setting, future studies may consider similar outcomes applied in long-term care settings.

Two national surveys provided a comprehensive description of current wheelchair skills training in education and practice. Although the results come from large geographic regions across Canada, respondents in both surveys were answering on behalf of an institution. Therefore, we cannot be sure that the results are an accurate reflection of all wheelchair skills training that is done in education and practice. Furthermore, the respondents were limited to clinicians practicing in a primary health care facility. Future studies may elicit individual responses from clinicians in both rehabilitation and community settings to gain a broader understanding of current education and practice related to wheelchair training.
The recruitment of volunteers is applicable to all research components of this dissertation. As a result, data may under- or over-represent a particular subgroup within the population. With regard to the surveys, responses were anonymously completed online and we lack information on potential reasons why individuals chose not to complete the surveys. We also do not know why some people chose not to take part in the WheelSee pilot study, but it is plausible that those who volunteered to participate were more motivated than those who do not. Therefore, the non-random sampling technique used in this study may limit the generalizations of the findings.

The use of self-report measures for physical activity outcomes in the systematic review, as well as for all the clinical outcomes in the WheelSee experimental study also poses a limitation that may have produced a social desirability bias. Although the WheelSee study measured satisfaction with participation, which included some physical activity goals, not measuring physical activity objectively poses another limitation to the findings. Moreover, in the WheelSee study, the intervention group was compared to a non-active control group which may have produced bias in the results due to researcher attention. Therefore, the results should be interpreted with caution.

Finally, the application of Social Cognitive Theory for the development of a self-efficacy enhanced wheelchair training intervention presents both strengths and limitations. With self-efficacy as the pinnacle of Social Cognitive Theory, there is a large body of evidence supporting the influence of self-efficacy on behavioural change and for predicting desired outcomes. Although social cognitive approaches are widely accepted for application in behavioural interventions, the underlying mechanisms of behaviour change are complex.
7.6 Future directions

Wheelchair intervention research is in its infancy and with the growing number of wheelchair users the need for continued research and development in this area has been identified. There is a need for continued development of novel approaches to wheelchair training. There is also a need to further evaluate existing interventions. This was the first study to evaluate a peer-led approach to wheelchair training, but the intervention also relied on collaboration from an experienced support-trainer. Future research is needed on the feasibility, efficacy, effectiveness, cost-effectiveness and ecological validity of peer-led programs administered in community based settings. To help establish these outcomes, comparison studies with active control groups need to be developed, as well as equivalency trials comparing different types of interventions.

Furthermore, future trials examining wheelchair use should include outcomes of wheelchair mobility (e.g., accelerometers, data loggers, global positioning systems), and participation (e.g., social participation, participation in physical and leisure activities). Moreover, studies evaluating the long-term effects of wheelchair training interventions are needed to understand how changes in wheelchair use self-efficacy and wheelchair skill may influence behavior change.

Importantly, future intervention research should focus on subgroups of wheelchair users at risk of low self-efficacy, and who those who may benefit the most from treatment. Findings from the WheelSee study suggest that both novice and experienced wheelchair users may benefit from training. However, such subgroups may respond differently to different treatments. Therefore, it may be important to develop and test different strategies or a combination of strategies in order to realize the greatest impact. Additionally, cost-effectiveness studies should be done to compare the cost of providing WheelSee with the cost of not providing WheelSee.
Finally, optimal timing for initiating wheelchair skills training in the wheelchair procurement process should be explored. What skills should be taught and at what time during the rehabilitation process. Knowledge translation of validated wheelchair skills training programs may help to devise ways to augment existing clinical practices with new wheelchair training approaches. Future studies should evaluate the best methods to incorporate wheelchair skills training into practice, progression of training into the community, need for booster training sessions as wheelchair users become experienced. Such studies may help to identify select skills that should be taught by clinicians during rehabilitation, and which skills may be too advanced to learn during short rehabilitation stays. Standardizing basic skills training as part of wheelchair procurement may help to reduce clinicians’ perceived barriers of time and knowledge. This could begin with the development of a standard curricular component specific to wheelchair skills training that could be implemented and evaluated across Canada. For clinicians who choose to advance their careers in physical rehabilitation, the usefulness of advanced wheelchair skills training workshops and continuing education credits at professional venues could be explored.
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Appendices

Appendix A: Wheelchair skills training in clinical practice survey.

WHEELCHAIR SKILLS TRAINING IN CLINICAL PRACTICE: A SURVEY OF CANADIAN REHABILITATION CENTRES.

Manual wheelchair mobility is critical for a growing number of Canadians. The clinical practice of wheelchair skills training provided to new and experienced wheelchair users by Canadian clinicians seems to be highly variable. The purpose of this survey is to examine the extent to which manual wheelchair skills training is conducted as part of clinical practice in Canadian rehabilitation centres.

For the purposes of this study manual wheelchair skills training refers to training of the specific motor skills that are required for the use of a manual wheelchair, including but not limited to: wheelchair propulsion, manoeuvring the wheelchair, overcoming environmental obstacles (i.e. doorways, ramps, curbs, etc) and performing wheelies.

You should complete this survey if you can answer questions related to current practices for manual wheelchair skills training in your facility. You may seek the help of other clinicians in your department to help you answer any of the survey questions.

This survey will take approximately 15-20 minutes of your time.

Continue to survey

Clicking 'continue to survey' will start the survey and indicates your consent to participate.

- Continue to survey
- I do not wish to participate in this survey
The following questions ask about manual wheelchair prescription and provision in your department.

1. Do any clinicians in your department prescribe or provide manual wheelchairs?
   - Yes
   - No

2. Approximately, how many clinicians are responsible for wheelchair prescription and/or provision in your department?
   - 0
   - 1-4
   - 5-9
   - 10-14
   - 15+

The following questions ask about current practices for manual wheelchair skills training for new wheelchair users in your facility.

Manual wheelchair skills training refers to training of the specific motor skills that are required for the use of a manual wheelchair, including but not limited to: wheelchair propulsion, manoeuvring the wheelchair, overcoming environmental obstacles (i.e. doorways, ramps, curbs, etc) and performing wheelies.

3. Do clinicians in your department do any type of manual wheelchair skills training with new wheelchair users?
   - Yes
   - No
4. What components of wheelchair skills training best reflect the current practices of clinicians in your facility? Select the best answer for each of the following.

Self-maintenance and repair of wheelchair

- Always
- Almost always
- Sometimes
- Rarely
- Never

Transfers (to and from wheelchair)

- Always
- Almost always
- Sometimes
- Rarely
- Never

Wheelchair skills training for mobility (e.g. propulsion, manoeuvring around obstacles and over ramps)

- Always
- Almost always
- Sometimes
- Rarely
- Never

Advanced wheelchair skills (e.g. ascending/descending curbs, wheelies, stairs)

- Always
- Almost always
Activities of daily living (e.g. bathing, grooming, dressing, feeding)

- Always
- Almost always
- Sometimes
- Rarely
- Never

Instrumental activities of daily living (e.g. cooking, cleaning, banking, shopping, accessing public transportation)

- Always
- Almost always
- Sometimes
- Rarely
- Never

Other (please specify below)

- Always
- Almost always
- Sometimes
- Rarely
- Never

If other, please describe here:

______________________________
5. While it might vary between individuals, on average, how many wheelchair skills training sessions do clinicians in your department complete with manual wheelchair users?

- 0
- 1-2
- 3-5
- 6-10
- More than 10
- Not sure

6. While it might vary between individuals, on average, how many hours do clinicians in your department spend doing wheelchair skills training with manual wheelchair users?

- less than 1 hour
- 1-2 hours
- 3-4 hours
- 5-6 hours
- 7-8 hours
- 9-10 hours
- More than 10 hours
- Not sure

The next questions ask about the use of formal manual wheelchair training programs to inform wheelchair skills training in your facility.

Formal wheelchair skills training programs include systematic, research-based programs that are documented in scientific journals, such as the Journal of Rehabilitation Medicine or the Archives of Physical Medicine and Rehabilitation.
7. To your best knowledge, how often do clinicians in your department use the following formal manual wheelchair skills training programs (in whole or in part) to inform clinical practice?

Wheelchair Skills Training Program (Dalhousie University, Halifax, Nova Scotia)

- Always
- Almost always
- Sometimes
- Rarely
- Never

Whizz-Kidz (London, UK)

- Always
- Almost always
- Sometimes
- Rarely
- Never

Other (please specify below)

- Always
- Almost always
- Sometimes
- Rarely
- Never

None

- Always
- Almost always
If other, please provide details here:

8. To your best knowledge, how long have clinicians in your department been using formal wheelchair skills training program as part of clinical practice?

○ Less than 1 year
○ 1-2 years
○ 3-5 years
○ More than 5 years
○ Not sure
○ Not applicable

The next questions ask about the training that clinicians in your facility receive specifically for teaching manual wheelchair skills.

9. Not including training that may or may not have been acquired as part of the university program curriculum, what additional training do clinicians in your department receive for teaching manual wheelchair skills? Select all that apply.

☐ Presentations
☐ Workshops
☐ Job shadowing
☐ Continuing education courses
☐ Clinical education seminars
☐ Self-directed learning (i.e. research papers, websites, etc.)

☐ Other (please specify) ______________________

☐ None

☐ Not sure

If you have any additional comments regarding the training received by clinicians in your department, please describe here:

______________________________________________________________________________

The next question asks about perceived barriers to implementing formal wheelchair skills training as part of practice.

10. Please indicate your level of agreement with the following barriers to implementing formal wheelchair skills training as part of clinical practice in your department. Select the best response for each barrier.

Too expensive

○ Strongly agree

○ Agree

○ Disagree

○ Strongly disagree

○ No opinion

Too much paper work

○ Strongly agree

○ Agree

○ Disagree

○ Strongly disagree

○ No opinion

Not sure how to implement

○ Strongly agree
<table>
<thead>
<tr>
<th>Statement</th>
<th>Strongly agree</th>
<th>Agree</th>
<th>Disagree</th>
<th>Strongly disagree</th>
<th>No opinion</th>
</tr>
</thead>
<tbody>
<tr>
<td>Not enough resources</td>
<td></td>
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<tr>
<td>Not enough time</td>
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<tr>
<td>Extra burden on clients</td>
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<tr>
<td>Not important</td>
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</tbody>
</table>
Section B: Demographic information

The following section will ask you demographic questions that will be used only to describe the study sample. Individual responses will not be disclosed during dissemination of findings.

11. You are responding on behalf of:

○ Physiotherapy
12. What province is your facility located in?

- BC
- AB
- SK
- MB
- ON
- QC
- NB
- NS
- NL
- PEI

13. What is the age range of the clientele at your facility? Select all that apply.

- 12 years of age and younger
- 13-19 years of age
- 20-64 years of age
- 65+ years of age

14. What is your current position within your facility?

- Clinical Practice Leader
- Department Leader
- Head
- Program Administrator
○ Program Coordinator

○ Other (please specify) ______________________

15. Where did you complete your professional training? (province/state, country)


16. How many years of professional practice do you have?

☐ Less than 5 years

☐ 6-10 years

☐ 11-15 years

☐ 16-20 years

☐ More than 20 years

17. How many years have you been practicing in a rehabilitation centre?

☐ Less than 5 years

☐ 6-10 years

☐ 11-15 years

☐ 16-20 years

☐ More than 20 years

18. What areas of expertise, if any, did you consult when answering this survey?


Thank you for completing this survey.

If you would like a summary of the results from this study please provide your name and mailing address below. Your name and mailing address will only be used for the above stated purpose.

Your name will not be associated with the information that you provided in the survey.
We would like to offer you a coffee card as a token of our appreciation for completing the survey. If you are interested, please provide your name and mailing address in the space below. Your name and mailing address will only be used for the above stated purpose. Your name will not be associated with the information that you provided in the survey.
Appendix B: Wheelchair skills training in curriculum survey.

WHEELCHAIR SKILLS TRAINING AS A CLINICAL COMPETENCE IN OCCUPATIONAL THERAPY AND PHYSIOTHERAPY: A SURVEY OF CANADIAN ACADEMIC ENTRY-LEVEL PROGRAMS

Manual wheelchair mobility is critical for a growing number of Canadians. The clinical practice of wheelchair skills training that is provided to new and experienced wheelchair users by Canadian clinicians seems to be highly variable. The purpose of this survey is to examine the extent to which manual wheelchair skills training is included in the curriculum of entry-level physiotherapy and occupational therapy programs in Canada.

