BRIDGING THE GAP: PROMOTING PHYSICAL ACTIVITY AMONG INDIVIDUALS WITH SPINAL CORD INJURY WITHIN THE CONTEXT OF THE THEORY OF PLANNED BEHAVIOUR

By

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Abstract

The purpose of this dissertation was to develop an understanding of physical activity behaviour and to promote physical activity participation among individuals with spinal cord injury (SCI) within the context of the theory of planned behaviour (Ajzen, 1985). Using a "bottom-up," programmatic research approach, this three-study thesis involved 1) validating a new measure of physical activity that is appropriate for use among individuals with SCI, 2) identifying theoretically meaningful, psychosocial predictors of physical activity participation in the SCI population, and 3) implementing and testing a theory-based intervention focused on helping people with SCI follow through with their physical activity intentions.

Specifically, Study 1 examined the construct validity of the Physical Activity Recall Assessment for Individuals with SCI (PARA-SCI). An assessment of convergent validity (*n*=73) and construct validation by extreme groups (*n*=158) provided evidence of the construct validity of the leisure time physical activity (LTPA) PARA-SCI category but not the lifestyle or cumulative activity PARA-SCI categories. It was concluded that the PARA-SCI is suitable for assessing LTPA among individuals with SCI and should be used to advance research examining physical activity determinants.

Using the LTPA PARA-SCI category as a primary outcome, the purpose of Study 2 was to examine determinants of physical activity among people with SCI (*n*=110) within the context of the theory of planned behaviour (Ajzen, 1985). This prospective study revealed that attitudes, subjective norms and perceived behavioural control (PBC) predicted physical activity intentions while intentions, but not PBC, explained a small

amount of the variance in LTPA. The poor prediction of behaviour suggested a need to investigate whether strategies that facilitate the translation of intentions into behaviour can serve to strengthen the intention-behaviour relationship.

Study 3 utilized a randomized, controlled design to examine the efficacy of an 8-week implementation intention intervention as a means of helping individuals with SCI (n=53) follow through with their intentions for physically active living. The results indicated that participants who formulated implementation intentions (i.e., the implementation intention condition) spent more time engaged in physical activity and were more likely to enact their intentions than individuals who did not create implementation intentions (i.e., the control condition). Further, participants in the implementation intentions condition had stronger intentions and greater confidence to schedule their physical activity than participants in the control condition, suggesting that implementation intentions may influence cognitions related to physical activity.

Considered together, these three studies deepen our understanding of physical activity behaviour among individuals with SCI and provide evidence of an efficacious strategy for increasing physical activity participation. The studies emphasize the importance of using well-constructed measures of theoretical constructs and valid assessments of physical activity for identifying determinants of LTPA. The results are also a testament to the value of using theory as a foundation for developing effective physical activity interventions for people with SCI.

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Life is a journey not a destination

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Do not go where the path may lead, go instead where there is not path and leave a trail…

Dedication

To Betty Anne Brown

My aunt whose vision and inner strength is inspiring

List of Abbreviations

1RM	-one repetition maximum
ACSM	-American College of Sports Medicine
ADL	- activities of daily living
ANCOVA	-analysis of covariance
ANOVA	-analysis of variance
CHD	- coronary heart disease
HDL-C	- high-density lipoprotein cholesterol
LTPA	- leisure time physical activity
MANCOVA	-multivariate analysis of covariance
MANOVA	-multivariate analysis of variance
NIDDM	- non-insulin dependent diabetes mellitus
PADS	- Physical Activity and Disability Survey
PARA-SCI	- Physical Activity Recall Assessment for Individuals with Spinal Cord Injury
PASIPDS	- Physical Activity Scale for Individuals with Physical Disabilities
PBC	- perceived behavioural control
RMR	- resting metabolic rate
SCI	- spinal cord injury
TACT	-target, action, context, time
TC	- total cholesterol
TDEE	- total daily energy expenditure
TPB	- theory of planned behaviour

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CHAPTER 1

Review of Literature

1.0 INTRODUCTION

Spinal cord injury (SCI) results from damage to the cells within the spinal cord. This damage disrupts the transmission of neural signals up and down the spinal cord thus compromising bodily function. These functional impairments include the loss of: 1) sensation, 2) voluntary control over movements and muscles, and/or 3) reflex function affecting autonomic activity below the point of injury (e.g., breathing, blood pressure regulation, sexual functioning, bowel and bladder control; National Spinal Cord Injury Association, 1996). The severity of impairment is largely dependent on the type and level of injury (American Spinal Injury Association, 1992). SCI can be divided into two types – complete and incomplete. With a complete injury, all motor and sensory function is lost below the level of the spinal cord lesion. With an incomplete injury, motor and/or sensory function is partially preserved below the injury site. In turn, the level of the SCI determines whether the injury results in tetraplegia or paraplegia. Tetraplegia reflects damage to the cervical segments of the spinal cord and can result in the impairment or loss of motor and/or sensory function in the arms, trunk, legs and pelvic organs. Paraplegia reflects damage in the thoracic, lumbar or sacral segments of the spinal cord. With paraplegia, arm functioning is spared, but depending on the injury level, impairment or loss of function may occur in the trunk, legs, and pelvic organs. Thus, injuries can be either complete or incomplete and may result in either tetraplegia or paraplegia.

Prior to World War II, SCI seriously compromised life expectancy (Collins, 2000). However, in recent years, innovations in medical technology have led to a dramatic increase in the life expectancy of individuals with SCI (DeVivo, Krause, &

Lammertse, 1999; Whiteneck et al., 1992). Thus, the 36,000 Canadians living with SCI (Canadian Paraplegic Association, 2000a) have a life expectancy approaching that of individuals in the able-bodied population (Yeo et al., 1998). As a result, the focus of SCI medicine has shifted from acute life support to the management of health issues associated with long-term survival.

2.0 Managing the Health Consequences of SCI: The Role of Physical Activity

According to the World Health Organization, health is "a state of complete physical, mental, and social well-being not merely the absence of disease" (World Health Organization, 2004). Consistent with this biopsychosocial perspective, it follows that an assessment of the effects of SCI on health include not only indication of the frequency and severity of physical and psychological diseases but also indication of changes in social functioning (i.e., ability to fulfill social roles, level of independence) and quality of life. Substantial evidence indicates poor health in all of these domains compared to the general population (Post, van Dijk, van Asbeck, & Schrijvers, 1998; Westgren & Levi, 1998). However, poor health is not an inevitable consequence of SCI. Accumulating evidence indicates that the multiple domains of health can be improved through physical activity (e.g., Hicks et al., 2003). The benefits of physical activity in each domain are discussed in turn.

2.1 Enhancing physical health through physical activity

2.1.1 Medical complications

As a result of functional loss, individuals with SCI often encounter a variety of secondary medical complications. The most frequently reported comorbidities include urinary tract infections, pressure sores, fractures and chronic pain (Johnson, Gerhart, McCray, Menconi, & Whiteneck, 1998). With the exception of chronic pain, these conditions can be managed effectively through pharmacological and surgical interventions (Dmochowski, Ganabathi, & Leach, 1995; Fleisch, 1987; Galloway, 1997; Garber, Rintala, Hart, & Fuhrer, 2000; Longe, 1986; Schryvers, Stranc, & Nance, 2000). Although a variety of strategies have been explored, a single effective intervention to reduce chronic pain is yet to be determined (Bowsher, 1999; Haythornthwaite et al., 2003), however, emerging evidence advocates physical activity as means for pain management (Curtis et al., 1999; Hicks et al., 2003).

Strong support comes from a 9-month randomized controlled trial examining the benefits of center-based physical activity for individuals with SCI. Thirty-four sedentary individuals with traumatic SCI were randomly assigned to participate in either twice-weekly aerobic and strength training (intervention group) or to maintain their usual level of activity (control group). Compared to the control group, the intervention group reported a significantly greater decrease in perceived pain. In a 3-month follow-up to this study, continued adherence to the physical activity regime by the intervention participants was associated with decreased pain (Ditor et al., 2003). Although physical activity is not commonly used for managing pain symptoms in the SCI population (Haythornthwaite et al., 2003), these findings suggest the need to promote physical activity as a strategy for alleviating pain.

2.1.2 Chronic disease

In addition to managing medical complications, recent research indicates an important role for physical activity for preventing chronic disease among individuals with SCI. Chronic disease is highly prevalent among survivors of SCI (Kocina, 1997). Of these diseases, obesity is a particularly serious health matter given its strong association with non-insulin dependent diabetes mellitus (NIDDM) and coronary heart disease (CHD; Maggioni et al., 2003; Spungen, Wang, Pierson, & Bauman, 2000). A comparison of the body composition of 133 men with SCI to an age-,height-, gender- and ethnicity-matched able-bodied reference group revealed that individuals with SCI were fatter compared to controls (Spungen et al., 2003). Specifically, results of dual energy X-ray absorptometry (DEXA) – a valid measure of body composition among individuals with SCI (Spungen, Bauman, Wang, & Pierson, 1995)– indicated less total body and regional lean mass (i.e., muscle) and more fat mass in persons with SCI compared with controls. The loss of lean muscle mass and relative gain in fat mass associated with SCI is attributed to muscle atrophy and a predominantly sedentary lifestyle (Kocina, 1997).

Of concern, decrease in lean mass and an increase in physical inactivity is associated with insulin resistance and a consequent reduction in the body's capacity to use carbohydrates as an energy source (Aksnes et al., 1996). As a result, individuals with SCI are at increased risk of developing NIDDM. In accordance with World Health Organization criteria for the diagnosis of diabetes (World Health Organization, 1980), in a sample of 100 veterans with SCI, 22% were diagnosed with NIDDM whereas only 6% of able-bodied controls were diabetic (Bauman & Spungen, 1994). NIDDM is a serious health threat. Along with the many potential acute and long-term health complications (e.g., diabetic coma, gangrene), NIDDM imparts increased risk for CHD (Meltzer et al., 1998).

The risk of CHD is indicated by high blood serum concentrations of total cholesterol (TC) and concentrations of high-density lipoprotein cholesterol (HDL-C) below the desirable level of 0.9 mmol/L (Stampfer, Sacks, Salvini, Willett, & Hennekens, 1991). In the general population, approximately 10% of individuals have HDL-C below 0.9 mmol/L whereas in a sample of 100 veterans with SCI (50 paraplegia, 50 tetraplegia), 40% had HDL-C below the desirable level (Bauman et al., 1992; Grundy, Goodman, Rifkind, & Cleeman, 1989). Given these blood serum profiles, individuals with SCI are at elevated risk of CHD compared to able-bodied individuals and as a result, CHD has become a leading cause of death (DeVivo et al., 1999; Whiteneck et al., 1992) in this population. The prevalence and severity of this health concern emphasize the need for interventions to prevent and manage CHD.

In the general population, a large body of evidence clearly establishes the role of physical activity for the prevention and management of CHD (Paffenbarger et al., 1993; Paffenbarger, Hyde, Wing, & Hsieh, 1986; Pate et al., 1995). Similar physical activity benefits have been uncovered among individuals with SCI (Kocina, 1997; Washburn & Figoni, 1999). Specifically, cross-sectional evidence indicate higher HDL-C levels (i.e., reduced risk) among athletes and active, aerobically fit individuals compared to nonathletes and sedentary, aerobically unfit individuals (Bostom et al., 1991; Brenes, Dearwater, Shapera, Laporte, & Collins, 1986; Dallmeijer, Hopman, & van der Woude, 1997; Dallmeijer, van der Woude, van Kamp, & Hollander, 1999). Aerobic and strength training studies provide further evidence of the important role of physical activity in CHD risk reduction (e.g., de Groot, Hjeltnes, Heijboer, Stal, & Birkeland, 2003; Hooker & Wells, 1989; Nash, Jacobs, Mendez, & Goldberg, 2001). For example, a study of five individuals with SCI participating in a 12-week, thrice-weekly circuit resistance and arm ergometry program noted increased HDL-C and decreased TC (Nash et al., 2001). These changes reflect an approximate 25% reduction in CHD risk.

Research indicates that physical activity can further decrease this risk by affecting positive changes in obesity and insulin resistance (US Department of Health and Human Services, 1996). With regards to obesity, individuals with SCI reporting regular exercise have been found to have lower average percent body fat than sedentary controls (Olle, Pivarnik, Klish, & Morrow, 1993). Furthermore, improvements in body composition can be elicited with training. Significant increases in muscle mass and decreased body fat were reported following eight-weeks of electrically stimulated leg cycling (Hjeltnes et al., 1997; Scremin et al., 1999) and 10-weeks of wheelchair ergometry (Midha, Schmitt, & Sclater, 1999).

With regards to insulin resistance in the SCI population, research in this area is not as well developed as in the CHD and obesity domains. Nonetheless, emerging evidence supports the notion of physical activity as a means of decreasing insulin resistance. A study of nine individuals with SCI involved in a six-month, thrice-weekly body weight supported treadmill training intervention, reported increased carbohydrate metabolism indicating decreased insulin resistance (Phillips et al., in press). These findings are consistent with studies of electrically stimulated leg cycling among individuals with SCI (Jeon et al., 2002). Whether other forms of physical activity (e.g., arm and wheelchair ergometry, sport) produce similar effects remains to be determined. In sum, CHD, obesity and NIDDM are serious concerns affecting physical health. Accumulating evidence indicates physical activity as a potent strategy for managing these concerns.

2.2 Enhancing psychological health through physical activity

Besides influencing physical health, the loss of voluntary movement, altered bodily functions and pain associated with SCI impacts psychological well-being (Boekamp, Overholser, & Schubert, 1996; North, 1999). The prevalence of depression and anxiety is high in the SCI population (Fuhrer, Rintala, Hart, Clearman, & Young, 1993; Judd, Stone, Webber, Brown, & Burrows, 1989; Kennedy & Rogers, 2000; Scivoletto, Petrelli, Di Lucente, & Castellano, 1997). For example, in a community-based sample of 140 individuals with SCI, 40% of respondents were identified as being at risk of clinical depression. Of further concern, the level of depressive symptomology among individuals with SCI was higher than reported for the general population (Fuhrer et al., 1993).

A similar pattern of findings has been reported for anxiety. In a cohort of 104 individuals, the prevalence of respondents reporting anxiety levels indicative of a clinical anxiety disorder fluctuated between 16%-30% over a 2-year period (Kennedy & Rogers, 2000). Furthermore, as demonstrated in a comparison of 41 individuals with SCI with age-, sex- and gender-matched controls, individuals with SCI experience greater anxiety than able-bodied people (Craig, Hancock, & Dickson, 1994; Hancock, Craig, Dickson, Chang, & Martin, 1993). With convincing evidence of the psychological consequences of SCI, improving and maintaining psychological well-being over the long-term is an important goal for SCI rehabilitation.

Research suggests that physical activity is one strategy for achieving this rehabilitation goal. A correlational study including 48 patients with SCI receiving treatment for a secondary medical complication, reported a negative association between level of physical activity and depression (Coyle, Shank, Kinney, & Hutchins, 1993). Additionally, cross-sectional evidence from a sample 169 men with SCI indicates that highly physically active persons report less depression and anxiety than their less active and inactive counterparts (Muraki, Tsunawake, Hiramatsu, & Yamasaki, 2000). Results from training studies further strengthen the support for the relationship between physical activity and psychological health. Hicks and colleagues (2003) reported greater decreases in depression and anxiety among individuals participating in 9-months of twice-weekly aerobic and strength training compared to nonexercising controls. Similarly, a decrease in depression was noted in a sample of 15 individuals following 32-sessions of electrically stimulated cycling (Guest, Klose, Needham-Shropshire, & Jacobs, 1997). Taken together, these findings indicate an important role for physical activity in managing the psychological impact of SCI.

2.3 Enhancing social functioning through physical activity

For some individuals, a further consequence of SCI is an inability to fulfill social roles (e.g., unable to return to work). Specifically, SCI-related impairments limit one's work capacity (i.e., in terms of physical strength and endurance) to perform physical tasks, thus necessitating major changes in personal independence (Janssen, Dallmeijer, Veeger, & van der Woude, 2002). A study of 72 individuals with SCI found that 71% of individuals with low physical work capacity (peak VO_2 less than 15ml/kg/min) could not perform activities of daily living (ADL) independently (Hjeltnes & Jansen, 1990). With these limitations, individuals often become reliant on others for assistance to perform ADL (dressing, bathing; Spinal Cord Injury Information Network, 2000) and are unable to return to work because they can no longer fulfill the physical demands of their jobs (Canadian Paraplegic Association, 2000b).