For the purposes of this study manual wheelchair skills training refers to training of the specific motor skills that are required for the use of a manual wheelchair, including but not limited to: wheelchair propulsion, manoeuvring the wheelchair, overcoming environmental obstacles (i.e. doorways, ramps, curbs, etc) and performing wheelies.

You should complete this survey if you can answer questions related to the current curriculum in your entry-level physiotherapy or occupational therapy program. You may seek the help of other faculty or staff in your institution to help you answer any of the survey questions.

This survey will take approximately 10 minutes of your time.

Continue to survey

Clicking 'Continue to survey' will start the survey and indicates your consent to participate.

- Continue to survey
- I do not wish to participate in this survey

1. Does your program include specific curriculum for manual wheelchair use?
2. Which of the following components of manual wheelchair training best reflect the content of your current curriculum? Select all that apply.

- Seating considerations
- Components of the wheelchair
- Wheelchair configuration and set-up
- Maintenance and repair
- Transfers
- Wheelchair skills training for mobility (e.g. propulsion, manoeuvring, obstacles, wheelies)
- Adapting activities of daily living
- Modifying the environment
- Other, please specify: ______________________

The next questions are going to ask specifically about manual wheelchair skills training within your program curriculum.

Manual wheelchair skills training refers to training of the specific motor skills that are required for using a manual wheelchair, including but not limited to: wheelchair propulsion, manoeuvring the wheelchair, overcoming environmental obstacles (i.e. doorways, ramps, curbs, etc) and performing wheelies.

3. Is manual wheelchair skills training included as part of your current curriculum?
   - Yes
   - No
4. Which of the following components in your program include compulsory curriculum to teach students about wheelchair skills training? Select the best answer for each component.

Theory
- Provides theoretical information only
- Practical competencies are described
- Students are evaluated on their competencies

- Theory
  - Yes
  - No
  - Not sure

- Practical
  - Yes
  - No
  - Not sure

- Clinical Competence
  - Yes
  - No
  - Not sure

5. Which of the following methods best describes how wheelchair skills training is included in your program? Select all that apply.

- Implemented as a mandatory course/section of the curriculum
- Implemented as an elective course/section of the curriculum
- Integrated as part of a course related to wheelchair prescription and provision
- Invited lecture by an expert in the field
- Self-directed studies
- Other, please specify: ______________________
6. Which of the following best describes the approach used within your program to teach students about manual wheelchair skills training? Select the best answer for each approach.

<table>
<thead>
<tr>
<th>Approach</th>
<th>Always</th>
<th>Sometimes</th>
<th>Rarely</th>
<th>Never</th>
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<tbody>
<tr>
<td>A formal lecture</td>
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<tr>
<td>Multiple formal lectures</td>
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<tr>
<td>Formal and systematic demonstration</td>
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<tr>
<td>Informal hands on practice with students using the wheelchair</td>
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<tr>
<td>Additional education outside of curriculum</td>
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<tr>
<td>Other</td>
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</table>
7. What is your best estimate of the total number of instructional hours that students in your program receive specifically for manual wheelchair skills training?

- Less than 1 hour
- 1-2 hours
- 3-5 hours
- 6-10 hours
- 10+ hours
- Not sure

8. What is your best estimate of the length of time that manual wheelchair skills training has been a part of your program’s curriculum?

- Less than 2 years
- 2-5 years
- 5-10 years
- 10+ years
- Not sure

9. Were any of the following formal wheelchair training programs consulted (in whole or in part) to inform the development of your curriculum? Select all that apply.
Wheelchair Skills Training Program (Dalhousie University, Halifax, Nova Scotia)

Whizz-Kidz (London, UK)

Other: ____________________

No formal wheelchair training programs were consulted

Section B: Demographic Information

The following section will ask you demographic questions that will be used only to describe the study sample. Individual responses will not be disclosed during dissemination of findings.

10. For which of the following entry-level programs do your responses represent? Select all that apply.

- Occupational Therapy
- Physiotherapy
- Other, please specify: ____________________

11. What province is your University located in?

- BC
- AB
- SK
- MB
- ON
- QC
- NB
- NS
- NL
- PEI
12. What degree is granted upon completion of your clinical program?

- Bachelors
- Masters
- Other (please specify): ______________________

13. What is your academic position? Select all that apply.

- Dean
- Acting Dean
- Director
- Acting Director
- Chair
- Head
- Professor
- Curriculum Coordinator
- Program Administrator
- Program Coordinator
- Other, please specify: ______________________

14. Where did you complete your professional training? (province/state, country)

__________________

Thank you for completing this survey.

If you would like a summary of the results from this study please provide your name and mailing address below. Your name and mailing address will only be used for the above stated purpose.

Your name will not be associated with the information that you provided in the survey.

__________________
Appendix C: Systematic Review Protocol

Background

Physical inactivity, a modifiable behaviour, is recognized globally as a public health issue. Despite efforts to increase physical activity (PA) levels, approximately 85% of Canadians are not active enough to receive the health benefits.

PA is among the best forms of medicine and it needs to be prescribed. Creating guidelines that recommend specific duration and frequency of PA is not enough to change behaviours. Various community-based behaviour modification approaches have been applied in diverse populations in effort to increase PA. One approach that has become quite popular in recent years is self-management programs (SMP). Based on Social Cognitive Theory, SMPs aim to provide the individual with the skills, knowledge and self-efficacy to manage their own health. Self-efficacy, defined as one’s perception of capability to perform a certain task or behaviour, is just as important as having the skill (Bandura, 1997). Self-efficacy is influenced by successful performances, verbal encouragement, perception of arousal, and vicarious learning. According to the tenants of self-efficacy, interventions that include all four sources will have the best outcomes.

Vicarious learning has been commonly incorporated into many SMPs through the use of peer-trainers. Peer-trainers may have psychological and social benefits that engage individuals in specific activities, such as PA. There may also be an economic advantage to using peer-trainers to administer community-based interventions.

Peer-led interventions have been effective for improving health status and functional behaviours through improved self-efficacy in many clinical and non-clinical settings. Despite a fairly large body of evidence of SMPs, there has been relatively little systematic appraisal of the combined effect of peer-led SMPs specifically on PA.

With less than 15% or the Canadian population physically active enough to receive health benefits, there is an eminent need for behaviour changing solutions that get people more active. Although many SMPs incorporate physical activity, the continued high prevalence of inactivity suggests a better understanding of existing interventions is needed.

The primary purpose of this systematic review was to synthesize the effects of peer-led SMPs on physical activity outcomes. Since self-efficacy is a strong theoretical predictor of behaviour change, the secondary objective was to examine the effect of peer-led SMPs on self-efficacy for behaviour change.

Review Questions
This review seeks to systematically establish the effectiveness of peer-led, social cognitive approaches to improving physical activity and self-efficacy. The specific review questions to be addressed are:
(1) What is the effect of peer-led self-management programs on physical activity outcomes compared to no intervention or expert led interventions in various clinical and non-clinical populations?
(2) What is the effect of peer-led self management programs on self-efficacy compared to no intervention or expert led interventions in various clinical and non-clinical populations?

Eligibility Criteria according to PICOs statement (participants, intervention, comparison, outcomes, study design) (http://www.prisma-statement.org)

Participants
This review will consider all studies that involve human subjects over the age of 19 who live in the community. Although the review is to be focused on community-based individuals, studies using hospitalised participants who expect to return to the community during the study period will also be included.

Interventions
Interventions of interest include peer-led (or co-peer-led) self-management programs that are grounded in Social Cognitive Theory. Peer-led interventions that are grounded in other theoretical frameworks or that are delivered by a peer solely through telephone or internet will not be excluded.

Comparison
The review considered all experimental studies that compared an intervention group (peer-led self-management program) to either a control group (e.g., no intervention, usual care, or active control) or another intervention (e.g., peer-led intervention versus professional led intervention).

Types of outcome measures
The primary outcome of interest is physical activity. The secondary outcome is self-efficacy, which may be specific to managing a particular health condition, or may be more general, such as self-efficacy for exercise. To be included in the systematic review, studies must contain at least one continuous end-point (primary or secondary outcome) for physical activity. Self-reported outcomes of physical activity will be included. Self-efficacy outcomes will be assessed as a secondary objective of this review, but are not required for inclusion. To be included in the meta-analyses, data required for calculation of effect size must be available. If the required data are not available, a request to obtain such data will be made to the corresponding author of the paper.

Study design
Peer-reviewed randomized controlled trials (RCT) and quasi-experimental studies will be included in the systematic review. However, only RCTs will be included in meta-analyses. For pragmatic reasons, only studies published in English will be included.

**Search strategy**

The search strategy will be designed to access manuscripts published in peer-reviewed journals and will comprise three stages:

1. A limited search of CINAHL, Medline and Pubmed to identify relevant keywords contained in the title, abstract and subject descriptors.

2. Terms identified in this way, and the synonyms used by respective databases, will be used in an extensive search of the literature.

3. Reference lists and bibliographies of the articles identified in stage 2 will be searched. The initial search terms will be ‘social cognitive theory’, ‘peer’, self-efficacy’ and ‘self-management’.

Articles published between 1989 and April 2014 in English and indexed in the following databases will be searched: MEDLINE, Pubmed, CINAHL, PsycINFO, EMBASE, Cochrane Database of Systematic Reviews

Full copies of articles identified by the search that meet the inclusion criteria (based on title, abstract and subject descriptors), will be obtained for data extraction and synthesis. Articles identified through reference list and bibliographic searches will also be considered for data collection based on their title. Two reviewers will independently select articles against the inclusion criteria. Discrepancies in reviewer selections will be resolved at a meeting between reviewers prior to selected articles being retrieved. If agreement cannot be reached, a third reviewer will assess articles and inclusion criteria.

**Critical appraisal**

Randomized controlled trials identified in the search will be assessed using the PEDro guidelines. When possible, PEDro scores will be obtained from the online PEDro database. For those articles that have not been previously scored, 2 reviewers will independently rate the methodological validity according to the PEDro. Any disagreements that arise between the reviewers will be resolved through discussion and with the assistance of a third reviewer if required.

**Data collection**

The papers will be grouped according to design (i.e., RCT or quasi-experimental trial). Using Cochrane Collaboration and the Centre for Reviews and Dissemination as a guide (http://www.cochrane.org), an evidence table has been developed to extract the data relevant for
this review. One reviewer will independently perform all data extraction, and a second reviewer will independently perform data extraction for 20% of the studies and verify the data extraction performed by the first reviewer.

**Data synthesis**

Standardised mean differences (for continuous data) and their 95% confidence intervals will be calculated from the data generated by each included randomised controlled trial. If appropriate with available data, results from comparable groups of studies will be pooled into statistical meta-analysis using Comprehensive Meta-analysis software. Heterogeneity between combined studies will be tested using $I^2$. Where statistical pooling is not possible the findings will be presented in narrative form.
Appendix D: Systematic review search example

- Database used: Embase
- Database Provider: OvidSP
- Date search was run: October 31, 2013

Search history:
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<tr>
<td>34</td>
<td>limit 33 to human and english language and emb and yr:=&quot;1989 - 2013&quot; and adult &lt;18 to 64 years or aged &lt;65+ years))</td>
<td>684</td>
<td>Advanced</td>
</tr>
</tbody>
</table>
Appendix E: Excluded references with reasons.

All studies listed below were reviewed in their full-text version and excluded as per the exclusion code in italics after each reference. Reasons for exclusion signify only the usefulness of the articles for this study and are not intended as criticisms of the articles.

Exclusion codes: E1 – wrong study design; E2 – did not measure physical activity (or did not measure physical activity at 2 time points); E3 – intervention did not meet inclusion criteria; E4 – did not include adults (≥ 19 years of age); E5 – not peer-reviewed; E6 – results previously reported.


45. Lui et al., 2012. Effectiveness of using group visit model to support diabetes patient self-management in rural communities of Shanghai: a randomized controlled trial. (E1)


49. Nguyen HQ, Donesky-Cuenco D, Wolpin S, Reinke LF, Benditt JO, Paul SM, Carieri-Kohlman V. Randomized controlled trial of an internet-based versus face-to-face dyspnea self-


51. Parent N. Social support intervention by former model patients for persons undergoing heart surgery. Rech Soins Infirm 1997;51:59-100. (E2)


54. Peteet JO. Self-management of Parkinson's disease: The effect of a group exercise program on lifestyle physical activity, self-efficacy, and function. 2002 Walden University. (E5)


Appendix F: Individual PEDro criterion assessment and total scores for RCTs (n= 21).