Although partially attributable to the injury itself (particularly among individuals with tetraplegia; Van Loan, McCluer, Loftin, & Boileau, 1987), this reduced work capacity is largely due to the sedentary lifestyle thought to result from the loss of voluntary muscle movement (Noreau & Shephard, 1995). In support of this suggestion, a regression analysis of data from 91 people with SCI identified physical activity participation as a significant predictor of physical work capacity after accounting for lesion level (Janssen et al., 2002). Further, in a sample of 13 individuals with paraplegia, participation in a 16-week exercise program consisting of three weekly sessions of aerobic and resistance activity led to increased muscle strength and endurance (Duran, Lugo, Ramirez, & Eusse, 2001). These findings are consistent with a large body of evidence demonstrating increased physical capacity following training (e.g., DiCarlo, 1988; Hicks et al., 2003; Jacobs, Mahoney, Nash, & Green, 2002; Wheeler et al., 2002). However, of great interest, concomitant to these improvements in physical capacity was a significant increase in self-reported functional independence. Taken together, these findings suggest that physical activity enhances physical capacity, which in turn should assist individuals in completing ADL and fulfilling social roles.

2.4 Enhancing health related quality of life through physical activity

Evidently, SCI pervades multiple aspects of an individual's health (e.g., physical, psychological) -- the effects of which have been suggested to culminate to influence quality of life. Quality of life is a multifaceted concept that includes "both subjective and objective evaluations of the "goodness" of one's life overall, and the goodness of all of the various domains that make up one's life" (Lox, Martin, & Petruzzello, 2003, p. 234). One facet that is considered an important health outcome is health related quality of life (HRQL). HRQL is the subjective evaluation of the valued dimensions of a person's life that can be affected by health and functioning (e.g., physical function, psychological well-being; Lox et al., 2003). Substantial evidence indicates reduced HRQL among individuals with SCI (Crewe, 1980; Dijkers, 1997; Fuhrer et al., 1993; Kannisto, Merikanto, Alaranta, Hokkanen, & Sintonen, 1998; Post et al., 1998; Siosteen, Lundqvist, Blomstrand, Sullivan, & Sullivan, 1990; Westgren et al., 1998). However, emerging research suggests that HRQL can be bolstered through physical activity participation (Noreau & Shephard, 1995). Cross-sectional data from 91 individuals with SCI reveals a positive association between HRQL and participation in leisure activities including physical activity (Coyle et al., 1993). Strong support for this relationship comes from the randomized controlled trial by Hicks and colleagues (2003) that indicated increased HRQL following participation in twice-weekly physical activity compared to nonexercising controls. Likewise, HRQL increased in a sample of 14 people with incomplete SCI following 12-months of thrice-weekly body weight supported treadmill walking (Hicks et al., 2004). Taken together, these findings suggest that physical activity can increase HRQL.

2.5 Summary

In summary, compromised functioning and health is a relevant concern for individuals with SCI. Emerging evidence suggests that physical activity is an effective strategy for enhancing certain functional and health outcomes. Specifically, participation in physical activity has been shown to decrease pain and risk of chronic disease (i.e., obesity, CHD, NIDDM) and increase physical functioning, social functioning, psychological well-being and HRQL. Clearly, with physical activity affecting multiple health domains, individuals should be encouraged to incorporate physical activity into their lifestyle.

3.0 Physical Activity Participation Levels

Despite the multiple benefits of physical activity, the majority of individuals with SCI subscribe to a sedentary lifestyle. A time-use survey of 312 men with SCI determined that the largest portion of the respondents' waking hours were spent doing leisure activity (Pentland, Harvey, Smith, & Walker, 1999). Closer examination of time allocation uncovered that 84% of leisure time was dedicated to sedentary activity including listening to the radio, watching television, reading and engaging in telephone conversations. To note, this study was conducted before the widespread use of the Internet. With data to suggest that at least 65% of individuals with physical disability use the Internet on a regular basis (National Centre for the Dissemination of Disability and Rehabilitation Research, 2001), it is likely that the time spent on sedentary leisure may be even greater now than when reported by Pentland and colleagues.

Consistent with these findings, cross-sectional studies examining energy expenditure indicate low levels of physical activity in the SCI population (Buchholz, McGillivray, & Pencharz, 2003; Dearwater, Laporte, Cauley, & Brenes, 1985; Mollinger et al., 1985; Monroe et al., 1998). For example, the total daily energy expenditure (TDEE) of 27 men and women with paraplegia was measured by heart rate monitoring on three non-consecutive days (Buchholz et al., 2003). Physical activity level was calculated as TDEE/resting metabolic rate (RMR) and frequency of sedentary activity was determined using an activity-log. According to World Health Organization standards (World Health Organization, 2000), the mean physical activity level could be considered 'limited' (TDEE/RMR range: 1.55-1.60). Sedentary activity (e.g., television watching, computer use) was frequent for all participants. Taken together, these findings suggest that sedentary activity is highly prevalent among individuals with SC I and physical activity is rare.

Most disconcerting about the low levels of physical activity in the SCI population is that participation rates are even lower than those observed in the general population (Buchholz et al., 2003). In a postal survey, 53% of the 45 respondents with SCI did not participate in *any* type of physical activity (Tasiemski, Bergstrom, Savic, & Gardner, 2000). By comparison, in the general population, only 38% of individuals indicate no physical activity whatsoever (Craig & Cameron, 2004). Consistent with these data, it has been shown that individuals with SCI expended less energy (measured by a respiratory chamber) over a 24-hour period than able-bodied controls (Monroe et al., 1998). Together, these findings coincide with reports of decreased physical activity following injury (Coyle et al., 1993; Tasiemski et al., 2000) and the suggestion that people with SCI may be at the lowest level of the physical activity spectrum (Dearwater et al., 1985).

4.0 Theory-Based Physical Activity Determinants: A Practical Foundation for Intervention

The inactive lifestyle of individuals with SCI is a serious functional and health liability. Failure to engage in physical activity increases the risk of chronic disease, pain and negatively impacts physical functioning, social functioning, psychological health and HRQL (Heath & Fentem, 1997). Consequently, developing effective interventions to promote physical activity is a research priority (Rimmer, Braddock, & Pitetti, 1996).

To develop effective interventions, Baranowski and colleagues (1997; 1998) recommend adopting a theory-driven approach. Using theory to guide intervention is practical because theory a) directs researchers' attention to the key factors to target for change, b) provides indication of the processes most susceptible to change, c) has measurable theoretical constructs thus allowing for the assessment of change, d) has demonstrated validity, and e) provides a basis for detecting why an intervention succeeded or failed to produce change (Biddle & Nigg, 2000; Brawley, 1993; Godin, 1993; Rejeski, 1995). Reciprocally, the success or failure of an intervention serves to expand or limit a theory's tenets – a major contribution to the scientific field (Brawley, 1993; Crocker, 1993). In sum, theory helps researchers to understand why people act the way they do, suggests how to maximize change in behaviour, and provides a foundation for evaluating the effectiveness of behaviour-change interventions.

4.1 Limitations of current physical activity determinants research

A first step to using theory to develop interventions, is identifying behavioural determinants within the context of a valid theory (Baranowski, Lin, Wetter, Resnicow, & Davis Hearn, 1997). These determinants then provide a “blueprint” for intervention (Brawley, 1993; Culos-Reed, Gyurcsik, & Brawley, 2001). Some factors related to physical activity involvement among individuals with SCI have been identified through qualitative and descriptive studies (e.g., knowledge of the benefits of physical activity, peer influence, time limitations; Martin et al., 2002; Wu & Williams, 2001). Although this descriptive body of research identifies interesting trends and possible determinants of physical activity among individuals with SCI, the conclusions that can be drawn from these findings are largely limited by their atheoretical nature. Due to a lack of theory, these findings fail to identify the factors that have the most potent influence on behaviour and the processes underlying physical activity involvement. Consequently, it remains unclear what variables should be targeted for change and why people think and act the way they do (Biddle & Nigg, 2000). As a result, from these atheoretical descriptive studies, health practitioners are unable to determine how to most effectively tailor interventions to the needs of individuals with SCI – the fundamental purpose of determinants research (Godin, 1993). Hence, there is a pressing need to identify SCI-specific, theory-based physical activity determinants on which to base interventions.

4.2 Using the theory of planned behaviour to identify theory-based determinants

One of the most widely used frameworks for examining determinants of physical activity is Ajzen's (1985) theory of planned behaviour (TPB; Maddux, 1993). The TPB was developed to account for goal-directed behaviours over which the individual does not have complete volitional control. The TPB posits that an individual's intentions are a proximal determinant of behaviour. Intentions are determined by three conceptually independent constructs: 1) attitudes (one's positive or negative evaluation of the behaviour), 2) subjective norms (the perceived social pressure to perform the behaviour), and 3) perceived behavioural control (PBC; the perceived ease or difficulty of performing the behaviour). Furthermore, PBC serves as a proxy indicator of the actual control individuals have over performing a behaviour. Along with intentions, PBC is considered to be a codeterminant of behaviour. Thus, it is this PBC construct that takes into account individuals' lack of perceived volitional control over certain behaviours.

Because the TPB is so widely used as a theoretical framework in the physical activity domain, substantial evidence exists demonstrating its utility for predicting behaviour. For instance, three separate reviews of the physical activity literature confirm the explanatory capabilities of the TPB's theoretical constructs (Godin & Kok, 1996; Hagger, Chatzisarantis, & Biddle, 2002; Hausenblas, Carron, & Mack, 1997). Specifically, evidence from the one review (Hagger et al., 2002) with a sufficiently large enough sample (n=72) to test the model's predictive utility using path analysis, revealed that intentions and PBC accounted for 27.4% of the variance in physical activity behaviour. Further, attitudes, subjective norms and PBC together accounted for 44.5% of the variance in intentions. Throughout all three reviews, intentions emerged as the strongest predictor of behaviour whereas PBC was the strongest predictor of intentions. The subjective norms construct was consistently the weakest predictor of intentions.

A limitation of these meta-analyses is that the majority of the works reviewed focused on the predictive utility of the TPB in the general population thus leaving to question whether the tenets of the TPB extend to special populations (Crocker, 1993). However, with a few studies of special populations producing findings in line with the TPB review papers, accumulating evidence supports the applicability of the TPB to special population physical activity research. Specifically, the TPB has demonstrated predictive utility among survivors of a variety of types of cancer (breast, prostate; Blanchard, Courneya, Rodgers, & Murnaghan, 2002; Courneya, Blanchard, & Laing, 2001), patient groups receiving cancer treatment (Courneya & Friedenreich, 1997; Courneya & Friedenreick, 1999; Courneya, Keats, & Turner, 2000) or enrolled in cardiac rehabilitation (Blanchard et al., 2003; Blanchard, Courneya, Rodgers, Daub, & Knapik, 2002), individuals suffering from back pain (Trafimow & Trafimow, 1998) and people with fibromyalgia (Culos-Reed, 2000). Indeed, for individuals with SCI, the TPB may be particularly relevant given that many of the physical activity determinants that have been uncovered through descriptive, atheoretical research are encompassed by the attitudes, subjective norms and PBC constructs.

4.3 The relevance of TPB constructs to physical activity among individuals with SCI

4.3.1 Attitudes

Attitudes are a function of individuals' beliefs about the possible outcomes of a behaviour and the evaluation (positive or negative) of these outcomes (Ajzen, 2002a). Qualitative evidence suggests that the perceived positive and especially perceived negative outcomes of engaging in physical activity (i.e., attitudes) may be potent determinants of physical activity participation among individuals with SCI. The findings from a series of focus groups involving 15 individuals with SCI identified a lack of knowledge about the benefits (i.e., positive outcomes) of physical activity and fear of muscle and joint tightness as primary factors preventing physical activity participation (i.e., negative outcomes; Martin et al., 2002; Rimmer et al., 1996). Consistent with these results, interview responses from 48 individuals with SCI revealed that fear of further injury was a physical activity barrier faced by 26% of the respondents (Coyle et al., 1993). Furthermore, in a postal survey of 45 individuals with SCI, safety was cited as a reason for discontinuing physical activity following SCI (Tasiemski et al., 2000). Taken together, these findings suggest individuals' evaluations of physical activity outcomes may be an influential factor in determining physical activity participation.

4.3.2 Subjective norms

Evidence is also beginning to accumulate relating subjective norms to physical activity participation. Subjective norms are a function of individuals' beliefs about the social pressure to engage in a behaviour and their motivation to comply with this pressure (Ajzen, 2002a). In an exploratory study of factors influencing postinjury physical activity participation (n=143), social groups (e.g., friends, peers with a disability) were central agents in influencing initial and continued physical activity participation (Wu & Williams, 2001). Specifically, it was friends and peers who introduced various forms of physical activity to 61% of individuals who were inactive preinjury but were active postinjury. These results support the influential role of important others in promoting physical activity participation.

In addition to peers, consultations with patient groups and health care professionals revealed that physicians are often identified as a source of social pressure to participate in physical activity (Blanchard et al., 2003; Courneya, Friedenreich, Sela, Quinney, & Rhodes, 2002). Given that individuals often value their physician's advice, they likely have a strong motivation to comply with a physician's recommendation. Thus, physicians are in an ideal position to promote physical activity among individuals with SCI. Of concern however, in a survey of 43 healthy individuals with SCI, physicians had recommended physical activity in only 48% of these cases (Zemper et al., 2003). With the suggestion that physicians are a potential source of social pressure and individuals tend to be motivated to conform to their recommendations, this lack of referral (i.e., social pressure) may be one of the factors leading to low activity levels among individuals with SCI. Further research is needed to firmly test this hypothesis.

4.3.3 Perceived behavioural control

Of the TPB constructs, PBC may be the most important determinant of physical activity (Latimer, Martin Ginis, & Craven, 2004). PBC is a function of one's beliefs about the presence of factors that may facilitate or impede participation and the perceived impact of these factors (Ajzen, 2002a). Individuals with SCI cite many factors that impede and few that facilitate participation. A lack of accessible physical activity services and facilities is the most frequently endorsed factor hindering participation (Martin et al., 2002; Tasiemski et al., 2000). In an assessment of health care programs desired but not received, 43% of respondents (n= 69) indicated a desire for physical activity programming (Warms, 1987). Further, in a sample of 43 participants, half of the participants did not feel that existing fitness programs would meet the unique needs of people with SCI. Additionally, 34% of respondents indicated being concerned about the accessibility of these facilities.

These concerns are valid. The accessibility of 50 public physical activity facilities in western Oregon was assessed in accordance with the Americans with Disabilities Act guidelines for accessibility of public facilities for all (Cardinal & Spaziani, 2003). Of the facilities assessed, none were 100% compliant with the guidelines. Interestingly, in these facilities, accessibility was worst around the exercise equipment – the most important area in a physical activity center. The findings were compared to those from a similar study that assessed the accessibility of physical activity facilities in the Kansas City metropolitan area (Figoni et al., 1998). From this comparison it was determined that despite the structural limitations noted, the facilities in western Oregon were more accessible than those in Kansas City. This result suggests that poor accessibility is likely a prevalent concern in many communities.

In addition to program availability and accessibility concerns, individuals with SCI encounter a variety of logistical and personal barriers to physical activity.

Descriptive studies identify transportation, program costs and a lack of skill and time as impediments to physical activity (Martin et al., 2002; Tasiemski et al., 2000; Zemper et al., 2003). As reported in a longitudinal assessment of 287 individuals, general financial concern (i.e.,> 25% of respondents reported financial limitations) and transportation problems (i.e., >20% reported difficultly) were highly prevalent among people with SCI (Johnson et al., 1998). Further, in a survey of 62 people, 73% were dependent on others for transportation to venues in the community (Harrison & Kuric, 1989). These problems interfere with community integration thus making participation in physical activity programs very difficult.

A perceived lack of ability to perform physical tasks is another factor impeding involvement in physical activity. Thirty-three percent of participants (n=48) who completed interviews examining leisure time activity endorsed "lacking activity skills" as a barrier to physical activity (Coyle et al., 1993). Further, in a cross-sectional study, perceived severity of disability (an indicator of physical ability) predicted physical activity behaviour among individuals with a physical disability including those with SCI (Hedrick & Broadbent, 1996). Together these findings propose that perceptions of ability may play a role in people's willingness to engage in physical activity.

Time constraints also make physical activity very difficult (Kinney & Coyle, 1989; Martin et al., 2002; Tasiemski et al., 2000). Participants in the qualitative study by Martin and colleagues indicated that postinjury, ADL take longer to perform leaving less time for leisure time physical activity. In line with this report, Pentland and colleagues (1999) found that compared to controls, men with SCI allocated more time to sleeping and personal care (e.g., bathing, dressing, bowel management). However, the men with SCI dedicated the majority of the remaining time in the day to leisure pursuits, most of which were sedentary, whereas, the able-bodied men tended to spend most of their time in productive activity (e.g., work, chores). According to these findings, individuals with SCI do have ample time in their schedules to engage in physical activity but instead, they choose to engage in sedentary activity. Thus, similar to the general population (Sallis & Owen, 1998), among individuals with SCI, a lack of time may be more of a perceived barrier than an actual barrier to physical activity participation.

Taken together, through a series of largely qualitative and descriptive studies, it has been shown that a variety of factors impede physical activity participation in the SCI population. Among these, financial problems, transportation difficulties, lack of accessible services and facilities, time and ability are the most frequently cited barriers. According to Ajzen's (2002b) conceptualization of PBC, this TPB construct captures perceptions of control over these barriers to physical activity participation. Given this conceptualization and the vast number of barriers faced by people with SCI, PBC may be a particularly potent determinant of physical activity behaviour in the SCI population (Godin, Shepard, Davis, & Simard, 1989).

4.4 Summary

Accumulating evidence from atheoretical, descriptive studies identifies possible factors related to physical activity among individuals with SCI. As with most descriptive research, this collection of studies serves a good starting point for generating research ideas. Specifically, with many of the identified reasons for an inactive lifestyle being encompassed by the attitudes, subjective norms and PBC constructs, these findings suggest that the TPB might be a suitable framework for investigating determinants of physical activity participation among individuals with SCI. Thus, given, 1) the need for theory-based investigations of physical activity determinants, 2) the strong body of evidence supporting the utility of the TPB in both nonclinical and clinical populations, and 3) the relevance of TPB constructs to the SCI population, it seems reasonable to examine the determinants of physical activity among individuals within the context of the TPB.

5.0 Applications of the TPB Framework

Following this reasoning, two studies have attempted to address the gap in SCI-specific physical activity determinants research, using tenets of the TPB as a guide. The first study was very preliminary in that it used a precursory model of the TPB (i.e., Theory of Reasoned Action) that did not include the PBC construct (Godin, Colantonio, Davis, Shephard, & Simard, 1986). Despite the absence of PBC, this study makes a worthy contribution to TPB research because it provides insight into all of the other relationships described by the TPB. Moreover, this study makes a significant contribution to SCI-specific research in that it is one of the only empirical investigations of physical activity determinants among individuals with SCI. Findings from this study indicated that among 62 individuals with SCI, intentions predicted later behaviour. However, neither subjective norms nor attitudes explained significant variance in intentions. These results attest to the important role of intentions in determining physical activity behaviour and the need to improve the prediction of intentions.

The authors attributed the poor prediction of intentions to their lack of consideration of factors that might affect volitional control over physical activity involvement (i.e., factors that could be captured by PBC). With evidence from the general population to suggest that in the context of the TPB, PBC is typically the strongest predictor of intentions, this suggestion is well-founded. Further, with a strong base of descriptive research indicating that individuals with SCI face numerous physical activity participation barriers, the possibility that PBC is a potent determinant of physical activity is worthy of further investigation.

Considering the limitations associated with this first study's exclusion of PBC, the second TPB and SCI study examined the explanatory capabilities of the TPB in its entirety (Latimer et al., 2004). Results from this investigation suggested limited utility of the TPB for explaining physical activity behaviour. Specifically, among individuals with tetraplegia, PBC emerged as the sole independent predictor of intentions and behaviour -- accounting for 30% and 6% of the variance in physical activity intentions and behaviour respectively. As in the first study by Godin and colleagues (1986), attitudes and subjective norms did not predict intentions. Further, intentions did not predict behaviour. Among individuals with paraplegia, none of the TPB constructs predicted physical activity intentions or behaviour. These results are in sharp contrast with those reported in the existing TPB and physical activity literature in general and chronic disease populations (e.g., Blanchard et al., 2003; Courneya & Friedenreich, 1997; Hagger et al., 2002).

The null findings reported in this second study may have been influenced by some measurement limitations. Specifically, the poor prediction of intentions was probably a result of the attitudes and subjective norms measures assessing the beliefs underlying each construct (i.e., indirect measures) rather than assessing the construct directly (i.e., direct measures). Although the indirect method of measurement is valid (Ajzen, 2002a), correlations between TPB constructs and intentions are smaller when measured indirectly versus directly (Armitage & Conner, 2001). Interestingly, indirect measures also were used in Godin and colleagues' study and they produced nonsignificant correlations between subjective norms, attitudes and intentions.

By contrast, the poor prediction of behaviour was likely attributable to a second measurement limitation - the lack of content validity in the physical activity measure. The measure was a modified version of a questionnaire developed for use in the general population (Godin Leisure Time Exercise Questionnaire; Godin & Shephard, 1985). Even with modifications to include SCI-relevant physical activities, the measure did not accurately capture the physical activity of the respondents. Given these two substantial measurement limitations, it seems premature to disregard the TPB as a viable framework for identifying physical activity determinants among individuals with SCI. Rather, before we can make a conclusion about the value of the TPB as a valid theoretical framework, careful consideration must be given to the appropriate measurement of TPB constructs and physical activity among individuals with SCI. A discussion follows of measurement issues pertinent to each of these domains (i.e., TPB, physical activity) and relevant to the studies included in this dissertation.

6.0 MEASUREMENT OF THE TPB CONSTRUCTS

One benefit of using a theory to identify determinants and to guide practice is that established theories come 'equipped' with an associated set of assessments of theorized variables (Brawley, 1993). In the case of the TPB, Ajzen (2002a) operationalizes each construct and provides an outline of how the constructs should be measured. The two principle guidelines for assessing TPB constructs are 1) the predictors of intentions (attitudes, subjective norms, PBC) can be measured indirectly or directly, and 2) the measures must be correspondent with the behaviour of interest regardless of the measurement approach (i.e., direct or indirect). It is important that researchers be aware of this pair of guidelines when using the TPB to identify physical activity determinants as they have implications for the strength of the research findings and design.

6.1 Measurement guideline 1: The use of indirect versus direct measures of TPB constructs

The first measurement guideline indicates that predictors of intentions can be measured either directly or indirectly. Direct measures simply ask participants to judge each construct on a set of scales (e.g., PBC item: "I feel like I have control over whether I do or do not participate in physical activity three times per week"). Indirect measures require participants to rate their corresponding beliefs. These belief-based measures are defined according to an expectancy-value model. In the context of physical activity, individuals' ratings of beliefs about the likelihood that participating in physical activity will elicit a particular outcome (the expectancy component; e.g., PBC expectancy item: "*I expect that I will have transportation difficulties*") are multiplied by their ratings of the desirability of that outcome (the value component; e.g., PBC value item: "*Transportation difficulties would make it difficult/easy for me to participate in physical activity three times per week*").

According to Ajzen (2002a), indirect and direct measures assess the *same* construct – however, indirect measures provide a latent form of the construct (unmeasured) whereas direct measures provide a manifest form (measured). Consistent with Ajzen's suggestion, a meta-analysis of 187 published TPB studies reported strong correlations between the direct and indirect measures of TPB variables indicating that both are tapping similar constructs (Armitage & Conner, 2001). The benefit of using indirect measures is that they provide more information than the direct measures (Valois, Desharnais, Godin, Perron, & Lecompte, 1993). Specifically, from belief-based measures it is possible to gain insight into the underlying cognitive foundation of each TPB construct. Thus, not only is it possible to explore what people think but also why they have certain thoughts. This information has great value for developing effective behavioural interventions (Ajzen, 2002a).

Although this benefit makes the use of indirect measures in physical activity determinants research very appealing, there is a substantial drawback to their use. When the multiplicative composite score of an indirect measure is used in simple correlation or regression analysis (the commonly used statistical techniques to examine TPB relationships), the size of the coefficient depends upon the scale used (Ajzen, 1991; Ajzen, 2002a; French & Hankins, 2003; Gagne & Godin, 2000; Hankins, French, & Horne, 2000; Valois et al., 1993). For example, the magnitude of the correlation can vary according to the location of the zero point (-3 to +3 versus 1 to 7) or the size of the scale interval (1 to 7 versus 0 to 1). Of concern, this measurement constraint may attenuate the prediction of intentions (Ajzen, 1991; Wankel, Mummery, Stephens, & Craig, 1994). Therefore, due to this measurement confound, it is recommended that belief-based measures not be used as predictors in the TPB (Hankins et al., 2000). Because the problem pervades the TPB literature, several additional belief-centered measurement strategies have been suggested (see French & Hankins [2003] for a review). Alternatively, it is advisable simply to use direct measures of TPB constructs in investigations of physical activity determinants.

6.2 Measurement guideline 2: The importance of measurement correspondence

The second measurement guideline stipulates the need for correspondence between the predictors of behaviour and the behaviour itself. Specifically, the measures must be congruent with the target, action, context and time (TACT) elements of behaviour. Thus, if behaviour is defined as mild intensity cycling (action) on an arm ergometer (target) at the gym (context) for 30 minutes a day in the past month (time), the intentions, PBC, attitudes and subjective norms constructs should be operationalized in terms of these same elements. To note, some of the TACT elements can be aggregated to make the behaviour more general. For example, items may broadly refer to physical activity in order to combine the action and target element. Of course, if elements of behaviour are combined, elements of the other TPB variables also should be combined.

This guideline is necessary because when there is a lack of measurement correspondence between constructs, the relationships between TPB variables are weakened (Ajzen & Timko, 1986). For example, in a study that defined physical activity in terms of both intensity and frequency, but defined intentions only in terms of frequency (i.e., correspondence was lacking in the action element), the intentions-behaviour relationship was weaker than in studies with congruent measures of intentions and behaviour (Dzewaltowski, Noble, & Shaw, 1990). Thus, to create conditions that will optimize TPB relationships, researchers should pay careful attention to ensure all TPB measurement items are consistent with the TACT elements of behaviour.

In addition to influencing the strength of relationships, item correspondence with the time element of behaviour shapes research design. Defining the time element of behaviour requires establishing a measurement time frame. In the example above, the measurement time frame is the past month. In this case, for intentions, subjective norms, and PBC to be correspondent with this time frame, they should be measured one month prior to measuring behaviour (e.g., correspondent intentions item: *"I intend to engage in cycling on an arm ergometer at the gym for 30 minutes a day in the next month – strongly disagree/strongly agree"*).

Of benefit, not only does this prospective measure create measurement correspondence, it maintains fidelity to the tenets of the TPB. According to the TPB, intentions and PBC *predict* behaviour. To allow for an assessment of this predictive relationship, a temporal sequence is necessary, with exposure to the determinant variables (intentions, PBC) preceding the outcome (behaviour; Bauman, Sallis, Dzewaltowski, & Owen, 2002). Specifically, this prospective research design allows investigators to develop an understanding of the *processes* of behaviour change proposed by the TPB and rules out that the relationships with behaviour are due to a common antecedent (Baranowski, Anderson, & Carmack, 1998). Nonetheless, due to concerns that intentions vary inversely with the time between the measurement of intentions and the behaviour (Ajzen & Madden, 1986), many TPB studies have employed a cross-sectional design. However, in their meta-analysis, Hausenblaus and colleagues (1997) indicated no support for the proposition that a delay between the measurement of intentions and behaviour weakened the intentions-behaviour relationship (i.e., the effect sizes were the same when intentions were measured proximal and distal to behaviour), thus further advocating the use of a prospective research design in the context of the TPB.

6.3 Summary

According to Ajzen, the TPB constructs can be measured either directly or indirectly and should be congruent with the TACT elements of the behaviour of interest. These guidelines are useful for developing TPB-based questionnaires and investigations. In applying the first guideline, although indirect measures have demonstrated validity, it is recommended that direct measures be used. This direct approach circumvents the measurement constraints of the belief-based multiplicative composite scores, thus preventing the potential attenuation of correlational relationships. Application of the second guideline calls for the use of a prospective research design. In addition to creating measurement correspondence, a benefit of this prospective design is that it allows for the examination of the cognitive-behavioural processes hypothesized by the TPB. Therefore, in terms of examining physical activity determinants among individuals with SCI conducted in the context of the TPB, the theoretical constructs should be assessed prospectively using direct measures correspondent with the TACT elements of the physical activity behaviour.

7.0 Measurement of Physical Activity

The lack of a psychometrically sound measure of physical activity for use in the SCI population is a second measurement issue limiting physical activity determinants research. As a result of this gap, no large data sets exist documenting physical activity patterns, consequently preventing the identification of population-based physical activity determinants. In addition to limiting determinants research, without a measure of physical activity, investigators are unable to establish the long-term benefits of physical activity participation and to assess the effectiveness of interventions to increase physical activity (Rimmer et al., 1996). Hence, it is critical that a valid and reliable measure of physical activity be developed for use among individuals with SCI in order to further advance behavioural determinants, health and intervention research.

7.1 The basic attributes of a physical activity assessment tool

A valid measure of physical activity must be able to approximate an individual's level of energy expenditure by assessing activity type, duration, frequency, and intensity (Sallis & Saelens, 2000). A variety of objective (e.g., direct calorimetry, doubly-labeled water, accelerometers) and subjective (e.g., self-report, observation) assessment tools have been developed to measure various physical activity attributes. Epidemiological studies of physical activity determinants rely primarily on self-report measures (e.g., surveys) to assess physical activity. Of benefit, this approach is cost-effective and convenient (can be administered quickly, only requires paper and a pencil), prevents behavioural reactance (respondents do not have opportunity to change their behvior) and provides a reasonably accurate estimate of activity (the measure must have demonstrated reliability and validity; Dishman, Washburn, & Schoeller, 2001; Heath & Fentem, 1997; Kriska & Casperson, 1997). In contrast, some objective measures provide a more accurate estimate of energy expenditure but are very costly (i.e., doubly labeled water costs approximately $3,500/person) and do not allow individuals to partake in their normal daily routine (direct calorimetry requires individuals to reside in a respiratory chamber for the duration of the measurement period) making them less suitable for large population-based studies. By virtue of being highly accurate, however, objective measures serve as a "gold standard" for establishing the criterion validity of self-report measures (Kriska & Casperson, 1997).

7.2 A critique of the validity of physical activity measures developed for able-bodied individuals for use in the SCI population

More than 30 physical activity surveys have been developed for use in the general population (refer to Table 1 for a list of commonly used measures; Kriska & Casperson, 1997). These questionnaires vary by degree of complexity (single-item versus interviewer administered), time frame (3-day versus lifetime) and type of activity assessed (LTPA versus lifestyle activity). Although many of these surveys have established reliability and validity in the general population, two key factors render these measures invalid in the SCI population: 1) the continuum of activities assessed is narrow and representative of activities commonly performed by people *without* SCI, and 2) the classification systems used to estimate the intensity of reported activities are based on standards set for people *without* SCI. A discussion of each of these concerns follows.

Table 1

A Review of The Attributes of Commonly Used Self-Report Measures of Physical Activity

					Assessing Activity Type						Assessing Intensity		
	Type	Intensity	Duration	Frequency	LTPA	Work	Household	Transportation	Personal Care	Ambulatory Activities	Assign MET	Assign Intensity	Inappropriate Definition
Godin Leisure Time Physical Activity Questionnaire (Godin et al., 1985)		X		X	X					X	X	X	X
Minnesota Leisure-Time Physical Activity Questionnaire (Taylor et al., 1978)	X	X	X	X	X		X			X	X		
Canada Fitness Survey (Canadian Fitness Survey, 1983)	X	X	X	X	X		X			X	X	X	X
Paffenbarger Physical Activity Questionnaire (Paffenbarger, Wing, & Hyde, 1978)	X	X	X	X	X		X			X			
Seven-Day Physical Activity Recall (Sallis et al., 1985)	X	X	X	X	X					X	X		X
CARDIA Physical Activity History (Jacobs, Hahn, Pirie, & Sidney, 1989)	X	X		X	X	X	X			X	X	X	
Baecke Questionnaire of Habitual Physical Activity (Baecke, Burema, & Fruters, 1982)		X		X	X	X				X		X	

	Type	Intensity	Duration	Frequency	Assessing Activity Type						Assessing Intensity		
					LTPA	Work	Household	Transportation	Personal Care	Ambulatory Activities	Assign MET	Assign Intensity	Inappropriate Definition
Framingham Physical Activity Index (Kannel & Sorlie, 1979)			X		X	X					X		
Health Insurance Plan of New York Activity Questionnaire (Shapiro, Weinblatt, & Frank, 1969)			X	X	X	X		X		X			
Lipid Research Clinics Questionnaire (Ainsworth, Jacobs, Jr., & Leon, 1993)					X	X	X	X	X				
Stanford Usual Activity Questionnaire (Sallis et al., 1985)					X			X		X			
Physicial Activity for Disabled Scale (Rimmer, Riley, & Rubin, 2001)	X		X	X	X	X	X	X	X				
Physical Activity Scale for Individuals with Physical Disability (Washburn, Zhu, McAuley, Frogley, & Figoni, 2002)	X	X	X	X	X	X	X	X	X	X	X	X	

7.2.1 Assessing the type of activity

With impaired functional ability in the SCI population, the physical demands of most activities increase, thus creating a need for a measure of physical activity that reflects the types of activity common among individuals with SCI. As described in Table 1, many of the existing measures of physical activity focus solely on leisure time physical activity (LTPA; e.g., sport, recreation, gardening, household chores) and disregard the energy costs of ADL (Heath & Fentem, 1997). For example, the Godin Leisure Time Exercise Questionnaire (Godin & Shephard, 1985) examines how frequently respondents participate in recreational activities only (e.g., basketball, swimming, dancing). Failing to assess other types of physical activity (e.g., work, household chores, personal care) may largely underestimate energy expenditure among individuals with SCI (Rimmer et al., 2001). As indicated in an assessment of the physical strain of performing many ADL, activities such as transferring and negotiation architectural barriers (e.g., curbs, ramps) represent strenuous tasks particularly among individuals with tetraplegia (Janssen et al., 1996). Therefore, ADL *and* LTPA should be assessed to provide an accurate indication of energy expenditure among individuals with SCI.