<table>
<thead>
<tr>
<th>Study</th>
<th>PEDro Criterion* (criterion met = 1, criterion not met = 0)</th>
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<th>3</th>
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<td>Vincent et al., 2007</td>
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<td>Williams et al., 2013</td>
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*PEDro criterion
1. eligibility criteria were specified; 2. subjects were randomly allocated to groups; 3. allocation was concealed; 4. the groups were similar at baseline regarding the most important prognostic indicators; 5. there was blinding of all subjects; 6. there was blinding of all therapists who administered the therapy; 7. there was blinding of all Data Collectors who measured at least 1 key outcome; 8. measures ≥ 1 key outcome obtained from >85% of the subjects initially allocated to groups; 9. intention to treat analysis was performed; 10. the results of between-group statistical comparisons are reported for at least 1 key outcome; 11. the study provides both point measures and measures of variability for at least 1 key outcome.
Appendix G: Funnel plot of Standard Error by Standardized Mean Differences (SMD) for physical activity outcomes in studies examined for inclusion in meta-analysis (n=17).
Appendix H: Folstein Mini Mental State Exam (MMSE)

Date: ___________________  Subject No: ___________

You do not have to answer any question that you do not feel comfortable answering.

1. What year is it? ________
2. What season are we in? ________
3. What month are we in? ________
4. What is today’s date? ________
5. What day of the week is it? ________
6. What country are we in? ________
7. What province are we in? ________
8. What city are we in? ________
9. What hospital are we in? ________
10. What floor of the hospital are we on? ________

Name three objects (“Ball,” “Car,” “Man”). Take a second to pronounce each word.
Then ask the patient to repeat all 3 words. Take into account only correct answers given on the first try. Repeat these steps until the subject learns all the words.

11. Ball? ________
12. Car? ________
13. Man? ________

Either “please spell the word WORLD and now spell it backwards” or “Please count from 100 subtracting 7 every time”
14. “D” or 93

15. “L” or 86

16. “R” or 79

17. “O” or 72

18. “W” or 65

What were the 3 words I asked you to remember earlier?

19. Ball?

20. Car?

21. Man?

Show the subject a pen and ask: “Could you name this object?”

22. Pen.

Show the subject your watch and ask: “Could you name this object?”

23. Watch

Listen and repeat after me:

24. “No ifs, ands, or buts.”

Put a sheet of paper on the desk and show it while saying: “Listen carefully and do as I say.”

25. Take the sheet with your dominant hand.

26. Fold it in half.
27. Put in on the floor.

Show the subject the visual instruction page directing him/her to “CLOSE YOUR EYES” and say:

28. Do what is written on this page.

Give the subject a blank sheet and a pen and ask:

29. Write or say a complete sentence of your choice.

Give the patient the geometric design page and ask:

30. Could you please copy this drawing?

Total Score: (/30)
Appendix I: Study design for WheelSee

Baseline data collection $T_1$
- Tester (blinded)

Group allocation
- Site coordinator
- Statistician

Experimental group
- WheelSee
  - 6, 1.5 hour sessions,
  - 1-2 sessions/week
- Peer-trainer & support trainer

Control group

Post-intervention data collection $T_2$
- Tester (blinded)
Self-efficacy enhanced wheelchair training for manual wheelchair use

Program Overview

**Who:** My name is (insert peer-trainer name) and I along with our support-trainer (insert support-trainer name) will be seeing you for the next 6 weeks in this program. Together we will help you achieve your wheelchair mobility goals. *Support-trainer introduces self.*

**Where and When:** We will meet at (insert location here) on (insert dates here). We can also meet in convenient community locations to practice some of your goals, but we will discuss this more later.

**Why:** The goal of this program is to help individuals learn skills and strategies to better use their wheelchair for mobility through goal setting, practice, and sharing challenges and successes with other wheelchair users.

**What:** There are 6, 1.5 hour sessions in total. You are encouraged to attend all sessions. The sessions will be discussion and practice based, consisting of 20 minutes of discussion, 10 minutes of goal setting, 40 minutes of practice, and 20 minutes of information discussion over coffee and snacks. Everyone is encouraged to share as much as they feel comfortable. Each session will begin with a short discussion and goal setting facilitated by the peer-trainer, followed by practice guided by both trainers, and we will end with informal discussion, take away tips, and a snack. We are here to learn about and from each other so let’s have some fun and see where our sessions take us!

**Before we begin, let’s review group expectations so each of us can have a great group experience together!**

1. Confidentiality
2. On time
3. Participation
4. Respect
The program content over the six sessions is structured as follows:

1. **Session 1** will focus on mobility goals for navigating the environment inside or around your home.
2. **Session 2** will concentrate on challenges that you face when trying to use your wheelchair outside and in the community.
3. **Session 3** will target your goals for performing specific activities in your wheelchair.
4. **Session 4** will allow you to choose new goals for navigating the environment or performing activities in your wheelchair, or you can continue to work on previously set goals.
5. **Session 5** will tap into skills for improving your knowledge about using your wheelchair and problem solving, and will also focus on learning how to advocate for yourself and your needs.
6. **Session 6** will provide tips for improving confidence in social situations and will facilitate discussion on managing emotions.
Session 1: Navigating the physical environment in and around your home.

Session Timeline:

- Introduction of study and sessions (see page 1) (10 mins)
- Wheels of Life (10 mins)
- Icebreaker game (10 mins)
- How to set goals (10 mins)
- Goal setting (10 mins)
- Practice (20 mins)
- Final thoughts, home practice, and snack. (20 mins)

Items needed for Session 1:

- Pens, pencils, manuals
- Computer and screen to project PowerPoint
- Snacks
Self-efficacy is another way to say confidence. Having the confidence to do something is more important than having the actual skill. There are probably some activities that you encounter on a regular basis that challenge your confidence when using your wheelchair. If your confidence is low, you may avoid these activities all together. WheelSee can help!

Did you know?

- Many people experience low confidence when using their wheelchair.
- Low confidence using a wheelchair may limit mobility and participation in important activities.

Think back to when you learned how to ride a bike... or drive a car. It seems as though The Wheels of Life sometimes challenge our confidence the most. But, once you acquire the skills and the confidence, it becomes second nature... just like using your wheelchair!
The purpose of WheelSee is to help you identify specific situations that you feel challenge your confidence when using your wheelchair. We will provide you with strategies to overcome some of those challenges and teach you skills to overcome other challenging situations that you may face.

To start, I propose that we make a slight change to The Wheels of Life:
Goal Setting
WheelSee is based on your specific goals. For each session we want you to think about a situation that you find challenging and we will help you achieve the skills you need to accomplish that goal. We will use SMART goal setting strategies...
SMART goals are:

**Specific:** Can your goal be broken into smaller steps? What will be achieved? Why is the goal important?

**Measurable:** How will you measure your goal? (e.g. Pass/fail, frequency the activity is completed in a day/week/month, how long it takes, how fatigued you feel afterwards.)

**Attainable:** You must believe that you can manage to do what you are setting out to do. You set your own standards by understanding your own abilities, strengths and weaknesses.

**Relevant (and Realistic):** Your goals must be relevant to what you want to achieve and you must consider what is realistic to achieve in the short...
Session 1 Goals:

Think about using your wheelchair inside or around your home… Are there any activities that you find really challenging?

Some examples of activities that you may do inside include, moving your wheelchair over carpet, transferring from your wheelchair to another surface, or make a hot meal and carry it to the table safely. You may have other activities that you would like to work on, these are just some examples.

Step 1: Write your goal for session 1 in the space provided. Make sure you apply the SMART goal principle

Specific______________________________________________________________
Measurable__________________________________________________________
Attainable___________________________________________________________
Relevant_____________________________________________________________
Time__________________________________________________________________

Step 2: What are the perceived obstacles to achieving your goal? You have maybe experienced this in the past, or can imagine experiencing it in the future. How can you overcome those obstacles?____________________________________________________________

Step 3: What tips from today will help you when you practice this goal at home or in the community? ____________________________________________________________________
Session 2: Navigating the physical environment outside of your home and in the community.

Session Timeline:
- Recap of navigating the physical environment in and around home (20 mins)
- Goal setting (10 mins)
- Practice (40 mins)
- Final thoughts, home practice, and snack. (20 mins)

Items needed for Session 2:
- Pens, pencils, manuals
- Snacks

Discussion: Before we begin, let’s discuss how you integrated the skills learned from last session into your daily life. Where you able to practice the skills? Did you run into any challenges? How did you overcome the challenges?

Goal Setting:
Think about using your wheelchair outside of your home and in the community… Are there any activities that you find really challenging?

Some examples of activities that you may do outside and in the community include, moving your wheelchair up or down a steep ramp, moving your wheelchair up or down a curb, or crossing a street light with or without traffic lights. Are there certain buildings in the city you have trouble accessing, or are there places you would like to go that you feel are inaccessible because of your wheelchair? You may have other activities that you would like to work on, these are just some examples.
Step 1: Write your goal for session 2 in the space provided. Make sure you apply the SMART goal principle

Specific__________________________________________________

Measurable________________________________________________

Attainable__________________________________________________

Relevant_____________________________________________________

Time_______________________________________________________

Step 2: What are the perceived obstacles to achieving your goal? You have maybe experienced this in the past, or can imagine experiencing it in the future. How can you overcome those obstacles? ___________________________________________________

Step 3: What tips from today will help you when you practice this goal at home or in the community? ___________________________________________________
Session 3: Performing activities in your wheelchair.

Session Timeline:
- Recap of navigating the physical environment outside of your home and in the community (20 mins)
- Goal setting (10 mins)
- Practice (40 mins)
- Final thoughts, home practice, and snack. (20 mins)

Items needed for Session 3:
- Pens, pencils, manuals
- Snacks

Discussion: Before we begin, let’s discuss how you integrated the skills learned from last session into your daily life. Where you able to practice the skills? Did you run into any challenges? How did you overcome the challenges?

Goal Setting:
Think about activities you perform when using your wheelchair… Are there any activities that you find really challenging?

Some examples of activities that you may perform in your wheelchair include, moving your wheelchair through a crowd of people, manage toileting activities in a public bathroom, or participating in leisure or recreational activities that you like. You may have other activities that you would like to work on, these are just some examples.

Step 1: Write your goal for session 3 in the space provided. Make sure you apply the SMART goal principle

Specific

Measurable

Attainable

Relevant

Time
**Step 2:** What are the perceived obstacles to achieving your goal? You have maybe experienced this in the past, or can imagine experiencing it in the future. How can you overcome those obstacles?

**Step 3:** What tips from today will help you when you practice this goal at home or in the community?
Session 4: Navigating the physical environment and performing activities in your wheelchair.

Session Timeline:
- Recap of performing activities in your wheelchair (20 mins)
- Goal setting (10 mins)
- Practice (40 mins)
- Final thoughts, home practice, and snack. (20 mins)

Items needed for Session 4:
- Pens, pencils, manuals
- Snacks

Discussion: Before we begin, let’s discuss how you integrated the skills learned from last session into your daily life. Where you able to practice the skills? Did you run into any challenges? How did you overcome the challenges?

Goal Setting:
Think about the goals you set over the past 3 sessions. Are there any other activities that you find challenging when using your wheelchair at home or in the community? Are there any other activities you find challenging to do in your wheelchair? This session is designed to allow you to continue to practice your goals. Or, if you have accomplished your goals, you can set a new one below...

Step 1: Write your goal for session 4 in the space provided. Make sure you apply the SMART goal principle
Specific_______________________________________________________________________
Measurable_______________________________________________________________________
Attainable_______________________________________________________________________
Relevant_______________________________________________________________________
Time_________________________________________________________________________
**Step 2:** What are the perceived obstacles to achieving your goal? You have maybe experienced this in the past, or can imagine experiencing it in the future. How can you overcome those obstacles?

**Step 3:** What tips from today will help you when you practice this goal at home or in the community?
Session 5: Knowledge, problem solving and advocating for yourself.

Session Timeline:
- Recap of navigating the physical environment and performing activities in your wheelchair (20 mins)
- Goal setting (10 mins)
- Practice (40 mins)
- Final thoughts, home practice, and snack. (20 mins)

Items needed for Session 5:
- Pens, pencils, manuals
- Snacks

Discussion: Before we begin, let’s discuss how you integrated the skills learned from last session into your daily life. Where you able to practice the skills? Did you run into any challenges? How did you overcome the challenges?

Goal Setting:
Think about situations in which you are challenged about your knowledge of your wheelchair, your problem solving abilities or your ability to advocate for yourself...

Can you recall a really challenging situation? What did you do to overcome this challenge?