In addition to having a limited scope, many surveys include activities that require independent ambulatory capabilities (see Table 1). For instance, the Minnesota Leisure-Time Physical Activity Questionnaire (Taylor et al., 1978) requires participants to indicate their frequency of involvement in a variety of listed physical activities. Among the listed activities are walking, jogging and cross country hiking. Although these types of measures may be valid for the few individuals with SCI who are capable of independent ambulation, these measures are wholly inappropriate for the majority of individuals with SCI who use a wheelchair as their primary mode of mobility (Canadian Paraplegic Association, 2000b). Evidently, special consideration must be taken in assessing activity type. Hence, a valid measure of physical activity for individuals with SCI must be sensitive to 1) energy expenditure across the entire activity spectrum (ADL, LTPA), and 2) individuals' mode of mobility.

7.2.2 Assessing the intensity of activity

Special consideration must also be given to the assessment of activity intensity. One strategy of assessing intensity is to *assign* a standard metabolic value (MET - the unit of measurement for energy expenditure) to each activity performed (see Table 1). The MET values are then summed to generate an index of energy expenditure. For example, the Canada Fitness Survey (Canadian Fitness Survey, 1983) assigns a MET value of 3.0 to walking at a light intensity and a MET value of 12.0 to running at a light intensity. This scoring algorithm is problematic because the MET values are based on standards set for able-bodied individuals. Furthermore, impaired autonomic functioning associated with SCI slows metabolic functioning, consequently making this method invalid for use among individuals with SCI (Mollinger et al., 1985).

A second strategy for quantifying intensity is to *assign* a category of intensity – mild, moderate or heavy – to each activity and then tally the amount of time spent in each intensity category (see Table 1). For example, the Paffenbarger Physical Activity Questionnaire (Paffenbarger et al., 1978) provides a list of sitting, light, moderate and vigorous activities and asks participants to indicate how much time they spend doing activities from each category. The obvious problem with this approach is that some individuals with SCI exert far more energy than others when performing similar activities. The physical strain of deskwork for example, is significantly greater for a person with tetraplegia than for someone with paraplegia or without a disability (Janssen et al., 1996).

A third strategy is to allow individuals to *self-designate* the level of intensity for each activity (see Table 1). Given the heterogeneous physiological profile of the SCI population, this approach is likely the most suitable. However, the existing guidelines for self-designating activity as mild, moderate and heavy intensity, suffer from the same overriding limitation – they were developed for able-bodied individuals only. For example, the Seven-Day Physical Activity Recall (Sallis et al., 1985) defines moderate intensity activity as "those activities that produce feelings similar to those accompanying brisk or fast walking." With a high prevalence of wheelchair use, this analogy clearly is inappropriate for people with SCI. Further, the Canada Fitness Survey (Canadian Fitness Survey, 1983) defines moderate intensity activity as activity which results in "some perspiration; above normal breathing." With some people with SCI experiencing a complete loss of or severely reduced sweat capacity (Price & Campbell, 1999; Yaggie, Niemi, & Buono, 2002), this intensity cue is not relevant. Therefore, to account for individual differences in physiological responses to physical activity, intensity definitions are needed that capture the unique characteristics of the SCI population.

7.2.3 Summary

In summary, despite the existence of numerous physical activity surveys developed for the general population, none appropriately reflect all of the attributes (i.e., activity type and intensity) of the physical activity performed by people with SCI. In reviewing the shortcomings of these measures, it is apparent that a valid measure for use among individuals with SCI must 1) assess all types of physical activity (ADL, LTPA),

2) take into consideration mode of mobility, 3) allow for self-designation of the intensity level of each activity, and 4) provide physiologically relevant intensity definitions.

7.3 A critique of the validity of generic physical activity measures developed for individuals with physical disability for use in the SCI population.

In realizing the limitations of the scales developed for the general population, two attempts have been made to develop scales that measure physical activity among people with various physical disabilities (Rimmer et al., 2001; Washburn et al., 2002). Both the Physical Activity and Disability Survey (PADS; Rimmer et al., 2001) and the Physical Activity Scale for Individuals with Physical Disabilities (PASIPD; Washburn et al., 2002) assess a variety of types of activity (e.g., ADL, LTPA) and account for variations in mobility. Yet unfortunately, neither includes a completely valid assessment of intensity.

Specifically, the PADS assesses frequency and duration for both ADL and LTPA activities but only assesses intensity for selected LTPA activities. Failing to account for the intensity of ADL will result in an underestimation of energy expenditure. In contrast, the PASIPD does account for intensity for all types of activity measured. But, by assigning activities to intensity categories and using MET values to calculate total energy expenditure, like the scales developed for the able-bodied population, this measure assumes that the intensity of an activity is the same for all individuals with any type of physical disability. A further flaw is that neither the PADS nor the PASIPD has demonstrated criterion validity in *any* population, let alone those with SCI. Consequently, it is unknown whether these scales provide information consistent with "gold standard," objective measures of energy expenditure. The constraints of these generic surveys developed for individuals with a physical disability suggest that in order to gain an accurate understanding of physical activity among individuals with SCI, a SCI-specific measure is needed.

8.0 Conclusion

In conclusion, emerging evidence indicates an important role for physical activity in enhancing health among survivors of SCI. Of concern however, the majority of individuals with SCI are not active enough to accrue the health-enhancing benefits of physical activity. Thus, there is a pressing need to develop interventions to promote participation. In developing effective interventions it is advisable to tailor programs to target theory-based determinants of behaviour. The adoption of this approach in the SCI population is hindered by a lack of theory-driven investigations of physical activity determinants. The TPB has been suggested as a useful framework for examining behavioural determinants. However, support for this proposition is weak due to constraints in the measurement of the theoretical constructs and the lack of a valid and reliable measure of physical activity for use among people with SCI. Together, the lack of the fundamental tools on which to base an effective intervention (i.e., a theoretical framework and a physical activity measure) necessitates a "bottom-up" research approach. First, a valid and reliable measure of physical activity must be developed. Second, using this measure in combination with an appropriate assessment of theoretical constructs, theory-based physical activity determinants must be identified. Finally, by targeting determinants identified as important, a theory-driven physical activity intervention can be developed and implemented.

This programmatic, "bottom-up" approach guided the following series of dissertation studies. Specifically, the purpose of Study 1 was to examine the construct validity of the PARA-SCI – a newly developed SCI-specific measure of physical activity. Using the PARA-SCI as an outcome measure, the purpose of Study 2 was to identify determinants of physical activity within the context of the TPB. Using findings from Studies 1 and 2 as a foundation, the purpose of Study 3 was to test the efficacy of a theory-based intervention promoting physical activity participation among individuals with SCI. These studies are presented next.

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CHAPTER 2

The Construct Validation of the Physical Activity Recall Assessment for Individuals with Spinal Cord Injury

Abstract

Purpose: To examine the construct validity of the Physical Activity Recall Assessment for Individuals with SCI (PARA-SCI). **Methods**: Two studies were conducted. Study 1 assessed convergent validity. For 73 individuals with SCI, measures of aerobic fitness and muscular strength were correlated with PARA-SCI scores. Study 2 involved construct validation by extreme groups. PARA-SCI scores from 158 individuals with SCI were compared between groups differing on demographic, disability and behavioural characteristics. **Results**: Scores from the leisure time physical activity (LTPA) and cumulative activity PARA-SCI categories correlated positively with parameters of aerobic fitness and muscular strength. Scores from the lifestyle activity PARA-SCI category were not consistently associated with fitness parameters. LTPA category scores were able to differentiate between-groups differing by age, gender, fitness club or sports team membership and frequency of participation in LTPA. Lifestyle and cumulative activity scores were not able to distinguish between most groups. **Conclusion**: Study 1 provides evidence of the convergent validity of the PARA-SCI LTPA and cumulative activity categories. Study 2 provides further evidence of the validity of the LTPA category by demonstrating differences in extreme groups. Together these findings provide support for the construct validity of the PARA-SCI LTPA category and its utility for assessing LTPA among individuals with SCI. These results also highlight measurement constraints of the lifestyle activity and cumulative activity categories.

Introduction

The health benefits of physical activity participation have been clearly established (US Department of Health and Human Services, 1996). For individuals with spinal cord injury (SCI), an active lifestyle is particularly important given that physical activity contributes to the maintenance of functional independence and the management of many comorbidities (e.g., pain, depression; Duran, Lugo, Ramirez, & Eusse, 2001; Hicks et al., 2003). Nonetheless, physical activity participation rates among individuals with SCI are alarmingly low (Dearwater, Laporte, Cauley, & Brenes, 1985). Consequently, a call has been put forth for research initiatives directed towards developing an understanding of physical activity patterns and establishing the long-term health benefits of physical activity participation among individuals with SCI (Rimmer, Braddock, & Pitetti, 1996). A few studies have attempted to address this call (Godin, Colantonio, Davis, Shephard, & Simard, 1986; Latimer, Martin Ginis, & Craven, 2004), however, they have been limited by the lack of a valid and reliable measure of the outcome of interest – physical activity.

A widely used, practical means of assessing physical activity is the self-report questionnaire. These instruments allow for the assessment of the fundamental dimensions of physical activity (i.e., frequency, intensity, type and duration) in an easy and cost-effective manner (Sallis & Owen, 1998). Numerous self-report physical activity measures exist, the majority of which were developed for use in the general population. These measures largely focus on sport and recreation activities requiring independent ambulation (e.g., walking, jogging). For the SCI population in which wheelchair use is predominant (Canadian Paraplegic Association, 2000) and activities of daily living

(ADL) are a primary source of physical activity (Pentland, Harvey, Smith, & Walker, 1999), many of these instruments are not sufficiently sensitive. Consequently, it is likely that many of the existing measures would severely underestimate physical activity among individuals with SCI (Heath & Fentem, 1997).

From the more than 30 existing self-report physical activity measures, only two instruments capture the unique lifestyle characteristics of individuals with a physical disability such as SCI. Both the Physical Activity and Disability Survey (PADS; Rimmer, Riley, & Rubin, 2001) and the Physical Activity Scale for Individuals with Physical Disabilities (PASIPD; Washburn, Zhu, McAuley, Frogley, & Figoni, 2002b) assess a variety of types of activity (e.g., ADL, work-related activity and leisure time physical activity [LTPA]) and account for variations in mobility. Although the scope of these two scales is appropriate for individuals with SCI, the utility of these measures for examining physical activity patterns is limited by flawed methods of assessing a crucial physical activity dimension – intensity.

Specifically, the PADS assesses the frequency and duration of structured exercise, LTPA and household activities but neglects to measure intensity for each of these activity categories. Rather, intensity is assessed only for activities included in the exercise category. Because intensity is an important determinant of the magnitude of the health benefits derived from physical activity participation (Bauman & Owen, 1991), the lack of an intensity measure for LTPA and household activities restricts the use of the PADS for examining physical activity patterns in relation to health outcomes.

Unlike the PADS, the PASIPD does account for intensity for all types of activity measured. For each activity category, the reported number of hours of activity per day is multiplied by a standard metabolic value (MET). However, this scoring algorithm is problematic for two reasons. Firstly, activity intensity varies between individuals with and without SCI. With impaired metabolism and loss of voluntary muscle control as a consequence of SCI, the number of METs expended by an individual with SCI for a particular task will not be equivalent to the number of METS expended by an individual without SCI (Mollinger et al., 1985; Monroe et al., 1998). Secondly, activity intensity is also variable within the SCI population. The intensity of many ADL is higher for individuals with tetraplegia compared to individuals with paraplegia (Janssen, van Oers, van der Woude, & Hollander, 1994). Taken together, these problems suggest that assigning generic MET values is an unsuitable approach to characterizing activity intensity among individuals with SCI. Given this diversity in physiological functioning and the unique lifestyle characteristics of people with SCI, the need for a SCI-specific measure of physical activity is clear.

The Physical Activity Recall Assessment for individuals with SCI (PARA-SCI; Martin Ginis, Latimer, Craven, & Hicks, 2004) was developed to meet this need. Administered in a semi-structured telephone interview format, the PARA-SCI is a measure of physical activity specifically for individuals with SCI who use a wheelchair as their primary mode of mobility. The PARA-SCI provides an estimate of total time spent performing self-reported mild, moderate and heavy intensity LTPA (activity that one chooses to do during free time) as well as lifestyle activity (routine activities:

personal hygiene, household chores, work-related activity, passive leisure activity). Preliminary data indicate that the PARA-SCI is a reliable measure. Over repeated administrations 1 week apart, test-retest reliability coefficients (*ICC*>.41; Martin Ginis et al., 2004) suggested adequate reliability for measures of all of three PARA-SCI activity categories. Although this initial evidence is promising, the construct validity of this scale is yet to be examined. Moreover, it is not yet known whether the PARA-SCI scores are indicative of physical fitness and sensitive to variation in physical activity levels. If the PARA-SCI is to be used as a tool for examining physical activity patterns and their relation to health outcomes, the construct validity of the PARA-SCI must be established. Given this need, the goal of the present study was to examine the construct validity of the PARA-SCI.

Construct validity can be established using a variety of different methods (Streiner & Norman, 1999). The two methods used in this study were the demonstration of convergent validity and extreme groups comparisons. For physical activity measures, convergent validity is typically indicated by demonstrating correlations between the scale scores and measures of physical fitness (Sallis & Saelens, 2000). With research indicating that physical activity leads to improvements in physical fitness among people with SCI (Hicks et al., 2003), it was hypothesized that PARA-SCI scores would correlate positively with physical fitness parameters. Validation by extreme groups involves administering the measure to two groups who should differ in terms of their physical activity and confirming that the groups' physical activity scores are in fact significantly different. In this study, extreme groups were created on the basis of demographic, disability and behavioural characteristics. Consistent with previous research in the general population, it was hypothesized that LTPA scores would be greater for men than women, younger participants than older participants, those belonging to a gym or sports team than those who do not and those reporting engaging in frequent LTPA than those reporting engaging in infrequent LTPA (Centers for Disease Control, 2004; Craig & Cameron, 2004). In accordance with SCI-specific research showing that individuals with tetraplegia participate in fewer daily activities compared to individuals with paraplegia (MacDonald, Nielson, & Cameron, 1987), it was predicted that individuals more physically-disabled (i.e., complete lesion, tetraplegia, power wheelchair use) would report less strenuous lifestyle activity than individuals less physically-disabled (i.e., incomplete lesion, paraplegia, manual wheelchair use). Further, it was hypothesized that individuals who were working or attending school would accumulate more minutes of mild intensity lifestyle activity than those who were not working or attending school (Canadian Paraplegic Association, 2000).

Two study designs were used to test the study hypotheses. A correlational research design was used to demonstrate convergent validity whereas a cross-sectional design involving planned comparisons was used for the construct validation by extreme groups. For this reason, convergent validity and extreme groups were examined in separate studies with Study 1 examining the convergent validity of the PARA-SCI and Study 2 examining extreme groups comparisons of the PARA-SCI scores.

STUDY 1 - CONVERGENT VALIDITY

Method

Participants

Participants were 73 individuals with SCI. Study eligibility requirements were the criteria for PARA-SCI administration: (a) neurological impairment secondary to SCI (i.e., traumatic or nontraumatic SCI), (b) 18-65 years of age, (c) wheelchair use (power or manual) as the primary mode of mobility outside of the home, (d) able to read and speak English, and (e) absence of memory deficiencies. To ensure that the participant had adequate residual function to perform the selected fitness tests, an additional requirement was a lesion level of C_5 or below. Participants were recruited using convenience-sampling methods. The majority of individuals were community dwelling (97.3% out-patients, 2.7% in-patients) and were recruited through community physical activity programs (38.3%), out-patient medical clinics (16.4%) and the consumer databases associated with these services (31.5%). The remaining 13.7% of participants were recruited using snowball sampling whereby other participants in the study referred them. The demographic characteristics of the sample are summarized in Table 1. All participants gave written informed consent for their involvement in the study. The study received approval by the human research review boards at the participating institutions.

Measures

Physical activity: Physical activity was assessed using the PARA-SCI (refer to Appendix A). The PARA-SCI provides an estimate of total time spent doing mild, moderate and heavy intensity physical activity for the three-day period preceding the interview. Physical activity was defined as any activity requiring physical exertion (Bouchard & Shephard, 1994). Participants self-designated the intensity of each activity using established PARA-SCI definitions that were provided in written format prior to the interview. A trained research assistant administered the PARA-SCI via telephone according to a detailed protocol.