Some examples of situations that you may find challenging include, knowing what to do if you fell out of your wheelchair, or advocating for your needs at work or at school, such as modifications to your office. You may have other activities that you would like to work on, these are just some examples.
**Step 1:** Write your goal for session 5 in the space provided. Make sure you apply the SMART goal principle
Specific______________________________________________________________
Measurable____________________________________________________________
Attainable____________________________________________________________
Relevant_______________________________________________________________
Time______________________________________________________________

**Step 2:** What are the perceived obstacles to achieving your goal? You have maybe experienced this in the past, or can imagine experiencing it in the future. How can you overcome those obstacles?______________________________________________________________

**Step 3:** What tips from today will help you when you practice this goal at home or in the community?______________________________________________________________
Session 6: Managing social situations and your emotions.

Session Timeline:
- Recap of knowledge, problem solving and advocating for yourself (20 mins)
- Goal setting (10 mins)
- Practice (40 mins)
- Final thoughts, home practice, and snack. (20 mins)

Items needed for Session 6:
- Pens, pencils, manuals
- Snacks

Discussion: Before we begin, let’s discuss how you integrated the skills learned from last session into your daily life. Where you able to practice the skills? Did you run into any challenges? How did you overcome the challenges?

Goal Setting:
Think about situations in which you are challenged to manage your emotions and manage social situations yourself...
Can you recall a really challenging situation? What did you do to overcome this challenge?

Some examples of situations that you may find challenging include, presenting yourself as you wish to be seen around peers and colleagues, figuring out how to negotiate an unusual physical obstacle, or continuing to move your wheelchair in situations that make you feel anxious or nervous. You may have other examples of situations that you find challenging, these are just some examples.
**Step 1:** Write your goal for session 6 in the space provided. Make sure you apply the SMART goal principle

Specific

Measurable

Attainable

Relevant

Time

**Step 2:** What are the perceived obstacles to achieving your goal? You have maybe experienced this in the past, or can imagine experiencing it in the future. How can you overcome those obstacles?

**Step 3:** What tips from today will help you when you practice this goal at home or in the community?

---

**Take Home Message**

“Man often becomes what he believes himself to be. If I keep on saying to myself that I cannot do a certain thing, it is possible that I may end by really becoming incapable of doing it. On the contrary, if I have the belief that I can do it, I shall surely acquire the capacity to do it even if I may not have it at the beginning.” - Mahatma Gandhi
Appendix K: Development of WheelSee

WheelSee

Self-efficacy Enhanced Wheelchair Training Program

- **Performance Mastery**: Individualized, task-specific practice of the skills required for self-identified goals. SMART goal setting and monitoring.
- **Facilitated by a peer trainer in groups of 4. Practice in partners.**
- **Physiological Feedback**: Situational vignettes, sharing experiences, discussing normal physiological responses and how to re-evaluate symptoms.
- **Verbal Persuasion**: Family and friends are encouraged to attend. Positive verbal reinforcement from family, friends and peers is trained.
- **Dosage**: 6 community-based sessions, 1.5 hours, 2 x per week
<table>
<thead>
<tr>
<th>Enactive Mastery</th>
<th>Vicarious Learning</th>
<th>Verbal Persuasion</th>
<th>Emotional arousal</th>
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<tbody>
<tr>
<td>Wheelchair skills training</td>
<td>Peer trainers (role models)</td>
<td>Encouragement</td>
<td>Address feelings of anxiety and stress as they arise</td>
</tr>
<tr>
<td>Goal setting</td>
<td>Training with a partner</td>
<td>Motivating feedback</td>
<td>Discuss physiological responses during practice</td>
</tr>
<tr>
<td>Review and progression of goals</td>
<td>Self-modeling</td>
<td>Positive self talk</td>
<td>Peers helps to re-interpret and explain symptoms</td>
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<tr>
<td>Recall of successes</td>
<td>Attention to successful performances (of self and others)</td>
<td>Compliments on progress</td>
<td>Explain impact of positive and negative moods and how that affects self-efficacy judgement</td>
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<tr>
<td>Role playing</td>
<td>Sharing experiences</td>
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<tr>
<td>Brainstorming</td>
<td>Education on community resources, support, and opportunities</td>
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<tr>
<td>Practice</td>
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<tr>
<td>Identifying challenging situations</td>
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Self-Efficacy Enhanced Wheelchair Training

Participant Manual

Self-efficacy is another way to say confidence. Having the confidence to do something is more important than having the actual skill. There are probably some activities that you encounter on a regular basis that challenge your confidence when using your wheelchair. If your confidence is low, you may avoid these activities all together. WheelSee can help!

Did you know?

- Many people experience low confidence when using their wheelchair.
- Low confidence using a wheelchair may limit mobility and participation in important activities.

Think back to when you learned how to ride a bike... or drive a car. It seems as though The Wheels of Life sometimes challenge our confidence the most. But, once you acquire the skills and the confidence, it becomes second nature... just like using your wheelchair!
The purpose of WheelSee is to help you identify specific situations that you feel challenge your confidence when using your wheelchair. We will provide you with strategies to overcome some of those challenges and teach you skills to overcome other challenging situations that you may face.

To start, I propose that we make a slight change to The Wheels of Life:
## WheelSee Overview

<table>
<thead>
<tr>
<th>Session 1</th>
<th>Session 2</th>
<th>Session 3</th>
<th>Session 4</th>
<th>Session 5</th>
<th>Session 6</th>
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</thead>
<tbody>
<tr>
<td>- Introductions and ‘get to know you’ icebreaker.</td>
<td>- Group discussion (revisit goals from previous session), review progress, identify new goals.</td>
<td>- Group discussion (revisit goals from previous session), review progress, identify new goals.</td>
<td>- Group discussion (revisit goals from previous session), review progress, identify new goals.</td>
<td>- Group discussion (revisit goals from previous session), review progress, identify new goals.</td>
<td>- Group discussion: revisit goals from previous session, review progress, identify new goals.</td>
</tr>
<tr>
<td>- Group discussion and goal setting</td>
<td>- Skills for improving your confidence to <strong>navigate the physical environment</strong></td>
<td>- Skills for improving your confidence to <strong>navigate the physical environment</strong></td>
<td>- Skills for improving your confidence to <strong>navigate the physical environment</strong> and <strong>perform activities in your wheelchair</strong></td>
<td></td>
<td>- Skills for <strong>improving knowledge and problem solving</strong> and for <strong>advocating for yourself</strong>.</td>
</tr>
<tr>
<td>- Skills for improving your confidence to <strong>navigate the physical environment</strong></td>
<td>- Group discussion: confirm goals to be practiced during the week. Break goal into steps.</td>
<td>- Group discussion: make new goal (or continue with steps of previous goal) and confirm goal to be practiced during the week</td>
<td>- Group discussion: make new goal (or continue with steps of previous goal) and confirm goal to be practiced during the week</td>
<td></td>
<td>- Skills for <strong>improving confidence in social situations</strong> and <strong>managing emotions</strong></td>
</tr>
<tr>
<td>- Group discussion: confirm goals to be practiced during the week. Break goal into steps.</td>
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<td></td>
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<td></td>
<td>- Summary of WheelSee, plan to continue with goal setting if needed, contact information exchange</td>
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Goal Setting

Setting SMART goals is fundamental to success, regardless of whether the outcomes are related to personal life, work, education, or rehabilitation. WheelSee focuses on goals that you have identified that are meaningful to you, with regard to participating in desired activities in your home or in the community. We will be using the goal setting methods of Scobbie and colleagues (2009), which means we will ask you to write your goals in this manual, discuss your goals with the group, break your goals into attainable steps, and help others do the same. We will monitor your successes and challenges, and you will provide and receive feedback from our peer-trainers and others in the group.

Can you recall the two goals that you selected during the initial testing that you did? If not, you can write new goals here. These goals will be your overall goals for the program.

Goal at home: ____________________________________________________________

Goal in the community: _________________________________________________

We are now going to make these goals into SMART goal, that is, Specific, Measurable, Attainable, Relevant and Time-based goals.

| Specific: Can your goal be broken into smaller steps? What will be achieved? Why is the goal important? |
| Measurable: How will you measure your goal? (e.g. Pass/fail, frequency the activity is completed in a day/week/month, how long it takes, how fatigued you feel afterwards.) |
| Attainable: You must believe that you can manage to do what you are setting out to do. You set your own standards by understanding your own abilities, strengths and weaknesses. |
| Relevant (and Realistic): Your goals must be relevant to what you want to achieve and you must consider what is realistic to achieve in the the short term and the long term. |
Smart goal at home

Specific

Measurable

Attainable

Relevant

Time___

Smart goal in the community

Specific

Measurable

Attainable

Relevant

Time___

During each session reflect on your 2 main goals. Try to choose your individual session goals to enhance the outcomes of your overall goals.
Think about activities you do inside using your manual wheelchair... are there any activities that you find really challenging? Are there any activities that you think we could help to improve your confidence?

Some examples of activities that you may do inside include, moving your wheelchair over carpet, transferring from your wheelchair to another surface, or make a hot meal and carry it to the table safely. You may have other activities that you would like to work on, these are just some examples.

<table>
<thead>
<tr>
<th>Step 1: Choose a personal goal for navigating the physical environment and write it in the space provided.</th>
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<tr>
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<table>
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<tr>
<th>Step 2: Can this goal be broken into smaller steps? Write down 2-3 steps to make this goal more achievable.</th>
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<td>3_____________________________________________________________________________________________</td>
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</tbody>
</table>
Step 3: Are there perceived obstacles to your goals? How can you overcome those obstacles?

**Obstacle 1**

______________________________________________________________________

Overcoming Obstacle 1

______________________________________________________________________

______________________________________________________________________

______________________________________________________________________

**Obstacle 2**

______________________________________________________________________

Overcoming Obstacle 2

______________________________________________________________________

______________________________________________________________________

______________________________________________________________________

**Obstacle 3**

______________________________________________________________________

Overcoming Obstacle 3

______________________________________________________________________

______________________________________________________________________

______________________________________________________________________
Step 4: What are some ways that you can practice this goal at home or in the community? Write them down in the space provided. Step 4 will form your take-home goals to practice during the week.

______________________________________________________________________

______________________________________________________________________

______________________________________________________________________

______________________________________________________________________

______________________________________________________________________

Step 5: Track your successes and challenges over the next few days to share with WheelSee.

______________________________________________________________________

______________________________________________________________________

______________________________________________________________________

______________________________________________________________________

______________________________________________________________________

______________________________________________________________________
Recap your goals and progress from Session 1. Share your progress that you made at home with the group. What is your goal for Session 2?

Now, you can continue to work on your Session 1 goals...

OR

You can choose another personal goal from ‘Navigating the physical environment in your wheelchair (outside)’.

Think about activities you do outside using your manual wheelchair… are there any activities that you find really challenging? Are there any activities that you think we could help to improve your confidence?