During the interview, the research assistant coded each reported physical activity as either LTPA or lifestyle activity. LTPA included all structured and unstructured physical activities that the individuals chose to do during their free time (Bouchard & Shephard, 1994). All other reported physical activities were classified as lifestyle activity. Mean daily total LTPA and lifestyle activity scores were calculated by averaging the number of minutes reported for all intensity categories of LTPA and lifestyle activity, respectively. Further, a mean daily total cumulative activity PARA-SCI score was calculated by averaging the number of minutes of physical activity reported for all three days. As well, for each category of activity (i.e., LTPA, lifestyle activity), separate scores for each level of intensity were calculated.

Muscle strength: Muscle strength was assessed to determine the maximum load that could be lifted in one repetition (1RM) for chest press (unilaterally), biceps curl (unilaterally) and lat pulldown. Tests were terminated at the participant's point of fatigue. Attainment of 1RM was confirmed by participants' indication that their last lift was 'heavy intensity' activity, as defined by the PARA-SCI.

Testing of muscle strength took place on multi-station, wheelchair accessible weight training systems at two testing sites. Sixty-two percent of the participants completed all strength testing at a community-based centre for health promotion (Site 1) using Equalizer Exercise Machines (Red Deer, AB, Canada). The remaining 38% of participants completed the strength testing at an in- and out-patient rehabilitation facility (Site 2) using a ProGym weight machine (Endorphin Corporation, Pinellas Park, FL) for lat pulldown and an H480 Access Trainer (Hoist Fitness System, San Diego, CA) for biceps curl and chest press. The weight systems at both testing sites were calibrated using a strain gauge (Aries Instruments Limited, Toronto, ON, Canada) and amplifier (Vishay Measurement Instrument Company, Raleigh, NC) thus allowing the loads lifted at either site to be equated.

Aerobic fitness: VO_{2peak} was assessed to determine aerobic fitness through a progressive exercise test on an arm ergometer (Monark Ergomedic 881E, Varberg, Sweden). Expired gases were collected during the test using the VO_{2000} portable metabolic unit (MedGraphics, St. Paul, MN, USA) for measurements of O_2 uptake and CO_2 output. Heart rate was determined using a telemetry monitor (Polar Electro, Woodbury, NY, USA). The highest value recorded during the test averaged over 30 seconds was deemed VO_{2peak}. Attainment of VO_{2peak} was corrobarated by participants' self-report of 'heavy intensity' activity in accordance with the PARA-SCI guidelines, and an observed ratio of carbon dioxide produced to oxygen consumed in excess of 1.00 (Manns & Chad, 1999). The workload at which the participant was cycling when VO_{2peak} was reached was used as an additional index of aerobic fitness.

For all participants, the first 3 increments of this continuous, multi-stage test were 2 minutes and the remaining increments were 1 minute. Initial workload and the increment of workload increase were determined by lesion level (tetraplegia, paraplegia). Individuals with tetraplegia began cycling at a rate of 50 rpm at a workload of 0W (DiCarlo, 1988; Manns et al., 1999). In each proceeding stage, the cycling rate was held constant and the workload was increased by 5W (Lasko-McCarthey & Davis, 1991). Individuals with paraplegia began cycling at a rate of 50 rpm at a workload of 25 W (Van Loan, McCluer, Loftin, & Boileau, 1987). In each proceeding stage, the cycling rate was held constant and the workload was increased by 10W for women and 15 W for men (Jacobs et al., 1997). For participants who reached the maximum resistance on the arm ergometer (100 W) before reaching their volitional point of exhaustion, the resistance was held constant (100 W) and the cycling rate was increased by 5 rpm. At 100W an increase in 5 rpm is equivalent to a 10 W increase in workload (Monark Exercise AB, n.d.). Tests were terminated at the participant's volitional point of exhaustion.

Procedure

Participants completed an assessment of muscle strength and aerobic fitness at one of two fitness-testing sites. Subsequently, participants were randomly assigned to an interview date. Interviews were scheduled for a date at least four days after the initial assessment to ensure that the participant's fitness assessment was not included in the 3-day recall. Participants were given a package of study materials including a copy of the PARA-SCI intensity definitions, an appointment reminder card and a $15 honorarium.

On the appointed date, a trained research assistant contacted the participant via telephone. Participants were required to have their copy of the intensity definitions available to refer to during the interview. In accord with the PARA-SCI interview script, the interviewer reviewed the definitions of physical activity (i.e., any activity requiring physical exertion) and of each intensity category. Participants were asked if they understood the definitions and if they had any questions before proceeding. At the completion of the interview, participants were debriefed and thanked.

Analyses

Preliminary descriptive analyses. Exploratory analyses were performed to examine the moderating effects of test location, gender and lesion characteristics (level, completeness) on each fitness parameter and PARA-SCI score. These analyses were necessary because gender (American College of Sports Medicine, 1998; Craig et al., 2004) and lesion characteristics have been shown to moderate physical fitness level (Janssen et al., 1994). First, Pearson chi-square analyses were conducted to determine whether the distributions of gender and lesion characteristics were not significantly different at both test locations. Second, separate univariate analyses of variance (ANOVA) were conducted to examine group differences in each fitness parameter as a function of test location, gender and lesion characteristics. For a few of these analyses, the Levene's test indicated unequal variances between groups that could not be rectified by transforming the variable. Because ANOVA is robust to the violation of the homogeneity of variance assumptions (Tabachnick & Fidell, 2001), the analyses proceeded using untransformed variables.

Convergent validity. A series of correlation analyses were performed to examine the convergent validity of the PARA-SCI. Specifically, one-tailed, bivariate correlations were conducted between each of the PARA-SCI scores and each of the fitness parameters. One-tailed tests were appropriate given our apriori hypotheses of positive relationships between PARA-SCI scores and each of the fitness variables. Unless otherwise stated, the p-value for all analyses was set at $p<.05$.

Results

Participants

Participant demographic characteristics are presented in Table 1. Chi-square analyses revealed no significant differences in the distributions for gender and lesion characteristics between testing sites (*p*s>.05).

Preliminary Descriptive Analyses

Muscle strength. Due to missing data (i.e., not all participants could complete all of the tests) and the exclusion of participants who classified the intensity of their 1RM exercise as less than heavy, the number of participants in each of the following analyses fluctuates between tests, ranging from 60 to 66.

Table 2 provides means and standard deviations for each of the fitness parameters. For all of the strength parameters, a main effect for gender emerged such that the men lifted significantly more weight than the women (all *p*s<.05). For all of the muscle groups with the exception of right biceps, a main effect for lesion level also emerged. Individuals with paraplegia had greater 1RM chest and latissimus dorsi strength than individuals with tetraplegia (*p*s<.05). Conversely, individuals with tetraplegia had greater 1RM left biceps strengthen then individuals with paraplegia (p=.46). No differences between test location or lesion completeness emerged.

Aerobic fitness. All 73 participants completed the aerobic fitness test. However, according to the criteria confirming attainment of VO_{2peak} (i.e., RER ≥ 1.00 and self-reported heavy intensity of activity at peak) only 48 individuals reached their VO_{2peak} during the test. A chi-square analysis indicated that significantly more individuals with paraplegia (80.6%) than tetraplegia (51.5%) attained VO_{2peak}, χ^2 (1) = 6.91, p=.009. There was no difference in the gender distribution between those who attained VO_{2peak} and those who did not. Only data from those 48 individuals who attained VO_{2peak} were used for the remaining analyses involving the aerobic fitness parameters.

Separate ANOVAs on each aerobic fitness parameter revealed a main effect for lesion level (ps<.05). VO_{2peak} and workload at VO_{2peak} were significantly greater among individuals with paraplegia compared to those with tetraplegia. The main effect for test location, gender and lesion completeness was not significant.

Given the moderating effects of gender and lesion level, each fitness parameter was standardized (converted to a z-score) accordingly. Right biceps 1RM was standardized for gender only. The remaining 1RM scores were standardized for gender and lesion level. VO_{2peak} and workload were standardized for lesion level.

Convergent validity

In an assessment of convergent validity, bivariate correlations were calculated between PARA-SCI scores and each standardized fitness parameter. The correlations between the main outcome variables are presented in Table 3. According to Cohen's (1992) guidelines, the effects for all significant correlations were small (r=.10-.29) to medium-sized (r=.30-.49).

Muscle strength. Biceps 1RM correlated positively with total and moderate and heavy intensity LTPA (*r*s>.21, *p*s<.05). Thus, as hypothesized, greater time spent engaging in LTPA, particularly moderate and heavy intensity LTPA, was related to greater 1RM biceps strength. Biceps strength also correlated with heavy intensity lifestyle and cumulative activity (*r*s>.30, *p*s<.008) indicating that greater time spent engaging in all modes of heavy intensity physical activity was associated with greater biceps 1RM. Left chest 1RM correlated only with moderate intensity LTPA (*r*=.23, *p*=.03) such that individuals reporting more moderate intensity LTPA had greater left chest strength. Right chest and lat pulldown 1RM were not related to any of the PARA-SCI scores.

Aerobic fitness. As hypothesized, VO_{2peak} correlated with heavy intensity LTPA and moderate and heavy intensity cumulative activity (*r*s>.26, *p*s<.04). Individuals spending more time engaged in moderate and heavy intensity cumulative activity had greater aerobic endurance. Workload was significantly related to moderate and heavy intensity and total LTPA as well as heavy intensity cumulative activity (*r*s>.28, *p*s<.02). Therefore, as predicted, individuals reporting more minutes of physical activity, particularly moderate and heavy intensity LTPA, attained a greater workload at VO_{2peak}.

Discussion

Study 1 provides preliminary evidence of the convergent validity of the PARA-SCI. Individuals who reported more minutes of moderate and heavy intensity LTPA and cumulative activity on the PARA-SCI exhibited greater physical fitness than individuals who reported fewer minutes of activity at these intensities. These findings are consistent with the large body of evidence indicating that physical fitness is directly related to the dose of physical activity performed at more vigorous intensities (American College of Sports Medicine, 1998). Further, the magnitude of the correlations between the aerobic fitness parameters and the PARA-SCI scores is comparable to values noted in validation studies of existing self-report physical activity surveys (e.g., PADS, Godin Leisure Time Exercise Questionnaire; Godin & Shephard, 1985; Rimmer et al., 2001).

According to guidelines from the American College of Sports Medicine (ACSM), moderate intensity activity is the minimal threshold for eliciting aerobic training effects. In line with this training principle, individuals with higher moderate and heavy intensity cumulative activity and LTPA scores exhibited greater aerobic fitness than individual with lower scores. ACSM further suggests that muscular strength is best developed through heavier intensity activity. Consistent with this recommendation, individuals who reported spending more time engaged in various modes of moderate and heavy intensity physical activity demonstrated greater muscular strength, particularly biceps strength. Together these findings provide evidence of the convergent validity of the PARA-SCI.

Notably, lifestyle activity scores were not related to aerobic fitness parameters nor associated with chest and latissimus dorsi strength. This null finding may be the result of the broad definition of lifestyle activity that encompasses a range of activities for which the direction of the relationship with fitness also varies from one activity to another. As demonstrated in the validation study of the PADS (Rimmer et al., 2001), some lifestyle activities may be positively associated with fitness while some lifestyle activities may be negatively correlated with fitness. For example, a lifestyle activity such as active transport is likely positively associated with fitness. By contrast, for individuals with poor physical functioning who designate the few activities that they do as strenuous, indoor passive leisure activity such as playing cards may be indicative of extreme deconditioning and thus, negatively associated with fitness. One remedy to this problem is to create separate lifestyle activity subcategories to distinguish between those lifestyle activities for which high scores represent poor fitness (e.g., playing cards) and those activities for which high PARA-SCI scores represent good fitness (e.g., wheeling for transportation). This categorization requires an extensive examination of the relationship of each lifestyle activity with fitness. Additionally, the lack of association between these fitness and lifestyle activity scores can be further explained by evidence that the magnitude of physical strain and the duration of many commonly performed lifestyle activities are below the minimal threshold to improve or maintain aerobic fitness and the strength of chest and back muscles (Janssen et al., 1994). Consequently, accumulating several minutes of lifestyle activity throughout the day may have no training effect and as found in this study, no relationship to fitness. Therefore, while we can measure lifestyle activity reliably (Martin Ginis et al., 2004), the construct validity of this PARA-SCI category is questionable.

In demonstrating relationships consistent with the evidence-based training principles advocated by ACSM, the findings from Study 1 attest to the convergent validity of the LTPA and cumulative activity categories of the PARA-SCI. Moreover, the positive association between PARA-SCI scores and fitness suggests that the PARA-SCI may be a useful assessment tool in longitudinal studies examining the relationship between physical activity patterns and health outcomes among individuals with SCI. Although these findings are promising, one study cannot unequivocally prove construct validity (Streiner & Norman, 1999). Thus, to further strengthen the evidence of validity, Study 2 examined extreme group differences in PARA-SCI scores.

STUDY 2 – CONSTRUCT VALIDATION BY EXTREME GROUPS

Method

Participants

The current investigation includes data from 158 individuals with SCI. The data were collected from participants involved in either the PARA-SCI reliability study (n=90) or convergent validity study (n=46) or both (n=23). For participants who were in the reliability study and/or both studies, PARA-SCI scores from the first administration of the scale were used. All participants met the criteria for PARA-SCI administration described in Study 1. Recruitment strategies are outlined elsewhere (Martin Ginis et al., 2004; see Study 1). The demographic characteristics of the participants are summarized in Table 1.

Procedure

At an appointed date and time, a trained research assistant contacted participants via telephone to administer the PARA-SCI. The interview format for administering the PARA-SCI was identical in both the reliability and the convergent validity studies and is described in Study 1. Participants who were part of the reliability study were contacted one week after completing the PARA-SCI to complete a single-item frequency rating of their physical activity participation.

Extreme Groups

PARA-SCI scores were compared by demographic (i.e., age, gender, employment status), disability (i.e., lesion level and completeness, mode of mobility) and behavioural (i.e., participation frequency, fitness club/sports team membership) characteristics that one would expect to be associated with differences in physical activity. For age, extreme groups were created using a tertile split. Independent t-tests confirmed that significantly different 'older' and 'younger' groups were created (ps<.05). Extreme groups were also created for 2 behavioural variables that were assessed using two separate indicators. The first indicator was a single item scale recommended by Ajzen (2002) to measure LTPA participation frequency. The single item was "In the course of the past week, how often did you engage in leisure time physical activity for at least 30 minutes?" (1=*never*, 7=*every day*). Similar single-item measures of physical activity have demonstrated adequate validity and reliability (Godin et al., 1985). The second indicator was a self-report of fitness club membership or sport participation. According to self-report, individuals were classified as either belonging to or not belonging to a fitness program or a sports team.

Analyses

A series of between-groups comparisons were performed to examine statistical differences in PARA-SCI scores among extreme groups. Prior to conducting the analyses, all of the PARA-SCI scores were submitted to either square root or log transformations as dictated by the skewness and kurtosis of each variable (Tabachnik & Fiddell, 2001) to remedy their non-normal distributions. For each PARA-SCI category (i.e., cumulative activity, LTPA, lifestyle activity), a MANOVA was performed with mild, moderate and heavy intensity activity as the dependent variables and an extreme group characteristic as the independent variable. Separate MANOVAs were conducted for each independent variable. In a few of these analyses, Box's M tests were significant indicating differences in the scores' covariance matrices. To account for these cases of significance, Pillai's trace was used as the criterion for testing for multivariate effects. Significant multivariate effects were followed-up with ANOVAs. ANOVAs were conducted also to compare total scores for each PARA-SCI category (i.e., total cumulative activity, total LTPA and total lifestyle activity) by extreme groups. Because education can be a determinant of the nature of an individual's work (blue collar versus white collar; Sallis & Owen, 1998), education was entered as a covariate in all of the analyses in which employment status was the independent variable. The p-value for all analyses was set at $p<.05$.

Results

Due to missing data, a tertile split on some of the variables, and the administration of the participation frequency measure only in the reliability study, the sample size fluctuates between each of the analyses, ranging from 83-158.

Leisure time physical activity. Table 4 presents the LTPA scores as a function of each independent variable. The MANOVA on mild, moderate and heavy intensity LTPA scores was significant for age, $F(6,106)=3.08$, Pillai's trace=.11, $p=.01$. Post hoc analyses revealed that as predicted, younger respondents engaged in more moderate intensity LTPA than older participants, $F(1,108)=10.68$, $p=.001$, $d=.62$. Separate

ANOVAs on total LTPA scores indicated a main effect for age, $F(1,108)=11.18$, $p=.001$, $d=.64$, and gender, $F(1,156)=4.51$, $p=.04$, $d=.36$. Consistent with trends in the general population, men and younger participants reported more total LTPA compared to women and older participants respectively. None of the other demographic characteristics differentiated LTPA scores.