Some examples of activities that you may do outside include, moving your wheelchair up or down a steep ramp, moving your wheelchair up or down a curb, or crossing a street light with or without traffic lights. You may have other activities that you would like to work on, these are just some examples.
Appendix M: Participant Information Form

Date: ___________________ Subject No: ________________

Demographics

Age: (in years ) __________
Primary language: ______________
Sex: ❑ Male ❑ Female
Marital Status: ❑ Married ❑ Common Law ❑ Separated ❑ Widowed ❑ Divorced ❑ Single
Education: ❑ Less than high school ❑ High school ❑ College ❑ University ❑ Graduate studies ❑ Post graduate studies

Income: ❑ Less than $14,999/year ❑ $15,000-$29,999/year ❑ $30,000-$49,999/year ❑ $50,000-$74,999/year ❑ $75,000-$99,000/year ❑ $100,000+/year

Background Information

Primary reason for using a wheelchair: ________________________________
Secondary Diagnoses: ________________________________

Have you used your current wheelchair for a period of 6 weeks or greater?
❑ Yes  ❑ No

How long using any wheelchair? __________ How long using this wheelchair? __________

Do you use your wheelchair daily?
❑ Yes  ❑ No
How many hours per day do you spend in your wheelchair?
□ < 2 hours □ 2-5 hours □ 5-8 hours □ > 8 hours

Where do you use your wheelchair?
□ home □ work □ recreation or sports □ work □ school □ community (restaurants/shopping)
□ other________________

How do you propel your wheelchair?
□ two hands □ two feet □ one hand ______ □ one foot_______
□ one hand, one foot_______ □ two hands, two feet □ other ____________

Have you had any accidents while using your manual wheelchair in the past year? □ Yes □ No
If yes, how many accidents have you had in the past year?
□ 1 □ 2 □ 3+
Did any of these accidents result in you requiring medical attention? □ Yes □ No

Have you ever taken part in a wheelchair skills training program?
□ Yes If so, where?_________________ When? _________________

Can you briefly describe the program that you took part in? ______________________________

□ No
## Appendix N: Wheelchair Specification Form

![Wheelchair Specification Form](image)

### Manufacture:
- Invacare
- Quickie
- Pride
- Permobil
- Other (specify)

### Model name:

### Serial #:

### Frame:
- **Power:**
  - Front
  - Mid
  - Rear wheel
- **Manual:**
  - Folding
  - Rigid
- **Power:**
  - Tilt
  - Recline
- **Manual:**
  - Tilt
  - Recline
- **Other:**

### Armrests:
- Full length
- Desk length
- Adjustable height
- Other:

### Brake Extensions:
- L
- R

### Anti-tippers:
- Present
- Not present

### Headrest:
- **Type:**
- **Size:**
- **Hardware:**

### Size:
- 16’wide x 16’deep
- 16’wide x 18’deep
- 18’wide x 16’deep
- 18’wide x 18’deep
- Other: __________ wide x __________ deep

### Height:
- Front seat height __________

### Seat:
- Sling
- Pan
- Dropbase
- StumpRest
- Cushion rigidizer

### Cushion:
- **Size:** __________ x __________
- **Type:**

### Back:
- **Size:** __________
- **Type:**

### Front rigging:
- L
- R
- None
- Hanger angle (measured down from seat rails):
  - 60°
  - 70°
  - 90°
  - Elevating
- Other __________
- Adjustable angle footplates

### Accessories:
- Full lap tray
- Half lap tray:
  - L
  - R
- Arm trough:
  - L
  - R
- Please describe:
- Positioning belt
- **Type:**
- **Weight:** __________ kg

### Power Controls:
- Joystick:
  - L
  - R
- Drives:
  - L
  - R
- On/off:

### Comments/other features:

Note: Where features are bilateral, it will be assumed that the left and right sides are symmetrical unless otherwise stated.
Appendix O: Hospital Anxiety and Depression Scale (HADS)

Date: ___________________  Subject No: _____________

This questionnaire is designed to help us know how you feel. Read each item and circle the number corresponding to the response that comes closest to how you have been feeling in the past week. Don’t take too long over your replies. Your immediate reaction to each item will probably be more accurate than a long thought out response. The questions relating to anxiety are marked "A", and to depression "D". You do not have to answer any question that you do not feel comfortable answering.

<table>
<thead>
<tr>
<th>A</th>
<th>I feel tense or 'wound up':</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Most of the time</td>
</tr>
<tr>
<td></td>
<td>A lot of the time</td>
</tr>
<tr>
<td></td>
<td>From time to time, occasionally</td>
</tr>
<tr>
<td></td>
<td>Not at all</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>D</th>
<th>I still enjoy the things I used to enjoy:</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Definitely as much</td>
</tr>
<tr>
<td></td>
<td>Not quite so much</td>
</tr>
<tr>
<td></td>
<td>Only a little</td>
</tr>
<tr>
<td></td>
<td>Hardly at all</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>A</th>
<th>I get a sort of frightened feeling as if something awful is about to happen:</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Very definitely and quite badly</td>
</tr>
<tr>
<td></td>
<td>Yes, but not too badly</td>
</tr>
<tr>
<td></td>
<td>A little, but it doesn't worry me</td>
</tr>
<tr>
<td></td>
<td>Not at all</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>D</th>
<th>I can laugh and see the funny side of things:</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>As much as I always could</td>
</tr>
<tr>
<td></td>
<td>Not quite so much now</td>
</tr>
<tr>
<td></td>
<td>Definitely not so much now</td>
</tr>
<tr>
<td></td>
<td>Not at all</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>A</th>
<th>Worrying thoughts go through my mind:</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>A great deal of the time</td>
</tr>
<tr>
<td></td>
<td>A lot of the time</td>
</tr>
<tr>
<td></td>
<td>From time to time, but not too often</td>
</tr>
<tr>
<td></td>
<td>Only occasionally</td>
</tr>
<tr>
<td>I feel cheerful:</td>
<td></td>
</tr>
<tr>
<td>------------------</td>
<td></td>
</tr>
<tr>
<td>Not at all</td>
<td>3</td>
</tr>
<tr>
<td>Not often</td>
<td>2</td>
</tr>
<tr>
<td>Sometimes</td>
<td>1</td>
</tr>
<tr>
<td>Most of the time</td>
<td>0</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>I can sit at ease and feel relaxed:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Definitely</td>
</tr>
<tr>
<td>Usually</td>
</tr>
<tr>
<td>Not Often</td>
</tr>
<tr>
<td>Not at all</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>I feel as if I am slowed down:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nearly all the time</td>
</tr>
<tr>
<td>Very often</td>
</tr>
<tr>
<td>Sometimes</td>
</tr>
<tr>
<td>Not at all</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>I get a sort of frightened feeling like 'butterflies' in the stomach:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Not at all</td>
</tr>
<tr>
<td>Occasionally</td>
</tr>
<tr>
<td>Quite Often</td>
</tr>
<tr>
<td>Very Often</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>I have lost interest in my appearance:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Definitely</td>
</tr>
<tr>
<td>I don't take as much care as I should</td>
</tr>
<tr>
<td>I may not take quite as much care</td>
</tr>
<tr>
<td>I take just as much care as ever</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>I feel restless as I have to be on the move:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Very much indeed</td>
</tr>
<tr>
<td>Quite a lot</td>
</tr>
<tr>
<td>Not very much</td>
</tr>
<tr>
<td>Not at all</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>I look forward with enjoyment to things:</th>
</tr>
</thead>
<tbody>
<tr>
<td>As much as I ever did</td>
</tr>
<tr>
<td>Rather less than I used to</td>
</tr>
<tr>
<td>Definitely less than I used to</td>
</tr>
<tr>
<td>Hardly at all</td>
</tr>
<tr>
<td>A</td>
</tr>
<tr>
<td>---</td>
</tr>
<tr>
<td>Very often indeed</td>
</tr>
<tr>
<td>Quite often</td>
</tr>
<tr>
<td>Not very often</td>
</tr>
<tr>
<td>Not at all</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>D</th>
<th><strong>I can enjoy a good book or radio or TV program:</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>Often</td>
<td>0</td>
</tr>
<tr>
<td>Sometimes</td>
<td>1</td>
</tr>
<tr>
<td>Not often</td>
<td>2</td>
</tr>
<tr>
<td>Very seldom</td>
<td>3</td>
</tr>
</tbody>
</table>
Appendix P: Interpersonal Support and Evaluation List (ISEL)

This scale is made up of a list of statements each of which may or may not be true about you. For each statement check "definitely true" if you are sure it is true about you and "probably true" if you think it is true but you are not absolutely certain. Similarly, you should check "definitely false" if you are sure the statement is false and "probably false" if you think it is false but are not absolutely certain. You do not have to answer any question that you do not feel comfortable answering.

<table>
<thead>
<tr>
<th></th>
<th>definitely true</th>
<th>probably true</th>
<th>probably false</th>
<th>definitely false</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. When I feel lonely, there are several people I can talk to.</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>2. I often meet or talk with family or friends.</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>3. If I were sick, I could easily find someone to help me with my daily activities.</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>4. When I need suggestions on how to deal with a personal problem, I know someone I can turn to.</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>5. If I had to go out of town for a few weeks, it would be difficult to find someone who would look after my house or apartment (the plants, pets, garden, etc.).</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>6. There is at least one person I know whose advice I really trust.</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
</tr>
</tbody>
</table>
### Appendix Q: Measurement properties of the clinical outcome measures.

<table>
<thead>
<tr>
<th>Measure</th>
<th>Reliability</th>
<th>Validity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wheelchair Use Confidence Scale (WheelCon)</td>
<td>Cronbach’s α = 0.92</td>
<td><strong>Construct validity</strong></td>
</tr>
<tr>
<td>(Rushton et al., 2013)</td>
<td>ICC test-retest = 0.84</td>
<td>WheelCon significant Spearman r&lt;sub&gt;s&lt;/sub&gt; with:</td>
</tr>
<tr>
<td></td>
<td>SEM = 5.9</td>
<td>Previous WC experience = 0.32</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Age x sex interaction (p = 0.004)</td>
</tr>
<tr>
<td></td>
<td></td>
<td><strong>Concurrent validity</strong></td>
</tr>
<tr>
<td></td>
<td></td>
<td>WheelCon significant Spearman r&lt;sub&gt;s&lt;/sub&gt; with:</td>
</tr>
<tr>
<td></td>
<td></td>
<td>wheelchair skill = 0.52</td>
</tr>
<tr>
<td></td>
<td></td>
<td>perceived wheelchair skill = 0.58</td>
</tr>
<tr>
<td></td>
<td></td>
<td>activities of daily living = 0.32</td>
</tr>
<tr>
<td></td>
<td></td>
<td>anxiety and depression = -0.43</td>
</tr>
<tr>
<td></td>
<td></td>
<td>mobility = 0.38</td>
</tr>
<tr>
<td></td>
<td></td>
<td>social support = 0.21</td>
</tr>
<tr>
<td>Wheelchair Skills Test - Questionnaire (WST-Q)</td>
<td>Wheelchair skills Capacity</td>
<td>Correlation between WST* and WST-Q was ρ = 0.89 (p&lt;0.001).</td>
</tr>
<tr>
<td>(Rushton et al., 2012)</td>
<td></td>
<td>WST-Q scores were 3.5±6.5% higher than WST scores.</td>
</tr>
<tr>
<td>*Wheelchair Skills Test (WST)</td>
<td>¹ICC interrater = 0.86</td>
<td><strong>Construct validity</strong></td>
</tr>
<tr>
<td>¹Lindquist et al., 2010; ²Lemay et al., 2012;</td>
<td>¹ICC intrarater = 0.95</td>
<td>WST significant Pearson r with:</td>
</tr>
<tr>
<td>³Phang et al., 2012, ⁴Kirby et al., 2004a;</td>
<td>¹ICC test-retest = 0.91</td>
<td>²age = -0.32</td>
</tr>
<tr>
<td>⁵Hosseini et al., 2012; ⁶Kirby et al., 2002</td>
<td></td>
<td>²distance wheeled per day = 0.36</td>
</tr>
<tr>
<td></td>
<td></td>
<td>³maximum velocity = 0.72</td>
</tr>
<tr>
<td></td>
<td></td>
<td>³spontaneous velocity = 0.57</td>
</tr>
<tr>
<td></td>
<td></td>
<td>WST has significant associations with:</td>
</tr>
<tr>
<td></td>
<td></td>
<td>⁴experience p = 0.01</td>
</tr>
<tr>
<td></td>
<td></td>
<td>⁴sex p = 0.001</td>
</tr>
<tr>
<td></td>
<td></td>
<td>⁴diagnosis p&lt; 0.05</td>
</tr>
<tr>
<td></td>
<td></td>
<td>⁴wheelchair type p&lt; 0.001</td>
</tr>
<tr>
<td></td>
<td></td>
<td>⁵Predictive validity</td>
</tr>
<tr>
<td></td>
<td></td>
<td>WST predicted CHART score, perceived health status, and satisfaction with life scale in linear regression (p&lt; 0.05).</td>
</tr>
<tr>
<td></td>
<td></td>
<td>⁶Concurrent validity</td>
</tr>
<tr>
<td></td>
<td></td>
<td>WST Pearson r with occupational therapists global rating of WC skills (r = 0.40 – 0.54).</td>
</tr>
<tr>
<td>Measure</td>
<td>Reliability</td>
<td>Validity</td>
</tr>
<tr>
<td>-------------------------------</td>
<td>--------------------------------------------------</td>
<td>--------------------------------------------------------------------------</td>
</tr>
<tr>
<td>Life-Space Assessment (LSA)</td>
<td>ICC&lt;sub&gt;test-retest&lt;/sub&gt; = 0.87&lt;sup&gt;1&lt;/sup&gt;</td>
<td>1&lt;sup&gt;Concurrent validity&lt;/sup&gt;</td>
</tr>
<tr>
<td></td>
<td></td>
<td>LSA significant Spearman r&lt;sub&gt;s&lt;/sub&gt; with:</td>
</tr>
<tr>
<td></td>
<td></td>
<td>physical performance = 0.19 - 0.60</td>
</tr>
<tr>
<td></td>
<td></td>
<td>ADL difficulty = 0.25 - 0.43</td>
</tr>
<tr>
<td></td>
<td></td>
<td>SF12 physical = 0.31 - 0.46</td>
</tr>
<tr>
<td></td>
<td></td>
<td>SF12 mental = 0.12 - 0.25</td>
</tr>
<tr>
<td></td>
<td></td>
<td>depression = 0.17 - 0.41</td>
</tr>
<tr>
<td></td>
<td></td>
<td>perceived health = 0.27 - 0.42</td>
</tr>
<tr>
<td></td>
<td></td>
<td>2&lt;sup&gt;Construct validity&lt;/sup&gt;</td>
</tr>
<tr>
<td></td>
<td></td>
<td>WheelCon significant Spearman r&lt;sub&gt;s&lt;/sub&gt; with:</td>
</tr>
<tr>
<td></td>
<td></td>
<td>age = -0.22</td>
</tr>
<tr>
<td></td>
<td></td>
<td>sex = -0.21</td>
</tr>
<tr>
<td></td>
<td></td>
<td>walking = -0.33</td>
</tr>
<tr>
<td></td>
<td></td>
<td>device type</td>
</tr>
<tr>
<td></td>
<td></td>
<td>drives a vehicle = 0.28</td>
</tr>
<tr>
<td>Wheelchair Outcome Measure (WhOM)</td>
<td>ICC&lt;sub&gt;interrater&lt;/sub&gt; = 0.90 - 0.91  ICC&lt;sub&gt;test-retest&lt;/sub&gt; = 0.83 - 0.88</td>
<td>2&lt;sup&gt;Construct validity&lt;/sup&gt;</td>
</tr>
<tr>
<td>(Miller et al., 2011)</td>
<td></td>
<td>WhOM significant Spearman ρ with:</td>
</tr>
<tr>
<td></td>
<td></td>
<td>life habits ρ = 0.3 -0.5</td>
</tr>
</tbody>
</table>
Appendix R: Wheelchair Use Confidence Scale for Manual Wheelchair Users

(WheelCon-M, version 3.0)

Subject #: ___________ Date: ___________ Circle: Time 1 / Time 2

Instructions: A number of situations are described below that can challenge confidence when using a manual wheelchair. Please rate how confident you are as of now for each of the situations described using the following scale:

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

For example, a person may be 82% confident they can memorize a grocery list of 5 items, but only 63% confident they can memorize a grocery list with 10 items.

For items requiring physical ability, rate your confidence in performing the activity in a safe manner. For this assessment, confidence refers to your belief in your ability to perform each item independently.

Answer all items even if it is not a situation you would normally experience. If you have never experienced the situation, please rate your confidence as if you had to safely attempt it today.

Some questions include measurement, such as 5cm. Please refer to the ruler on the last page of this assessment if you are uncertain about these measurements.
<table>
<thead>
<tr>
<th></th>
<th>As of now, how confident are you that you:</th>
<th>Confidence (0-100)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>can move your wheelchair over carpet?</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>can move your wheelchair around furniture in your own home?</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>can move your wheelchair over thresholds, such as between rooms?</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>can manoeuvre your wheelchair in small spaces, such as a bathroom?</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>can transfer from your wheelchair to your bed?</td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>can transfer from your wheelchair to your toilet?</td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>can transfer from your wheelchair into your bathtub (including use of bathseats) OR using your commode to get into your shower stall?</td>
<td></td>
</tr>
<tr>
<td>8</td>
<td>can transfer from the floor to your wheelchair by yourself?</td>
<td></td>
</tr>
<tr>
<td>9</td>
<td>can transfer from your wheelchair to your vehicle?</td>
<td></td>
</tr>
<tr>
<td>10</td>
<td>can make a light meal while using your wheelchair?</td>
<td></td>
</tr>
<tr>
<td>11</td>
<td>can carry a hot drink while moving in your wheelchair?</td>
<td></td>
</tr>
<tr>
<td>12</td>
<td>can move your wheelchair through a door that opens automatically?</td>
<td></td>
</tr>
<tr>
<td>13</td>
<td>can open, go through, and then close a standard 81cm (32”) lightweight door?</td>
<td></td>
</tr>
<tr>
<td>14</td>
<td>can open and go through a spring loaded door, such as a door at your local mall?</td>
<td></td>
</tr>
<tr>
<td>15</td>
<td>can move your wheelchair <strong>up</strong> a standard ramp, built to code (5° incline)?</td>
<td></td>
</tr>
<tr>
<td>16</td>
<td>can move your wheelchair <strong>down</strong> a standard ramp, built to code (5° incline)?</td>
<td></td>
</tr>
<tr>
<td></td>
<td>As of now, how confident are you that you:</td>
<td>Confidence (0-100)</td>
</tr>
<tr>
<td>---</td>
<td>---------------------------------------------------------------------------------------------------------</td>
<td>-------------------</td>
</tr>
<tr>
<td>17</td>
<td>can move your wheelchair <strong>up</strong> a dry steep slope (&gt; 5° incline)?</td>
<td></td>
</tr>
<tr>
<td>18</td>
<td>can move your wheelchair <strong>down</strong> a dry steep slope (&gt; 5° incline)?</td>
<td></td>
</tr>
<tr>
<td>19</td>
<td>can move your wheelchair <strong>down</strong> a dry steep slope (&gt; 5° incline) and stopping <strong>as soon as</strong> you are off the slope?</td>
<td></td>
</tr>
<tr>
<td>20</td>
<td>can move your wheelchair <strong>up</strong> a curb cut?</td>
<td></td>
</tr>
<tr>
<td>21</td>
<td>can move your wheelchair <strong>down</strong> a curb cut?</td>
<td></td>
</tr>
<tr>
<td>22</td>
<td>can move your wheelchair over a drainage grate and then up a curb cut?</td>
<td></td>
</tr>
<tr>
<td>23</td>
<td>can move your wheelchair <strong>down</strong> a curb cut then over a drainage grate?</td>
<td></td>
</tr>
<tr>
<td>24</td>
<td>can move your wheelchair through a puddle then up a curb cut?</td>
<td></td>
</tr>
<tr>
<td>25</td>
<td>can move your wheelchair <strong>down</strong> a curb cut then through a puddle?</td>
<td></td>
</tr>
<tr>
<td>26</td>
<td>can move your wheelchair through slush then up a curb cut?</td>
<td></td>
</tr>
<tr>
<td>27</td>
<td>can move your wheelchair <strong>down</strong> a curb cut then through slush?</td>
<td></td>
</tr>
<tr>
<td>28</td>
<td>can move your wheelchair <strong>down</strong> a curb cut then through 5cm (2”) snow?</td>
<td></td>
</tr>
<tr>
<td>29</td>
<td>can move your wheelchair through 5cm (2”) snow then up a curb cut?</td>
<td></td>
</tr>
<tr>
<td>30</td>
<td>can move your wheelchair <strong>up</strong> a standard height curb 15cm (6”) without a curb cut?</td>
<td></td>
</tr>
<tr>
<td>31</td>
<td>can move your wheelchair <strong>down</strong> a standard height curb 15cm (6”) without a curb cut?</td>
<td></td>
</tr>
<tr>
<td>32</td>
<td>can manoeuvre your wheelchair to press the crosswalk button and cross the street before the traffic light changes?</td>
<td></td>
</tr>
<tr>
<td>Question</td>
<td>Confidence (0-100)</td>
<td></td>
</tr>
<tr>
<td>------------------------------------------------------------------------</td>
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<td></td>
</tr>
<tr>
<td>As of now, how confident are you that you:</td>
<td></td>
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</tr>
<tr>
<td>33) can cross a street with light traffic at a crosswalk with no traffic lights?</td>
<td></td>
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<tr>
<td>34) can move your wheelchair across 3m (10ft) of flat, freshly mowed, dry grass?</td>
<td></td>
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</tr>
<tr>
<td>35) can move your wheelchair through a pothole that is wider than your wheelchair and 5cm (2”) deep?</td>
<td></td>
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</tr>
<tr>
<td>36) can move your wheelchair along a paved sidewalk that is cracked and uneven?</td>
<td></td>
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<tr>
<td>37) can move your wheelchair along a flat dirt path or trail with some tree roots and rocks?</td>
<td></td>
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</tr>
<tr>
<td>38) can move your wheelchair across 3m (10ft) of flat, unpacked gravel?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>39) can move your wheelchair along a sidewalk with 5cm (2”) of snow?</td>
<td></td>
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</tr>
<tr>
<td>40) can move your wheelchair through a crowd of people without hitting anyone?</td>
<td></td>
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</tr>
<tr>
<td>41) can ask people to move out of your way while moving in your wheelchair?</td>
<td></td>
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</tr>
<tr>
<td>42) can move your wheelchair down a store aisle that has just enough room for your wheelchair without knocking items over?</td>
<td></td>
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</tr>
<tr>
<td>43) can manage all toileting activities while in an accessible public bathroom?</td>
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</tr>
<tr>
<td>44) can use public transportation in your town?</td>
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</tr>
<tr>
<td>45) can do your chosen leisure activities in your manual wheelchair?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>46) can transport items in a backpack that is on the back of your wheelchair?</td>
<td></td>
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</tr>
<tr>
<td>47) can use strategies, such as humour, that will help people feel comfortable if they are unsure how to act because you use a wheelchair?</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>As of now, how confident are you that you:</strong></td>
<td><strong>Confidence (0-100)</strong></td>
<td></td>
</tr>
<tr>
<td>---------------------------------------------</td>
<td>------------------------</td>
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</tr>
<tr>
<td>48) can correct others’ mistaken beliefs about people who use wheelchairs?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>49) can present yourself as you wish to be seen while in your wheelchair around acquaintances, colleagues, or peers?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>50) can present yourself as you wish to be seen while in your wheelchair when you are in public and feel people are watching you?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>51) can present yourself as you wish to be seen while in your wheelchair when you want to impress others, such as during a job interview?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>52) can problem solve how to get to your destination when there is an unexpected situation, such as construction detours on a sidewalk?</td>
<td></td>
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<tr>
<td>53) can figure out how to negotiate a challenging, and unusual physical obstacle?</td>
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</tr>
<tr>
<td>54) can continue to move your wheelchair in a situation that is making you feel anxious or nervous?</td>
<td></td>
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</tr>
<tr>
<td>55) know when your wheelchair is not working properly?</td>
<td></td>
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</tr>
<tr>
<td>56) know what <em>your</em> wheelchair can and can’t do, separate from your own abilities? For example, a wheelchair can go down stairs but many individuals do not go down stairs with their wheelchair due to their inability to do so.</td>
<td></td>
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</tr>
<tr>
<td>57) can tell someone how to move your wheelchair if it gets stuck?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>58) can ask someone for help?</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
As of now, how confident are you that you:

<table>
<thead>
<tr>
<th></th>
<th>Confidence (0-100)</th>
</tr>
</thead>
<tbody>
<tr>
<td>59) can tell a cab driver how to fold/unfold your wheelchair, making sure all parts are taken off and put back on properly?</td>
<td></td>
</tr>
<tr>
<td>60) can tell a stranger how to help you safely get back into your wheelchair if you tip over?</td>
<td></td>
</tr>
<tr>
<td>61) know what to do if you fall out of your wheelchair?</td>
<td></td>
</tr>
<tr>
<td>62) can advocate for changes you want made to your wheelchair, such as a different cushion to be more comfortable?</td>
<td></td>
</tr>
<tr>
<td>63) can advocate for changes you want in your home, such as doorways widened or a ramp installed?</td>
<td></td>
</tr>
<tr>
<td>64) can advocate for your needs at work or school, such as modifications in the bathroom?</td>
<td></td>
</tr>
<tr>
<td>65) can advocate for changes in your community, such as having a curb cut added in your neighborhood to improve your accessibility?</td>
<td></td>
</tr>
</tbody>
</table>

Measurement Scale 0-5 cm

0 cm    3 cm    5 cm
Appendix S: Manual Wheelchairs Operated by Their Users

Name of wheelchair user: ______________________________ Circle: Time 1 / Time 2

Name of proxy (if any): ______________________________

Date (MM/DD/YY): ______________________________

Manner of administration:
○ Tester administered: in-person _____ by phone _____

Notes:
○ Testers should refer to the WST 4.1 Manual (www.wheelchairskillsprogram.ca/eng/testers.php) for details about the WST.
○ The tester should have an understanding about the characteristics of the wheelchair prior to beginning the WST-Q. This will permit the tester to score “no part” for questions related to features (e.g. whether the wheelchair folds) that the wheelchair does not have.
○ If a test subject is unclear about the meaning of the question, the tester may repeat the question or re-phrase it.