As hypothesized, LTPA scores discriminated between participants with different behavioural characteristics. The MANOVA on mild, moderate and heavy intensity LTPA was significant for the index of fitness club/sports team membership, $F(3,129)=7.01$, Pillai's trace=.14, $p<.001$. ANOVAs indicated that the scores for total, $F(1,131)=12.87$, $p<.001$, $d=.62$, and moderate, $F(1,131)=4.93$, $p=.03$, $d=.39$, and heavy intensity LTPA, $F(1,131)=19.93$, $p<.001$, $d=.79$, were different between people who belonged to a fitness club or sports team and individuals who did not belong to a fitness club or sports team. Likewise, the multivariate effect for those who reported a high frequency of LTPA participation versus those who reported a low frequency of participation was significant, $F(3,80)=3.65$, Pillai's trace=.12, $p=.02$. Separate ANOVAs indicated significant between-groups differences in the number of minutes of mild, $F(1,82)=4.76$, $p=.03$, $d=.47$, moderate, $F(1,82)=5.17$, $p=.03$, $d=.50$, and heavy intensity, $F(1,82)=6.20$, $p=.02$, $d=.53$, and total LTPA, $F(1,82)=12.64$, $p=.001$, $d=.77$. None of the disability characteristics discriminated LTPA scores between groups.

Lifestyle Activity. Table 5 presents the lifestyle activity scores as a function of each independent variable. The overall multivariate analysis of covariance (MANCOVA) was significant for work status, $F(3,151)=3.21$, Pillai's trace=.06 $p=.03$. Consistent with

SCI research, employed people and students accumulated more minutes of mild intensity lifestyle activity than individuals who were unemployed/not attending school, $F(1,153)=4.94$, $p=.03$, $d=.37$. The lifestyle activity scores did not differ along any of the other independent variables.

Cumulative Activity. Table 6 presents the scores from the cumulative activity category as a function of each independent variable. Fitness club/sports team membership was the only variable that produced a significant multivariate effect, $F(3,129)=3.14$, Pillai's trace=.07, $p=.03$. Specifically, ANOVAs indicated that heavy intensity cumulative activity, $F(1,131)=8.60$, $p=.004$, $d=.29$, differentiated between people who belonged to a fitness club or sports team and those who did not belong to a fitness club or sports team. No between-groups differences were found for any of the other extreme group characteristics.

Discussion

Study 2 provides further evidence of the construct validity of the PARA-SCI, particularly the LTPA category. In a series of extreme groups comparisons, LTPA scores differed significantly in the expected direction. Overall, men, younger respondents and individuals who self-identified as participating in LTPA reported more physical activity than their counterparts. These findings are in parallel with well-documented trends in the general population (Centers for Disease Control, 2004; Craig & Cameron, 2004) and among individuals with a physical disability (Rimmer et al., 2001; Washburn, Zhu, McAuley, Frogley, & Figoni, 2002a). The demonstration that the LTPA scores distinguish between high and low active people supports the construct validity of the PARA-SCI.

In contrast, the measures of cumulative activity and lifestyle activity were unable to differentiate between many of the extreme groups. Cumulative activity scores only distinguished between individuals who belonged to a fitness club or sports team and those who did not. Lifestyle activity scores only differentiated between individuals who were employed/attending school and people who were unemployed/not attending school. Cumulative activity and lifestyle activity scores did not differentiate on the basis of disability characteristics (lesion level and completeness, mode of mobility). This finding further highlights the issues with the lifestyle activity category that emerged in Study 1 – lifestyle activity scores are unable to differentiate between individuals with high physical functioning who lead an active lifestyle and individuals with poor physical functioning who designate the few activities that they do as strenuous. For example, a person with poor physical functioning who reports that sitting in the passenger seat of a car for 20 minutes on the way to the store is moderate intensity activity will seem equally as active as a person who is conditioned and wheels to the store for 20 minutes at a moderate intensity. This equality may be viewed as a strength of the PARA-SCI in that the survey seems to capture all types of physical activity unique to individuals with SCI – a measurement objective. Conversely, this issue may also be viewed as a flaw of the PARA-SCI in that individuals who participate in lifestyle activity that may produce health benefits (e.g., wheeling for 20 minutes) cannot be distinguished from individuals who participate in lifestyle activity that will not produce health benefits (e.g., sitting). To note, because the cumulative activity category is a function of the lifestyle activity category, it suffers from the same limitation. Once again, the solution to this problem may be to create lifestyle activity subcategories (e.g., wheeling, instrumental ADL).

Despite this limitation, with evidence of between-groups differences in LTPA, findings from Study 2 provide indication of construct validity of the PARA-SCI LTPA category. These findings also emphasize the need to refine and validate the lifestyle activity category. Thus, construct validation should be ongoing. Generating and testing hypotheses in an effort to learn more about the PARA-SCI must continue to be an objective for future research (Streiner & Norman, 1999).

General Discussion

Physical activity rates among individuals with SCI are low. Research examining this problem has been limited by the lack of a physical activity measure that reflects the unique lifestyle characteristics of individuals with SCI. The PARA-SCI was developed to meet this need. With preliminary evidence indicating adequate reliability and validity, the purpose of this investigation was to further examine the psychometric properties of this SCI-specific measure. A pair of studies examined construct validity by assessing convergent validity (Study 1) and extreme groups (Study 2).

Findings from Study 1 were consistent with physical fitness training principles and provided evidence of the convergent validity of the LTPA and cumulative activity categories. Specifically, individuals who spent more time doing moderate and heavy intensity physical activity were more physically fit than individuals who spent less time doing these activities. Lifestyle activity was not strongly associated with the fitness parameters suggesting that the lifestyle activity category may not be a good indicator of physical activity level.

In Study 2, LTPA scores differed significantly in the expected direction in several extreme group comparisons. LTPA scores were greater for men than women, younger respondents than older respondents, those belonging to a fitness club or sports team than those who did not belong to a fitness club or sports team and those reporting a high frequency of LTPA participation than those who reported a low frequency of LTPA participation. The cumulative and lifestyle activity categories only differentiated between individuals who did and did not belong to a fitness club or sports team and people who were and were not employed/attending school, respectively. Failing to differentiate on the basis of disability characteristics further emphasized the limitations of the cumulative and lifestyle activity categories. Taken together, these findings indicate a lack of construct validity for the cumulative and lifestyle activity categories. Further refinement and validation of the cumulative and lifestyle activity categories is needed. Nonetheless, the PARA-SCI is suitable for assessing LTPA among individuals with SCI. Confirming the validity of the LTPA category has important implications for advancing physical activity research. More generally, these findings have value for LTPA prescription.

Having a valid and reliable measure of LTPA for individuals with SCI enables researchers to investigate a spectrum of health issues. In the general population, longitudinal studies have used valid and reliable self-report measures of LTPA to provide strong evidence of the association between LTPA and improved health which in turn, has served as the basis for developing public health guidelines (Paffenbarger et al., 1993;

Paffenbarger, Hyde, Wing, & Hsieh, 1986). Demonstrating that LTPA scores are indicative of physical fitness and sensitive to variation in physical activity levels suggests that it would be appropriate to use this measure in similar health outcome studies in the SCI population. This suggestion is timely given the emerging need to establish the health benefits of physical activity for people with SCI (Rimmer et al., 1996).

In addition to providing evidence of the validity of the PARA-SCI LTPA category for use in health research, the study findings offer direction for LTPA prescription for improving or maintaining fitness. Accordingly, individuals should be encouraged to partake in a physical activity regime including structured bouts of moderate to heavy intensity LTPA. In line with the Study 1 findings, participating in heavier intensity activity should be associated with better strength and aerobic fitness. Consistent with evidence from Study 2 that people who belonged to a fitness club or sports team were more active than individuals who did not belong to a fitness club or sports team, structured bouts of LTPA should be advocated in hopes of increasing physical activity participation. However, it must be noted that this prescription to generate fitness benefits may differ from the prescription needed to attain health-related benefits. With evidence to suggest that lower levels of physical activity (particularly intensity) may reduce the risk of obesity and certain chronic diseases without leading to improvement in physical fitness (American College of Sports Medicine, 1998), further research is needed to examine the optimal mode, intensity, frequency and duration of activity to maximize the health and fitness benefits of LTPA (Washburn & Figoni, 1999).

Although the development of the PARA-SCI advances the domain of physical activity assessment, its contribution is limited in some respects. Firstly, the PARA-SCI has been validated for telephone use only. An instrument valid for telephone-based interviewing is ideal for large population studies, yet has limited use in clinical settings where face-to-face interviews are preferable. Evidence from a validation study of another self-report measure of physical activity suggests that recall surveys can be administered in person and over the telephone interchangeably (Hayden-Wade, Coleman, Sallis, & Armstrong, 2003). This versatility in mode of administration is likely generalizable to the PARA-SCI as well; however, further validation studies should be conducted to confirm this prediction.

Secondly, the study results were obtained from a sample in which the majority of respondents were men and individuals who used manual wheelchairs. While the likeness of the demographic characteristics of the study sample to the population of individuals with SCI is a strength of the study, the extent to which these findings can be generalized to minority groups (women, individuals who use power wheelchairs) is unknown. Thus, generalizability of the PARA-SCI should be the object of future research.

Despite these limitations, as the only valid and reliable SCI-specific measure of physical activity, the PARA-SCI makes a major contribution to physical activity research in the SCI population. The PARA-SCI enables researchers to examine the health benefits of LTPA and to develop activity prescription guidelines. Additionally, by having a tool for tracking activity patterns, researchers now have the means to examine determinants of LTPA. This possibility represents an important step towards developing activity-enhancing interventions and allows researchers to pursue an agenda striving to promote health through active living.

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Table 1

Participant Demographic Characteristics

	Study 1	Study 2
Age (yrs)	*M*=39.00±11.02	*M*=38.47±11.11
Years post injury (yrs)	*M*=11.27±9.90	*M*=11.86±10.21
Perceived pain	----	*M*=5.00±2.40
Gender		
Male	*n*=52 (71.2%)	*n*=110 (69.6%)
Female	*n*=21 (28.8%)	*n*=48 (30.4%)
Lesion level		
Tetraplegia	*n*=37 (50.7%)	*n*=81 (51.3%)
Paraplegia	*n*=36 (49.3%)	*n*=77 (48.7%)
Completeness of injury		
Complete	*n*=41(56.2%)	*n*=87 (55.1%)
Incomplete	*n*=32 (43.8%)	*n*=65 (41.1%)
Unknown	*n*=0 (0%)	*n*=6 (3.8%)
Cause of injury		
Traumatic	*n*=63 (86.3%)	*n*=136 (86.1%)
Nontraumatic	*n*=10 (13.7%)	*n*=22 (13.9%)

(*table continues*)

Table 1 (*continued*)

Participant Demographic Characteristics

	Study 1	Study 2
Mode of mobility		
Power chair	*n*=10 (13.7%)	*n*=31 (19.6%)
Manual chair	*n*=63 (86.3%)	*n*=127 (80.4%)
Education		
High school or less	*n*=33 (45.8%)	*n*=68 (34.2%)[§]
Post-secondary	*n*=40 (54.2%)	*n*=88 (55.7%)
Employment status		
Working/student	*n*=32 (43.8%)	*n*=74 (46.8%)[§]
Not working	*n*=41 (56.2%)	*n*=82 (51.9)
Structured activity involvement		
Structured	---	*n*=59(37.3%)[§]
Unstructured	---	*n*=74(46.8%)
LTPA frequency	---	*M*=3.29±1.86

Note. [§]Some participants did not report therefore missing data.

Table 2

Between Groups Comparisons and Effects Sizes for Strength and Aerobic Fitness Parameters

Fitness Parameter	Gender				Lesion Level			
	Female	Male			Paraplegia	Tetraplegia		
	M	*M*	*F*	*d*	*M*	*M*	*F*	*d*
Right biceps (kg)	8.70 ± 2.29	15.37 ± 3.96	40.43**	1.84	12.65 ± 4.24	14.80 ± 4.86	3.51	.48
Left biceps (kg)	8.75 ± 2.22	15.16 ± 4.16	32.26**	.46	12.45 ± 4.27	14.83 ± 4.86	4.16*	.52
Right chest (kg)	20.68 ± 6.40	27.40 ± 14.11	3.96*	.54	33.38 ± 11.48	17.24 ± 7.73	43.93**	1.65
Left chest (kg)	20.42 ± 6.82	27.67 ± 14.20	4.29*	.57	32.69 ± 12.27	17.79 ± 8.53	32.01**	1.40
Lat pulldown (kg)	41.39 ± 9.03	56.00 ± 22.08	7.75**	.76	63.09 ± 17.90	39.57 ±15.19	33.31**	1.41
VO_2peak (ml/kg/min)	14.15 ± 3.69	15.11 ± 6.14	.28	.17	17.20 ± 5.20	11.26 ± 4.01	17.16**	1.25
Workload (Watts)	45.18 ± 23.78	65.76 ± 34.96	3.82	.63	79.04 ± 27.49	31.39 ± 16.91	45.58**	1.99

Note. *p<.05, **p<.001

Table 3

Mean PARA-SCI Scores and Correlations with Fitness Parameters

	M (min/day)	Right biceps	Left biceps	Right chest	Left chest	Lat	VO_{2peak}	Workload
LTPA								
Mild	10.23±22.04	0.16	0.15	0.01	0.03	-0.13	-0.09	0.12
Moderate	13.46±23.17	0.21*	0.28*	0.10	0.23*	-0.02	0.16	0.29*
Heavy	5.97±13.04	0.18	0.22*	0.16	0.20	0.07	0.35**	0.33**
Total	29.66±42.31	0.25*	0.30**	0.11	0.19	-0.06	0.18	0.34**
Lifestyle Activity								
Mild	145.05±135.60	0.09	0.16	0.08	0.16	0.03	0.08	0.00
Moderate	57.98±91.38	-0.04	-0.07	0.04	0.02	-0.10	0.23	0.15
Heavy	9.83±20.05	0.31**	0.14	-0.03	-0.03	-0.19	0.11	0.15
Total	212.86±184.31	0.07	0.10	0.08	0.13	-0.05	0.19	0.09
Cumulative Activity								
Mild	155.28±136.90	0.11	0.18	0.08	0.16	0.00	0.06	0.02
Moderate	71.45±96.02	0.01	0.00	0.06	0.08	-0.10	0.26*	0.22
Heavy	15.80±25.19	0.36**	0.23*	0.08	0.10	-0.11	0.33**	0.34**
Total	242.53±200.28	0.12	0.15	0.09	0.16	-0.06	0.21	0.16

Note. All correlations were one-tailed.

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

Table 4

Between-Groups Comparisons of Mean PARA-SCI Scores for the LTPA Category

Extreme Group	LTPA (min/day)			
	Mild	Moderate	Heavy	Total
Age category (*n*=110)				
Younger (18-32y)	11.73 ± 21.88	23.40 ± 27.84**	16.09 ± 34.55	51.23 ± 47.49**
Older (43-66y)	10.88 ± 22.94	12.27 ± 27.59	7.28 ± 14.82	30.44 ± 47.64
Gender (*n*=158)				
Female	9.32 ± 18.55	12.21 ± 17.93	4.72 ± 10.47	26.24 ± 32.61*
Male	13.39 ± 25.58	21.15 ± 33.00	12.02 ± 28.14	46.56 ± 55.06
§Employment Status (*n*=156)				
Employed/student	7.51 ± 24.42	18.86 ± 29.65	9.29 ± 25.16	35.66 ± 51.42
Not employed/student	16.40 ± 24.34	17.04 ± 29.55	9.52 ± 25.08	42.95 ± 51.26
Lesion Level (*n*=158)				
Paraplegia	14.01 ± 23.69	16.82 ± 28.15	6.64 ± 15.11	37.47 ± 47.81
Tetraplegia	10.38 ± 23.68	19.97 ± 30.80	12.80 ± 30.49	43.15 ± 52.35
Lesion Completeness (*n*=152)				
Complete	9.45 ± 15.94	14.82 ± 25.50	9.58 ± 28.90	33.86 ± 43.86
Incomplete	15.01 ± 30.02	24.35 ± 34.42	10.72 ± 18.08	50.08 ± 56.72

(*table continues*)

Table 4 (*continued*)

Between-Groups Comparisons of Mean PARA-SCI Scores for the LTPA Category

Extreme Group	LTPA (min/day)			
	Mild	Moderate	Heavy	Total
Mode of Mobility (*n*=158)				
Power	9.84 ± 16.21	19.84 ± 28.83	4.03 ± 10.07	33.71 ± 39.34
Manual	12.72 ± 25.19	18.09 ± 29.75	11.20 ± 26.56	42.01 ± 52.41
Club/team Membership (*n*=133)				
Belonged to club/team	12.31 ± 21.29	23.28 ± 31.77*	19.15 ± 35.51**	54.73 ± 50.49**
Did not belong to club/team	10.20 ± 21.10	14.90 ± 27.66	4.06 ± 11.27	29.16 ± 44.31
Participation Frequency (*n*=84)				
High	19.86 ± 32.48*	25.01 ± 35.57*	17.94 ± 40.40*	62.81 ± 65.86**
Low	6.49 ± 11.63	12.52 ± 25.25	5.40 ± 11.83	24.41 ± 37.47
Total (*n*=158)	12.15 ± 23.68	18.43 ± 29.49	9.80 ± 24.37	40.38 ± 50.11

Note. [§]Means adjusted for level of education.