Introductory Remarks by Tester to Test Subject
○ For about the next 10 minutes, I will be asking you questions about a number of different skills that you might perform in your wheelchair.
○ If you don’t understand the question, please feel free to ask for clarification.
○ If you have more than one wheelchair, please remember that it is your manual wheelchair that I will be asking about.
○ For each skill, I will ask you if you can do the skill. If the answer is ‘yes’, I will also ask you if you have actually used this skill in the past month.
○ It is not expected that you will be able to perform every skill or that you will use the skills.
○ When I ask you these questions about each skill, what I want to understand is if you can do the skill successfully, consistently, without any help and safely.
○ Regarding safety, we consider a skill to be unsafe if you injured yourself while performing it or if you required someone else to prevent you from being injured.
○ In addition to answering ‘yes’ or ‘no’ to each question, please feel free to explain or comment on your answer.
○ Do you have any general questions now, before we begin?
○ Okay, let’s begin.
Specific Skills

Score with a ✔️ or a Y for ‘yes’, an X or an N for ‘no’, NP for ‘no part’ or TE for ‘testing error’.

<table>
<thead>
<tr>
<th>Questions</th>
<th>Capacity</th>
<th>Performance</th>
<th>Comment</th>
</tr>
</thead>
<tbody>
<tr>
<td>(C = Capacity, P = Performance)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1C. Can you make your manual wheelchair go straight <strong>forward</strong> on a smooth level surface for a distance of about 10 times the length of your wheelchair?</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1P. Have you done this in the past month?</td>
<td></td>
<td></td>
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</tr>
<tr>
<td>2C. Can you move your manual wheelchair this far in the time it would take to <strong>count to 30</strong>?</td>
<td></td>
<td></td>
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</tr>
<tr>
<td>2P. Have you done this in the past month?</td>
<td></td>
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</tr>
<tr>
<td>3C. Can you make your manual wheelchair go straight <strong>backward</strong> for a distance of about 5 times the length of your wheelchair?</td>
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</tr>
<tr>
<td>3P. Have you done this in the past month?</td>
<td></td>
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</tr>
<tr>
<td>4C. When moving your manual wheelchair <strong>forward</strong>, can you make it <strong>turn around a corner</strong>? Can you do this to the left and right?</td>
<td></td>
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</tr>
<tr>
<td>4P. Have you done this in the past month?</td>
<td></td>
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</tr>
<tr>
<td>5C. When moving your manual wheelchair <strong>backward</strong>, can you make it turn around a corner? Can you do this to the left and right?</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5P. Have you done this in the past month?</td>
<td></td>
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</tr>
<tr>
<td>6C. Imagine that you find yourself in a tight space, with only about an arm’s length of extra space around your manual wheelchair in all directions. When that is the case, can you <strong>turn your wheelchair around</strong> so that it is facing in the opposite direction? Can you do this to the left and right?</td>
<td></td>
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</tr>
<tr>
<td>6P. Have you done this in the past month?</td>
<td></td>
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</tr>
<tr>
<td>7C. Imagine that you are sitting in your manual wheelchair with something (such as a window) about an arm’s length away on one side. If you have limited space in front of and behind you (about an arm’s length), can you move your wheelchair <strong>sideways</strong> next to that object? Can you then move the wheelchair back to its original position?</td>
<td></td>
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</tr>
<tr>
<td>7P. Have you done this in the past month?</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Questions</td>
<td>C</td>
<td>P</td>
<td>Comment</td>
</tr>
<tr>
<td>--------------------------------------------------------------------------</td>
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</tr>
<tr>
<td>8C. Imagine a <strong>door</strong> with a latch handle that swings open away from you without any resistance. Can you open such a door, use your manual wheelchair to go through it and then close the door behind you? Can you do this if the door opens toward you?</td>
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<tr>
<td>8P. Have you done this in the past month?</td>
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</tr>
<tr>
<td>9C. Imagine that you are sitting in your manual wheelchair and you need to <strong>reach up</strong> overhead for something (such as an elevator button) on the wall ahead of you. Can you maneuver your wheelchair and do that?</td>
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<tr>
<td>9P. Have you done this in the past month?</td>
<td></td>
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</tr>
<tr>
<td>10C. Imagine that you are sitting in your manual wheelchair and there is something (such as a paperback book) on the ground in front of your wheelchair that you want to <strong>pick up</strong>. Can you maneuver your wheelchair and do that?</td>
<td></td>
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<tr>
<td>10P. Have you done this in the past month?</td>
<td></td>
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</tr>
<tr>
<td>11C. Imagine that you wish to relieve the weight from your <strong>buttocks</strong> for several seconds, for comfort or to prevent skin sores. Can you do it yourself?</td>
<td></td>
<td></td>
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</tr>
<tr>
<td>11P. Have you done this in the past month?</td>
<td></td>
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</tr>
<tr>
<td>12C. Can you <strong>transfer</strong> from your manual wheelchair to another level surface (such as a bench or a bed) of about the same height as your wheelchair? Can you then get back into your wheelchair?</td>
<td></td>
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<td></td>
</tr>
<tr>
<td>12P. Have you done this in the past month?</td>
<td></td>
<td></td>
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</tr>
<tr>
<td>13C. Imagine that you wish to make your manual wheelchair as small as possible, for instance to put it in a car. Can you <strong>fold your wheelchair</strong> or break it down into its parts without tools? Can you then restore the wheelchair to its original condition?</td>
<td></td>
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</tr>
<tr>
<td>13P. Have you done this in the past month?</td>
<td></td>
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</tr>
<tr>
<td>14C. Can you make your manual wheelchair go straight forward on a smooth level surface for a <strong>distance</strong> that is about 100 times the length of your wheelchair (for instance in a long hallway or across a parking lot)?</td>
<td></td>
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</tr>
<tr>
<td>14P. Have you done this in the past month?</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Questions</td>
<td>C</td>
<td>P</td>
<td>Comment</td>
</tr>
<tr>
<td>--------------------------------------------------------------------------</td>
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</tr>
<tr>
<td>15C. While you are moving your manual wheelchair over this longer distance, imagine that someone is about to <strong>collide</strong> with you from one side. Can you avoid the collision? Can you avoid collisions from both the left and right?</td>
<td></td>
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</tr>
<tr>
<td>15P. Have you done this in the past month?</td>
<td></td>
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</tr>
<tr>
<td>16C. Imagine that you are at the bottom of a moderately steep <strong>incline</strong> that is about 3 times the length of your wheelchair and that there are no handrails. Can you move your manual wheelchair <strong>up</strong> the incline?</td>
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<tr>
<td>16P. Have you done this in the past month?</td>
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<tr>
<td>17C. Can you get your manual wheelchair <strong>down</strong> such an incline?</td>
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<tr>
<td>17P. Have you done this in the past month?</td>
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<tr>
<td>18C. If the incline was about twice as <strong>steep</strong>, can you get your manual wheelchair <strong>up</strong> it?</td>
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<tr>
<td>18P. Have you done this in the past month?</td>
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<tr>
<td>19C. Can you get your manual wheelchair <strong>down</strong> such a steeper incline?</td>
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</tr>
<tr>
<td>19P. Have you done this in the past month?</td>
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</tr>
<tr>
<td>20C. Imagine that you are sitting in your manual wheelchair facing across a moderately steep <strong>side-slope</strong> (such as on a hill or driveway) that is about 3 times the length of your wheelchair to get across. Can you get your wheelchair across the slope? Can you do this if you are coming back the other way?</td>
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<tr>
<td>20P. Have you done this in the past month?</td>
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</tr>
<tr>
<td>21C. Imagine that you wish to move your manual wheelchair about 3 wheelchair lengths across a <strong>soft surface</strong> (such as grass or a thick carpet). Can you do it?</td>
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</tr>
<tr>
<td>21P. Have you done this in the past month?</td>
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</tr>
<tr>
<td>22C. Imagine that you are moving in your manual wheelchair and you come to a <strong>pothole</strong> or a gap that you cannot steer around. Can you get your wheelchair over such a pot-hole?</td>
<td></td>
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<td></td>
</tr>
<tr>
<td>22P. Have you done this in the past month?</td>
<td></td>
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<td></td>
</tr>
<tr>
<td>Questions</td>
<td>C</td>
<td>P</td>
<td>Comment</td>
</tr>
<tr>
<td>----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------</td>
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</tr>
<tr>
<td>23C. Imagine that you are moving in your manual wheelchair and come to an <strong>obstacle</strong> (like a door threshold) that sticks up slightly above the surface. Can you get your wheelchair over such an obstacle?</td>
<td></td>
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</tr>
<tr>
<td>23P. Have you done this in the past month?</td>
<td></td>
<td></td>
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</tr>
<tr>
<td>24C. Imagine that you are using your manual wheelchair and you come to a small <strong>level change</strong> about 3 finger widths high. Can you get your wheelchair <strong>up</strong> onto the upper level?</td>
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<tr>
<td>24P. Have you done this in the past month?</td>
<td></td>
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</tr>
<tr>
<td>25C. Can you get your manual wheelchair <strong>down</strong> from the upper to the lower level?</td>
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<tr>
<td>25P. Have you done this in the past month?</td>
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</tr>
<tr>
<td>26C. Imagine that you are using your manual wheelchair and you come to a large <strong>level change</strong> (like a curb) about 8 finger widths high. Can you get your wheelchair <strong>up</strong> onto the upper level?</td>
<td></td>
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<tr>
<td>26P. Have you done this in the past month?</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>27C. Can you get your manual wheelchair <strong>down</strong> from the upper to the lower level?</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>27P. Have you done this in the past month?</td>
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<tr>
<td>28C. Can you balance your wheelchair on your rear wheels (that is, do a <strong>wheelie</strong>) for 30 seconds?</td>
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<tr>
<td>28P. Have you done this in the past month?</td>
<td></td>
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</tr>
<tr>
<td>29C. While in the <strong>wheelie</strong> position, can you <strong>turn</strong> in a tight circle so you are facing the opposite direction? Can you do this to the left and right?</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>29P. Have you done this in the past month?</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>30C. Imagine that you are on the <strong>ground</strong>, perhaps after falling from your wheelchair. Can you get yourself up into your manual wheelchair yourself?</td>
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</tr>
<tr>
<td>30P. Have you done this in the past month?</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>31C. Can you get yourself and your wheelchair <strong>up a few stairs</strong>?</td>
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<td></td>
</tr>
<tr>
<td>31P. Have you done this in the past month?</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>32C. Can you get yourself and your wheelchair <strong>down the stairs</strong>?</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>32P. Have you done this in the past month?</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
## Derived Values

<table>
<thead>
<tr>
<th>Description</th>
<th>Value</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of ‘yes’ responses in Capacity (C) column (maximum of 32):</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Number of applicable skills (32 minus number of NP and TE responses in column):</td>
<td></td>
<td></td>
</tr>
<tr>
<td>WST-Q Total Capacity Score:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Number of ‘yes’ responses in Performance (P) column (maximum of 32):</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Number of applicable skills (32 minus number of NP and TE responses in column):</td>
<td></td>
<td></td>
</tr>
<tr>
<td>WST-Q Total Performance Score:</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

## General Comments

________________________________________________________________________
________________________________________________________________________
________________________________________________________________________
________________________________________________________________________

Tester: ______________________
### Appendix T: Life-Space Assessment (LSA)

Subject No: ___________  Date: ___________________________  Circle: Time 1 / Time 2