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

Table 5

Between-Groups Comparisons of Mean PARA-SCI Scores for the Lifestyle Activity Category

Extreme Group	Lifestyle Activity (min/day)			
	Mild	Moderate	Heavy	Total
Age category (*n*=110)				
Younger (18-32y)	110.54 ± 103.25	41.77 ± 59.01	6.53 ± 18.17	158.85 ± 148.35
Older (43-66y)	113.55 ± 147.37	48.37 ± 67.48	10.55 ± 17.85	172.48 ± 181.59
Gender (*n*=158)				
Female	115.89 ± 113.64	51.60 ± 62.94	7.81 ± 17.02	175.30 ± 145.40
Male	108.78 ± 119.48	46.45 ± 71.47	8.72 ± 17.96	163.94 ± 165.74
§Employment Status (*n*=156)				
Employed/student	132.17 ± 121.03*	48.48 ± 69.73	7.16 ± 18.27	187.81 ± 163.75
Not employed/student	90.47 ± 120.64	44.90 ± 69.51	9.81 ± 18.22	145.18 ± 163.22
Lesion Level (*n*=158)				
Paraplegia	91.54 ± 90.20	47.86 ± 78.69	7.24 ± 14.93	146.64 ± 139.51
Tetraplegia	129.38 ± 136.46	48.15 ± 58.44	9.58 ± 19.89	187.12 ± 174.94
Lesion Completeness (*n*=152)				
Complete	116.03 ± 138.09	44.68 ± 56.61	5.84 ± 13.98	166.55 ± 173.99
Incomplete	107.63 ± 87.90	53.81 ± 84.36	11.96 ± 21.27	173.39 ± 144.39

(table continues)

Table 5 (*continued*)

Between-Groups Comparisons of Mean PARA-SCI Scores for the Lifestyle Activity Category

Extreme Group	Lifestyle Activity (min/day)			
	Mild	Moderate	Heavy	Total
Mode of Mobility (*n*=158)				
Power	137.43 ± 139.83	63.16 ± 59.14	13.25 ± 21.40	213.84 ± 177.98
Manual	104.47 ± 110.95	44.31 ± 70.72	7.27 ± 16.47	156.06 ± 153.24
Club/team Membership (*n*=133)				
Belonged to club/team	126.02 ± 126.38	46.70 ± 59.98	6.59 ± 18.51	179.31 ± 159.07
Did not belong to club/team	106.62 ± 116.62	51.58 ± 81.33	8.07 ± 15.95	166.27 ± 170.49
Participation Frequency (*n*=84)				
High	77.18 ± 65.07	47.07 ± 90.67	5.41 ± 13.37	129.66 ± 140.23
Low	91.60 ± 112.92	42.54 ± 46.08	7.75 ± 15.74	141.90 ± 149.01
Total (*n*=158)	110.94 ± 117.42	48.01 ± 68.83	8.44 ± 17.63	167.39 ± 159.46

Note. [§]Means adjusted for level of education.

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

Table 6

Between-Groups Comparisons of Mean PARA-SCI Scores for the Cumulative Activity Category

Extreme Group	Cumulative Activity (min/day)			
	Mild	Moderate	Heavy	Total
Age category (*n*=110)				
Younger (18-32y)	122.27 ± 105.39	65.18 ± 65.51	22.62 ± 38.70	210.07 ± 156.99
Older (43-66y)	124.43 ± 145.67	60.65 ± 72.31	17.84 ± 22.41	202.91 ± 184.90
Gender (*n*=158)				
Female	125.21 ± 115.48	63.81 ± 64.07	12.53 ± 20.29	201.55 ± 149.50
Male	122.17 ± 118.91	67.60 ± 77.90	20.73 ± 32.11	210.50 ± 171.50
§Employment Status (*n*=156)				
Employed/student	139.68 ± 121.79	67.34 ± 74.91	16.45 ± 30.23	223.47 ± 168.98
Not employed/student	106.87 ± 121.40	61.94 ± 74.67	19.33 ± 30.14	188.13 ± 168.44
Lesion Level (*n*=158)				
Paraplegia	105.55 ± 95.70	64.68 ± 83.15	13.88 ± 20.88	184.11 ± 151.12
Tetraplegia	139.77 ± 133.51	68.13 ± 64.13	22.38 ± 35.00	230.27 ± 174.63
Lesion Completeness (*n*=152)				
Complete	125.48 ± 138.68	59.51 ± 64.04	15.42 ± 31.10	200.41 ± 182.02
Incomplete	122.63 ± 86.71	78.16 ± 86.22	22.68 ± 27.09	223.47 ± 143.47

(table continues)

Table 6 (continued)

Between-Groups Comparisons of Mean PARA-SCI Scores for the Cumulative Activity Category

Extreme Group	Cumulative Activity (min/day)			
	Mild	Moderate	Heavy	Total
Mode of Mobility (*n*=158)				
Power	147.27 ± 138.58	82.99 ± 64.46	17.28 ± 21.89	247.55 ± 177.13
Manual	117.19 ± 111.61	62.41 ± 75.58	18.47 ± 30.81	198.07 ± 160.78
Club/team Membership (*n*=133)				
Belonged to club/team	138.33 ± 128.14	69.98 ± 66.18	25.74 ± 39.20**	234.04 ± 165.58
Did not belong to club/team	116.82 ± 116.07	66.48 ± 84.82	12.13 ± 19.41	195.43 ± 171.53
Participation Frequency (*n*=84)				
High	97.04 ± 72.09	72.08 ± 93.88	23.35 ± 41.05	192.47 ± 140.95
Low	98.09 ± 110.94	55.06 ± 55.98	13.16 ± 20.08	166.31 ± 154.78
Total (*n*=158)	123.09 ± 117.52	66.45 ± 73.79	18.24 ± 29.21	207.78 ± 164.71

Note. [§]Means adjusted for level of education.

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

CHAPTER 3

Examining the Utility of the Theory of Planned Behaviour for Predicting Leisure Time Physical Activity Among Individuals with Spinal Cord Injury

Abstract

Objective: To examine the utility of the theory of planned behaviour (TPB) for predicting leisure time physical activity (LTPA) among individuals with spinal cord injury (SCI). **Study Design:** Prospective correlational design. **Participants:** 110 men and women with SCI. **Method:** Participants completed a telephone interview assessing the TPB constructs (i.e., attitude, subjective norms, perceived behavioural control [PBC], intentions) in the context of LTPA. LTPA was assessed via telephone one-week later using the Physical Activity Recall Assessment for Individuals with SCI (PARA-SCI). **Results:** Regression analyses indicated that attitudes, subjective norms, and PBC each predicted intentions. Intentions, but not PBC, predicted LTPA. **Conclusions:** These findings support the tenets of the TPB and provide a direction for promoting LTPA in the SCI population.

In recent years, innovations in medical technology have led to a dramatic increase in the life expectancy of individuals with spinal cord injury (SCI; DeVivo, Krause, & Lammertse, 1999). In turn, chronic illness (e.g., coronary heart disease, noninsulin-dependent diabetes mellitus) has become increasingly prevalent in the SCI population (Bauman, Kahn, Grimm, & Spungen, 1999). Given these trends, the focus of health care for individuals with SCI has shifted from basic life support to health promotion and quality of life enhancement (Clayton & Chubon, 1994; Evans et al., 1994). With evidence indicating that physical activity leads to improved cardiovascular fitness, muscular strength, psychological well-being and functional independence (Duran, Lugo, Ramirez, & Eusse, 2001; Hicks et al., 2003; Martin Ginis et al., 2003), participation in regular physical activity is one strategy that has been recommended as a means of achieving these health care objectives (Hicks et al., 2003). Despite this recommendation, the majority of individuals with SCI are inactive (Buchholz, McGillivray, & Pencharz, 2003; Dearwater, Laporte, Cauley, & Brenes, 1985), leaving health professionals with the challenge of persuading people with SCI to become more active.

As indicated in previous studies of people with SCI (Hicks et al., 2003; Martin et al., 2002), a primary reason for inactivity is the numerous physical activity barriers that these individuals encounter when trying to engage in structured forms of activity (e.g., sports, exercise). For example, individuals with SCI often have difficulty finding and getting to accessible recreation facilities and many simply cannot afford a membership for such facilities. Given the prevalence of barriers like these, it has been recommended that in addition to promoting participation in structured physical activity, interventions should also be designed to encourage people with SCI to increase their daily energy expenditure by doing more unstructured activity during their leisure time (e.g., gardening, woodworking and wheeling around the block to take the dog for a walk; Latimer, Martin Ginis, & Craven, 2004). However, before we can develop effective interventions to increase structured and unstructured forms of leisure time physical activity (LTPA), it is first necessary to identify determinants of LTPA that can serve as targets for these interventions (Baranowski, Lin, Wetter, Resnicow, & Davis Hearn, 1997; Crocker, 1993; Rimmer, Braddock, & Pitetti, 1996).

One of the most widely used frameworks for examining determinants of physical activity is Ajzen's (1985) theory of planned behaviour (TPB; Maddux, 1993). The TPB posits that an individual's intentions are a proximal determinant of behaviour. Intentions are determined by three conceptually independent constructs: (a) attitudes (one's positive or negative evaluation of the behaviour), (b) subjective norms (the perceived social pressure to perform the behaviour), and (c) perceived behavioural control (PBC; the perceived ease or difficulty of performing the behaviour). Furthermore, PBC serves as a proxy indicator of the actual control individuals have over performing a behaviour and thus is considered to be a codeterminant of behaviour along with intentions. With TPB-related factors such as a lack of knowledge concerning the benefits of physical activity (aspects of attitude), inaccessible facilities (aspects of PBC) and a lack of encouragement from significant others to participate in physical activity (aspects of subjective norms) cited as obstacles to physical activity participation among individuals with SCI (Hicks et al., 2003; Martin et al., 2002; Rimmer et al., 1996), the TPB has been suggested as an appropriate framework for guiding investigations of physical activity determinants in this population (Crocker, 1993; Godin, Colantonio, Davis, Shephard, & Simard, 1986).

Contrary to this suggestion however, findings from a preliminary study (Latimer et al., 2004) indicated that the TPB had limited utility in predicting physical activity intentions and behaviours among individuals with SCI. Specifically, among individuals with tetraplegia, PBC emerged as the sole independent predictor of intentions and behaviour -- accounting for 30% and 6% of the variance in physical activity intentions and behaviour respectively. Surprisingly, attitudes and subjective norms did not predict intentions, and intentions did not predict behaviour. Among individuals with paraplegia, none of the TPB constructs predicted physical activity intentions or behaviour.

In failing to support the TPB relationships, these preliminary findings conflict with meta-analytic evidence supporting the theory's utility for identifying determinants of LTPA (Godin & Kok, 1996; Hagger, Chatzisarantis, & Biddle, 2002; Hausenblas, Carron, & Mack, 1997). However, our study was limited by: (a) the use of indirect measures of TPB constructs which tend to attenuate the magnitude of the relationship between intentions and its antecedents (Ajzen, 1991), (b) a narrow definition of LTPA (i.e., structured exercise behaviour only), (c) the lack of a valid and reliable measure of physical activity for individuals with SCI, and (d) a cross-sectional study design. Given these substantial study limitations, it seems premature to disregard the TPB as a viable framework for identifying constructs underlying LTPA among individuals with SCI. Rather, a follow-up study is warranted, using (a) direct measures of TPB variables, (b) a broader operationalization of LTPA to include both structured and unstructured forms of activity, (c) a valid and reliable measure of behaviour for use among individuals with SCI, and (d) a prospective research design.

Accordingly, using a prospective research design, the purpose of the present study was to reexamine the utility of the TPB for predicting LTPA intentions and behaviour among individuals with SCI. The findings from this investigation will extend our understanding of the theoretical tenets of the TPB in the SCI population and will help to direct health care initiatives promoting LTPA for individuals with SCI. Given that the limitations of our preliminary study prohibited clear conclusions regarding the utility of the TPB in the SCI population (Latimer et al., 2004), our research hypotheses for the current study were based on the findings from earlier TPB and LTPA meta-analyses (Godin et al., 1996; Hagger et al., 2002; Hausenblas et al., 1997). Specifically, it was hypothesized that (a) intentions to engage in LTPA would be predicted by attitudes, subjective norms and PBC, and (b) LTPA behaviour would be predicted prospectively by intentions and PBC.

Method

Participants

One hundred and ten individuals with SCI completed a baseline interview. One hundred and four of these individuals completed the one-week follow-up interview. This final sample size of 104 satisfies the minimum number of participants necessary to test the tenets of the TPB using regression models (Green, 1991). Eligibility criteria stipulated that participants (a) have neurological impairment secondary to SCI (i.e., traumatic or nontraumatic SCI), (b) use a wheelchair as their primary mode of mobility outside the home and, (c) report no cognitive deficits. These criteria were consistent with the conditions for using the Physical Activity Recall Assessment for Individuals with SCI (PARA-SCI) -- the selected measure of LTPA. A lack of cognitive impairment was also stipulated to minimize inaccurate recall. Participants were recruited using convenience-sampling methods. The majority of participants (92.7%) were community dwelling and were recruited through community service programs and their associated consumer databases. The service programs included community-based fitness programs, outpatient medical clinics and an information network offered in various provinces (Ontario, Saskatchewan and Alberta) and states (Oregon) across North America. The remaining 7.3 % of participants were in-patients and were recruited through a physician's referral. A multivariate analysis of variance (MANOVA) revealed no differences in any of the TPB variables between individuals drawn from these recruitment locations, $F(32, 372)=.36$, Pillai's Trace=.06, $p=.27$. Accordingly, data were collapsed across all of the recruitment sources to maximize the variance of the TPB measures. Greater variance in the predictors improves the precision of regression estimates (Wonnacott & Wonnacott, 2004).

There were fewer women in the study than men (72% men). This is typical of the SCI population, of which 80% is male (Canadian Paraplegic Association, 2000). Due to the small number of women in the sample and no differences in TPB variables between the men and women, $F(8,94)=.75$, Pillai's Trace=.06, $p=.65$, the data were collapsed across sex. Participant characteristics are presented in Table 1.

Measures

All measures are included in Appendix B.

Attitudes. Attitudes were assessed using seven adjective pairs suggested by Ajzen (2002a) that tapped both the instrumental (beneficial-harmful, valuable-worthless, good-bad) and experiential (relaxing-stressful, enjoyable-unenjoyable, pleasant-unpleasant, not painful-painful) components of attitude. Items were preceded by the statement "I think that participating in leisure time physical activity for at least 30 min on most days in the next week would be ... " and were then rated on a 7-point scale with the verbal anchor *extremely* at points 1 and 7. These adjective pairs have been used extensively to measure attitudes toward physical activity within the TPB framework (e.g., Courneya, Friedenreich, Sela, Quinney, & Rhodes, 2002; Rhodes & Courneya, 2003a). According to Nunnally's (1978) criterion, the scale demonstrated adequate internal consistency (α= .84) in this investigation.

Subjective norms. Subjective norms were assessed using two items recommended by Ajzen (2002a). The two items, including the common stem, were "Most people who are important to me ... " (a) "think I should participate in leisure time physical activity for at least 30 min on most days in the next week," and (b) "approve of me participating in leisure time physical activity for at least 30 min on most days in the next week." Each item was rated on a 7-point scale ranging from 1 (*strongly disagree*) to 7 (*strongly agree*). These two items have been used frequently in investigations of physical activity behaviour within a TPB framework (e.g. Courneya et al., 2002).

Perceived behavioural control. PBC was assessed using 6-items (see Table 2) from Armitage and Conner's (1999) measure of control-related constructs. All items were rated on a 7-point scale and have been used in previous research examining physical activity in the context of the TPB (Rhodes & Courneya, 2003b; Terry & O'Leary, 1995). In accordance with Ajzen's (2002a) recommendation for scale development, this measure assessed both the controllability (beliefs about the extent to which performing the behaviour is up to the actor) and self-efficacy (perceived ease or difficulty of performing the behaviour) aspects of PBC. Emerging evidence suggests that controllability and self-efficacy should be considered as two separate factors (Armitage & Conner, 1999; Terry et al., 1995). In the physical activity domain, this two-factor structure has been supported by studies in the general population (Terry et al., 1995). In the current study of people with SCI, inspection of the scree plot from a principle component analysis with varimax rotation revealed a solution with only one factor having an eigenvalue>1. As described in Table 2, all 6 items loaded on this single factor (i.e., factor loading coefficients >.32; Tabachnick & Fidell, 2001), accounting for 56.9% of the variance. The internal consistency for this composite measure of PBC was adequate (α= .86).