<table>
<thead>
<tr>
<th>Life Space Level</th>
<th>Frequency</th>
<th>Independence</th>
<th>Score</th>
</tr>
</thead>
<tbody>
<tr>
<td>During the past four weeks, have you been to …</td>
<td>How often did you get there?</td>
<td>Did you use aids or equipment? Did you need help from another person?</td>
<td>Level x Frequency x Independence</td>
</tr>
<tr>
<td><strong>Life Space Level 1</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Other rooms of your home besides the room where you sleep?</td>
<td>Yes No</td>
<td>Less than 1/ wk 1 times/ wk 1 1-3 times/ wk 2 4-6 times/ wk 3 Daily</td>
<td>1 = personal assistance 1.5 = equipment only 2 = no equipment or personal assistance</td>
</tr>
<tr>
<td></td>
<td>1 0</td>
<td>1 2 3 4</td>
<td></td>
</tr>
<tr>
<td><strong>Life Space Level 2</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>An area outside your home such as your porch, deck or patio, hallway (of an apartment building) or garage, in your own yard or driveway?</td>
<td>Yes No</td>
<td>Less than 1/ wk 1 times/ wk 1 1-3 times/ wk 2 4-6 times/ wk 3 Daily</td>
<td>1 = personal assistance 1.5 = equipment only 2 = no equipment or personal assistance</td>
</tr>
<tr>
<td></td>
<td>2 0</td>
<td>1 2 3 4</td>
<td></td>
</tr>
<tr>
<td><strong>Life Space Level 3</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Places in your neighborhood, other than your own yard or apartment building?</td>
<td>Yes No</td>
<td>Less than 1/ wk 1 times/ wk 1 1-3 times/ wk 2 4-6 times/ wk 3 Daily</td>
<td>1 = personal assistance 1.5 = equipment only 2 = no equipment or personal assistance</td>
</tr>
<tr>
<td></td>
<td>3 0</td>
<td>1 2 3 4</td>
<td></td>
</tr>
<tr>
<td><strong>Life Space Level 4</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Places outside your neighborhood, but within your town?</td>
<td>Yes No</td>
<td>Less than 1/ wk 1 times/ wk 1 1-3 times/ wk 2 4-6 times/ wk 3 Daily</td>
<td>1 = personal assistance 1.5 = equipment only 2 = no equipment or personal assistance</td>
</tr>
<tr>
<td></td>
<td>4 0</td>
<td>1 2 3 4</td>
<td></td>
</tr>
<tr>
<td><strong>Life Space Level 5</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Places outside your town?</td>
<td>Yes No</td>
<td>Less than 1/ wk 1 times/ wk 1 1-3 times/ wk 2 4-6 times/ wk 3 Daily</td>
<td>1 = personal assistance 1.5 = equipment only 2 = no equipment or personal assistance</td>
</tr>
<tr>
<td></td>
<td>5 0</td>
<td>1 2 3 4</td>
<td></td>
</tr>
</tbody>
</table>
Appendix U: Wheelchair Outcome Measure (WhOM)

ID#: __________  Date: _______________ Circle : Time 1 / Time 2

**THE WhOM**

Some people use their wheelchairs because they want to participate in activities outside of their home such as dog walking, going for coffee, to work or to the park. What activities outside of your home or in your community would you use your wheelchair to perform?

Use this numerical scale to help fill in the table:

<table>
<thead>
<tr>
<th>Scale</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
</tr>
<tr>
<td>1</td>
</tr>
<tr>
<td>2</td>
</tr>
<tr>
<td>3</td>
</tr>
<tr>
<td>4</td>
</tr>
<tr>
<td>5</td>
</tr>
<tr>
<td>6</td>
</tr>
<tr>
<td>7</td>
</tr>
<tr>
<td>8</td>
</tr>
<tr>
<td>9</td>
</tr>
<tr>
<td>10</td>
</tr>
</tbody>
</table>

### Initial assessment

**Participation goals:**

Eg. Walking the dog  
Visiting my sister  
Watching a hockey game

<table>
<thead>
<tr>
<th>Importance</th>
<th>Satisfaction 1</th>
<th>Importance x Satisfaction 1</th>
<th>Satisfaction 2</th>
<th>Importance x Satisfaction 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>(0 - 10)</td>
<td>(0 - 10)</td>
<td></td>
<td>(0 - 10)</td>
<td></td>
</tr>
<tr>
<td>0 = Not at all important</td>
<td>0 = Not satisfied at all</td>
<td>Extremely satisfied</td>
<td>0 = Not satisfied at all</td>
<td>Extremely satisfied</td>
</tr>
<tr>
<td>10 = Extremely important</td>
<td>10 = Extremely satisfied</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>i.</th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>ii.</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>iii.</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>iv.</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>v.</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Total of importance x satisfaction 1 scores = Score 1  
Total of importance x satisfaction 2 scores = Score 2  
Change in satisfaction = Score 2 - Score 1
Appendix V: Post WheelSee Questionnaire

(You do not have to answer any questions that you are not comfortable with)

1. Do you feel that your confidence using your wheelchair impacts how you use your wheelchair?

________________________________________________________________________
________________________________________________________________________

2. Do you feel that your confidence using your wheelchair impacts your ability to complete daily activities?

________________________________________________________________________
________________________________________________________________________
________________________________________________________________________

3. Do you feel that your confidence using your wheelchair was improved by participating in WheelSee? If yes, can you describe how?

________________________________________________________________________
________________________________________________________________________

4. What WheelSee activities/components worked best for you or were the most important to you for improving your confidence?

________________________________________________________________________
________________________________________________________________________
________________________________________________________________________

5. What WheelSee activities/components worked least for you or were the not important to you for improving your confidence?

________________________________________________________________________
________________________________________________________________________
________________________________________________________________________
6. What WheelSee activities/components would you change?

________________________________________________________________________
________________________________________________________________________
________________________________________________________________________

a. How would you change these activities?

________________________________________________________________________
________________________________________________________________________
________________________________________________________________________

7. What did you particularly like about the WheelSee program?

________________________________________________________________________
________________________________________________________________________
________________________________________________________________________

8. What didn’t you like about the WheelSee program?

________________________________________________________________________
________________________________________________________________________
________________________________________________________________________

9. Do you think we could include other activities that would help improve your confidence?

________________________________________________________________________
________________________________________________________________________
________________________________________________________________________

a. If yes, could you provide an example of an activity that you think may help improve your confidence using your manual wheelchair?

________________________________________________________________________
Appendix W: Assessment of raw data

The Kolmogorov-Sminov statistic shows the post-intervention scores are normally distributed and meet this assumption for analysis of variance (statistical significance > 0.05).

<table>
<thead>
<tr>
<th>Statistic</th>
<th>df</th>
<th>Significance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Control</td>
<td></td>
<td></td>
</tr>
<tr>
<td>WheelCon</td>
<td>.198</td>
<td>12</td>
</tr>
<tr>
<td>WSTQ Capacity</td>
<td>.185</td>
<td>12</td>
</tr>
<tr>
<td>WSTQ Performance</td>
<td>.109</td>
<td>12</td>
</tr>
<tr>
<td>LSA</td>
<td>.166</td>
<td>12</td>
</tr>
<tr>
<td>WhOM</td>
<td>.249</td>
<td>12</td>
</tr>
<tr>
<td>Intervention</td>
<td></td>
<td></td>
</tr>
<tr>
<td>WheelCon</td>
<td>.206</td>
<td>16</td>
</tr>
<tr>
<td>WSTQ Capacity</td>
<td>.184</td>
<td>16</td>
</tr>
<tr>
<td>WSTQ Performance</td>
<td>.170</td>
<td>16</td>
</tr>
<tr>
<td>LSA</td>
<td>.206</td>
<td>16</td>
</tr>
<tr>
<td>WhOM</td>
<td>.092</td>
<td>16</td>
</tr>
</tbody>
</table>

Levene’s test for equality of variances show the variability of scores for the WheelCon and the WSTQ Capacity violate the homogeneity of variance assumption (statistical significance ≤ 0.05*). The WSTQ Performance, LSA and WhOM score meet the equal variance assumption of analysis of variance (statistical significance > 0.05).

<table>
<thead>
<tr>
<th>Statistic</th>
<th>F</th>
<th>df1</th>
<th>df2</th>
<th>Significance</th>
</tr>
</thead>
<tbody>
<tr>
<td>WheelCon</td>
<td>5.947</td>
<td>1</td>
<td>26</td>
<td>.022*</td>
</tr>
<tr>
<td>WSTQ Capacity</td>
<td>9.062</td>
<td>1</td>
<td>26</td>
<td>.006*</td>
</tr>
<tr>
<td>WSTQ Performance</td>
<td>3.645</td>
<td>1</td>
<td>26</td>
<td>.067</td>
</tr>
<tr>
<td>LSA</td>
<td>.362</td>
<td>1</td>
<td>26</td>
<td>.552</td>
</tr>
<tr>
<td>WhOM</td>
<td>1.720</td>
<td>1</td>
<td>26</td>
<td>.202</td>
</tr>
</tbody>
</table>
Appendix X: Assessment of Log10 transformations (WheelCon and WSTQ Capacity)

After Log10 transformations, Levene’s test for equality of variances show the variability of scores for the WheelCon and the WSTQ Capacity meet the homogeneity of variance assumption (statistical significance > 0.05).

<table>
<thead>
<tr>
<th></th>
<th>F</th>
<th>df1</th>
<th>df2</th>
<th>statistical significance</th>
</tr>
</thead>
<tbody>
<tr>
<td>WheelCon</td>
<td>.432</td>
<td>1</td>
<td>26</td>
<td>.517</td>
</tr>
<tr>
<td>WSTQ Capacity</td>
<td>2.207</td>
<td>1</td>
<td>26</td>
<td>.149</td>
</tr>
</tbody>
</table>
Appendix Y: Sample size calculation

The sample size calculation was based on the primary outcome measure (Wheelchair Use Confidence Scale) according to methods described by Chow et al., 2008 for a 2-sided comparison of 2 groups using one-way analysis of variance (ANOVA). Variability data from a pilot study examining the effect of a wheelchair training intervention of wheelchair use SE (WheelCon) was used (Sakakibara et al., 2012). Since this data comes from a sample of non-wheelchair users, the variability is likely higher than expected in wheelchair users. However, no previous intervention studies have reported on the WheelCon for wheelchair users. This study will provide the first effect size estimates in a population of wheelchair users that may be used in subsequent studies.

Evidence to support wheelchair training is emerging, but wheelchair users have only been evaluated in 3 previous training studies. Although this is a pilot study to obtain the first effect size estimates of novel wheelchair training intervention using a new outcome measure, a significance level of 0.05 was selected. To achieve 80% power, this study required a total of 24 participants, 12 in each group. Previous wheelchair intervention studies have reported drop-out rates varying from 9 – 18%; therefore, the sample size was conservatively adjusted by 20% for a total of 28.
Mean within-subjects change score ($\mu$): Intervention group (A) = 13.7; Control group (B) = -0.4

Mean between-group change score = 14.1%

Change score standard deviation ($\sigma$): 17.1

$\eta^2 = 0.39$

Type I error = .05

Type II error = 20%

$\beta = 80$

$$n = 2\left[\frac{\sigma (Z_{1-\alpha/2} + Z_{1-\beta})}{(\mu_A - \mu_B)}\right]^2$$

$$n = 2[17.1 (1.96 + 0.84) / (13.7/-0.40)]^2$$

$n = 24$ (12 per group)
Appendix Z: WheelSee per-protocol analysis

Mean (SD) \(^\dagger\) changes from baseline to post-intervention and estimated effect sizes for primary and secondary clinical outcomes based on participants who completed the study per protocol.

<table>
<thead>
<tr>
<th></th>
<th>Intervention group</th>
<th>Control group</th>
<th>F(_{1,26})</th>
<th>Effect</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>T1</td>
<td>T2</td>
<td>T1</td>
<td>T2</td>
</tr>
<tr>
<td><strong>Primary</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>WheelCon</td>
<td>69.1 (18.7)</td>
<td>87.8 (81.2, 95.0(^\dagger))</td>
<td>78.9 (15.3)</td>
<td>75.6 (63.0, 91.0(^\dagger))</td>
</tr>
<tr>
<td><strong>Secondary</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>WST-Q capacity</td>
<td>82.2 (13.1)</td>
<td>87.7 (84.9, 92.6(^\dagger))</td>
<td>78.4 (18.2)</td>
<td>75.5 (62.7, 92.6(^\dagger))</td>
</tr>
<tr>
<td>WST-Q performance</td>
<td>55.5 (21.0)</td>
<td>71.3 (13.4)</td>
<td>64.3 (20.0)</td>
<td>66.4 (20.3)</td>
</tr>
<tr>
<td>LSA</td>
<td>40.5 (19.5)</td>
<td>48.6 (14.3)</td>
<td>49.2 (16.3)</td>
<td>53.7 (14.4)</td>
</tr>
<tr>
<td>WhOM</td>
<td>45.7 (30.4)</td>
<td>63.2 (19.1)</td>
<td>39.4 (30.1)</td>
<td>48.4 (29.4)</td>
</tr>
</tbody>
</table>

\(^\dagger\) 95% Confidence Intervals are presented for back transformations of non-normally distributed data (Howell, 2007).

* \(p \leq 0.10\)
† \(p < 0.05\)

T1 = baseline, T2 = post-intervention, IQR = Inter Quartile Range, SD = standard deviation, WheelCon = Wheelchair Use Confidence Scale, WST-Q = Wheelchair Skills Test-Questionnaire, LSA = Life-space Assessment, WhOM = Wheelchair Outcome Measure.