Intentions. Intentions were measured using two items from Ajzen (2002a), rated on a 7-point scale. The two items were: (a) "I will try to do at least 30 minutes of leisure time physical activity on most days in the next week (1=*definitely false*/7=*definitely true*) and, (b) I intend to do at least 30 minutes of leisure time physical activity on most days in the forthcoming week (1=*extremely unlikely*/7=*extremely* likely). These items are commonly used in the exercise and TPB literature (Courneya et al., 2002).

Leisure Time Physical Activity. LTPA was assessed using the Physical Activity Recall Assessment for Individuals with SCI (PARA-SCI; Martin Ginis, Latimer, Craven, & Hicks, 2004). The PARA-SCI provides an estimate of total time spent doing mild, moderate and heavy intensity physical activity for the three-day period preceding the interview. Participants self-designated the intensity of each activity using the PARA-SCI intensity classification system that was provided in written format prior to the interview. Trained research assistants followed a detailed interview protocol to administer the PARA-SCI via telephone.

The research assistant coded each reported physical activity as either a lifestyle activity or LTPA. LTPA included all structured and unstructured physical activities that individuals *chose* to do during their *free time*. All other reported physical activities were classified as lifestyle activity. A total PARA-SCI LTPA score was calculated by averaging the number of minutes of LTPA reported for all three days across all intensity categories. This measure corresponded with the focus of our study (predicting LTPA) and the wording of the TPB items (which referred to LTPA). Although PARA-SCI lifestyle activity data were collected, because these activities were not correspondent with the TPB items, they were not included in this study. The PARA-SCI LTPA category has demonstrated adequate test-retest reliability (ICC>.41; Martin Ginis et al., 2004). Construct validity has been shown through the PARA-SCI's significant correlations with daily energy expenditure and fitness variables (Martin Ginis et al., 2004, refer to dissertation Study 1).

Procedure

A member of the research team contacted potential participants either via telephone, e-mail or in-person and invited them to participate in the study. Individuals who were successfully recruited via phone or email were scheduled to complete the initial experimental interview during a subsequent phone call. Participants who were recruited in-person were given the option of completing the initial interview immediately during a face-to-face interview, or later via a telephone interview (this option was offered to reduce the length of time an individual was required to spend on the telephone). To facilitate the interview, participants were given a package of study materials including a copy of the TPB questionnaire, the intensity definitions and a $5 honorarium. The honorarium was given at the onset of the study as a means of encouraging continued participation (Streiner & Norman, 1999). Participants recruited in-person received the study package immediately upon agreeing to participate. For the remaining participants, the study materials were sent via e-mail or ground mail, and the honorarium followed via ground mail.

At the time appointed for the baseline interview, participants were contacted via telephone and asked to retrieve the TPB questionnaire from their package and to read along with the interviewer as she administered each item. The interviewer reviewed the definition and examples of LTPA printed on the TPB questionnaire. In accordance with Bouchard and Shephard (1994), LTPA was defined as *"all of the activities that you choose to do during your free time that require physical exertion."* Examples of LTPA included exercise, sport, gardening, woodworking and wheeling around the block with the dog. Examples of non-LTPA included physiotherapy, stretching, shopping, cleaning and other lifestyle activities. Following this review, participants were asked if they had any questions concerning the definition of LTPA. After answering any questions, the interviewer read each of the items on the TPB questionnaire and recorded participants' responses. At the end of the interview, participants were scheduled for a one-week follow-up interview.

One week later, participants were contacted via telephone at their scheduled interview time in order to complete a follow-up interview. Participants were required to have their copy of the intensity definition sheet from their study package available to refer to during the interview. After a review of the intensity definitions, participants were encouraged to ask questions if they needed clarification. Participants then completed the PARA-SCI. At the completion of the interview, participants were debriefed and thanked for their time.

Results

The descriptive statistics and bivariate correlations among the TPB variables are presented in Table 3. Overall, as predicted by the TPB, LTPA intentions were significantly correlated with attitudes (r=.57, p<.001), subjective norms (r=.48, p<.001) and PBC (r=.70, p<.001). Additionally, LTPA behaviour correlated with intentions (r=.34, p<.001) and PBC (r=.27, p=.005).

A series of hierarchical multiple regression analyses were conducted to test the tenets of the TPB. Prior to conducting these analyses, regression assumptions were tested. P-P plots of the residuals were examined to determine whether the data met the assumptions of normality and homogeneity of variance. Inspection of the plots indicated that data were slightly skewed and heteroscedastic according to criteria outlined by Tabachnick and Fidell (2001). Because regression is robust with respect to deviations from normality and hetroscedasticity, data in slight violation of these assumptions still provide a reliable and accurate estimate of regression weights (Kleinbaum, Kupper, Muller, & Nizam, 1998). Thus, no steps were taken to correct for either skewness or hetroscedasticity. The variance inflation factor (VIF) for each independent variable was calculated to test the assumption of multicollinearity (VIFs <2.30). With none of the VIF values exceeding 2.5 (the point at which multicollinearity should be considered a concern; Allison, 1999), there was no evidence of high multicolinearity. Thus, the analyses could proceed.

Predicting LTPA intentions. With previous research demonstrating that years post injury and lesion level moderate TPB relationships (Hedrick & Broadbent, 1996; Latimer et al., 2004; Noreau, Shephard, Simard, Pare, & Pomerleau, 1993), these two variables were entered into the model first to control for their influence. Thus, intentions were regressed on number of years post injury and lesion level (Step 1), attitude and subjective norms (Step 2) and PBC (Step 3). The order of TPB variable entry was based on the tenets of the TPB (Ajzen, 1985) and previous research examining the predictive capabilities of the TPB in the physical activity domain (Courneya, 1995; Wankel, Mummery, Stephens, & Craig, 1994). Overall, this model was significant F (5, 94) =40.59, p<.001 accounting for 67% of the variance in intentions. As described in Table 4, together, attitudes and subjective norms accounted for 42% of the variance in intentions, F_{change} (2, 95) =36.07, p<.001. PBC accounted for an additional 24%, F_{change} (1, 94) = 70.46, p<.001. Inspection of the beta weights indicated that subjective norms, attitude and PBC were each unique predictors of intentions ($\beta s \geq .23$, $ps \leq .001$).

Predicting LTPA behaviour. To examine the determinants of behaviour, LTPA was regressed on the covariates number of years post injury and lesion level (Step 1), intentions (Step 2) and PBC (Step 3). Overall, this model was significant F (4, 95) =3.66, p=.008. As described in Table 4, intentions accounted for 10% of the variance in LTPA, F_{change}(1, 96)=10.76, p=.001. Contrary to our second hypothesis, PBC was not a significant predictor of LTPA.

Discussion

With improved research design and construct measurement compared to a preliminary investigation (Latimer et al., 2004), the results of this study support the utility of the TPB for understanding LTPA intentions. However, these findings suggest that the TPB framework only has modest value for predicting LTPA behaviour among individuals with SCI. Specifically, attitudes, subjective norms and PBC were each unique predictors of intentions whereas intentions, but not PBC, were a weak, but significant predictor of behaviour. From a theoretical perspective, determining that PBC does not explain behaviour among individuals with SCI suggests that alternative approaches to measuring the PBC construct should be explored. From a practical perspective, identifying determinants of intentions and, in turn, establishing that intentions are important determinants of LTPA, together provide direction for developing much needed LTPA-promoting interventions.

Consistent with the tenets of the TPB, attitudes, subjective norms and PBC predicted LTPA intentions – accounting for 67% of the total variance in intentions. These results demonstrate the utility of the TPB as a framework for understanding LTPA intentions among individuals with SCI. Accordingly, these findings suggest that to bolster intentions among individuals with poor intentions, health practitioners should target subjective norms (e.g., encourage physicians to recommend LTPA), attitudes (e.g., highlight benefits of participation), and PBC (e.g., provide detailed "how to" information; Olson & Zanna, 1987). Only one published study has examined the effectiveness of TPB-based intentions-enhancing interventions in the physical activity domain. In a manipulation of the subjective norms construct, individuals who received physical activity information presented as being from a physician (i.e., high social pressure condition) had greater intentions to engage in regular physical activity than individuals who received information presented as being from a member of the general public (i.e., low social pressure condition; Jones, Sinclair, & Courneya, 2003). Although very cursory, these findings suggest that targeting TPB variables may be a means of increasing intentions. Further prospective research is needed to confirm this hypothesis.

Contrary to the TPB, intentions, but not PBC, predicted behaviour – accounting for 10% of the total variance in LTPA. Failing to fully support the theory and explaining only a small portion of the variance in behaviour suggests limited utility of the TPB for understanding behaviour among individuals with SCI. This poor account of behaviour indicates a need to examine whether the current measure of PBC truly reflects LTPA barriers encountered by individuals with SCI. Specifically, the failure of PBC to emerge as a direct determinant of behaviour suggests that either LTPA is under complete volitional control (Ajzen, 1991) or that the PBC measure does not provide an accurate reflection of actual control. With evidence indicating that individuals with SCI encounter a variety of unexpected barriers preventing physical activity participation (e.g., illness, transportation, weather; Hicks et al., 2003; Martin et al., 2002), clearly LTPA is not under complete volitional control. Evidence of unexpected barriers, however, suggests that measurement limitations of the PBC construct are a plausible explanation.

According to Ajzen (2002a), PBC is a function of beliefs about the *presence* of factors that may facilitate or impede performance. Given that individuals with SCI experience a variety of unexpected barriers, in a prospective study, it is likely that between the assessment of PBC and the assessment of LTPA, some participants will experience barriers to participation that were *not present* at baseline. For example, individuals may report high PBC at baseline but unexpectedly develop a bladder infection causing them to forgo their physical activity regime. Thus, the measure of PBC at baseline would not be an accurate reflection of their PBC in the face of the unexpected barrier of a bladder infection. Consequently, high PBC at baseline may not directly translate into behaviour. This inconsistency implies a need to modify the measurement of the PBC construct in the PBC-behaviour relationship (Sheeran, Trafimow, & Armitage, 2003). Alternatives to the current measurement approach include: an assessment of physical symptoms (e.g., pain) or a measure of individuals' confidence to cope with secondary complications of SCI. Further research is needed to determine whether any of these alternatives improve the prediction of LTPA compared to the existing indicators of PBC.

The poor prediction of behaviour by intentions also raises the question as to whether strategies can be implemented to facilitate the translation of intentions into behaviour (i.e., strengthen the intentions-behaviour relationship). With intentions accounting for only 10% of the variance in behaviour, it seems that despite the best of intentions, people with SCI have considerable difficulty carrying through with their LTPA. According to Gollwitzer (1996), to facilitate the translation of intentions into action, individuals should create action-plans specifying when, where and how they are going to implement their intentions (i.e., implementation intentions). For individuals with SCI, these action-plans may be particularly important given that they often have to plan in advance to arrange for assistance, transportation and equipment to participate in physical activity (Martin et al., 2002). Given that the majority of individuals in the general population do not spontaneously create action-plans for LTPA (Rise, Thompson, & Verplanken, 2003), we suspect that most individuals with SCI do not create action plans either. Thus, for the SCI population, an implementation intentions intervention may be a practical strategy for strengthening the intentions-behaviour relationship.

Despite the important theoretical and practical implications of our findings, there are some limitations that warrant mention. First, the inclusion of self-efficacy items in the PBC measure may have created measurement redundancy, which in turn may have inflated the amount of variance in intentions accounted for by PBC (Ogden, 2003; Rhodes & Courneya, 2003b). Although the inclusion of both controllability and self-efficacy items is congruent with Ajzen's (2002b) conceptualization of PBC, emerging evidence suggests that self-efficacy captures motivation – a domain theoretically tapped by intentions (Rhodes & Courneya, 2003b). Thus, self-efficacy is at least partially redundant with intentions. To resolve this issue, a definition of PBC that clearly delineates the controllability aspects of PBC from the motivational aspects of intentions is needed. Second, the generalizability of our findings is limited to individuals currently using, or having previously used, community service programs. It is possible that such people are out in the community more often than nonusers, and are thus more aware of the benefits of LTPA by virtue of being more active. Although a random sample would provide greater generalizability, it was not possible to access a random sample for this study.

Regardless of the study limitations, the current investigation provides evidence of the utility of the TPB for understanding LTPA intentions and of the modest value of the TPB framework for understanding LTPA behaviour in the SCI population. Despite the modest prediction of behaviour, the findings begin to provide direction for intervention. With intentions emerging as the sole antecedent of behaviour, interventions that reduce the discrepancy between intentions and LTPA may be a particularly potent means of behaviour change (Ajzen, 2003). The effectiveness of intentions-centered interventions has not been determined. However, given the high rate of inactivity among individuals with SCI, examining the effectiveness of such interventions must become a research and health care priority.

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Table 1

Participant Demographics

	Participant Characteristics
Age	*M*=38.91 ± 11.28
Years post injury	*M*=11.67 ± 9.85
Gender	
Female	*n*=29 (28%)
Male	*n*=75 (72%)
Lesion Level	
Paraplegia	*n*=50 (48%)
Tetraplegia	*n*=54 (51%)
Lesion Completeness	
Incomplete	*n*=43 (41%)
Complete	*n*=56 (53%)
Unknown	*n*=5 (4.8%)

Table 2

Principle components analyses of 6-item PBC measure (varimax rotation)

Item	Loading
Controllability	
1. How much personal control do you feel you have over whether you participate in leisure time physical activity for at least 30 min on most days in the next week (1=*very little control*/ 7=*complete control*)	.81
2. Whether or not I participate in leisure time physical activity for at least 30 min on most days in the next week is entirely up to me (1=*strongly disagree*/7=*strongly agree*)	.76
3. How much do you feel that whether you participate in leisure time physical activity for at least 30 min on most days is beyond your control? (1=*very much so*/7=*not at all*).	.77
Self-Efficacy	
1. To what extent do you see yourself as being capable of participating in leisure time physical activity for at least 30 min on most days in the next week? (1=*very unlikely*/7=*very likely*).	.79
2. How confident are you that you will be able to participate in leisure time physical activity for at least 30 min on most days in the next week? (1=*very unsure*/7=*very sure*)	.84
3. If it were entirely up to me, I am confident that I would be able to participate in leisure time physical activity for at least 30 min on most days in the next week. (1=*strongly disagree*/7=*strongly agree*)	.53

Table 3

Descriptive Statistics and Bivariate Correlations Among the Theory of Planned Behaviour Variables

		Mean	1	2	3	4
1	Attitude	41.58 ± 6.18				
2	SN	12.01 ± 2.36	0.27**			
3	PBC	33.09 ± 7.86	0.53**	0.26**		
4	Intentions	10.74 ± 3.27	0.57**	0.48**	0.70**	
5	LTPA (min/day)	50.42 ± 67.96	0.29**	0.15	0.27**	0.34**

Note. SN= subjective norms, PBC=perceived behavioural control, LTPA= Leisure time physical activity.

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

Table 4

Hierarchical Linear Regression Models Predicting Intentions and LTPA

Step	R^2adj	ΔR^2	ß	*t*
Intentions				
1 YPI	0.01	0.03	0.03	0.57
Lesion level			0.05	0.71*
2 Attitude	0.42	0.42**	0.28	4.11**
SN			0.23	3.51**
3 PBC	0.67	0.24**	0.56	8.39**
LTPA Behaviour				
1 YPI	0.02	0.04	0.13	1.40
Lesion level			-0.06	-0.65
2 Intentions	0.11	0.10*	0.29	1.99*
3 PBC	0.10	0.00	0.04	0.26

Note. YPI= years post injury, PBC= perceived behavioural control, SN= subjective norms.

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

CHAPTER 4

Bridging the Gap between Intentions and Behaviour: Promoting Physical Activity among Individuals with Spinal Cord Injury

Abstract

Purpose: To evaluate the efficacy of an 8-week implementation intentions intervention for promoting physical activity among individuals with spinal cord injury (SCI) and to examine the effects of implementation intentions on variables and relationships encompassed by the theory of planned behaviour. **Methods**: Participants were randomly assigned to an intervention (n=28) or control (n=27) condition and were asked to try to engage in 30-minutes of moderate to heavy intensity physical activity 3-times per week. Physical activity behaviour, intentions and perceived behavioural control were measured at pretest and 8-weeks later. Barrier and scheduling self-efficacy were measured at Weeks 1 and 5. **Results**: The implementation intentions intervention strengthened the intentions - behaviour relationship and resulted in greater physical activity participation, intentions and scheduling self-efficacy compared to the control condition. **Discussion:** Implementation intentions facilitated the translation of intentions into behaviour, increased perceptions of control over physical activity behaviour and sustained physical activity intentions. Together these findings suggest an important role for implementation intentions in health promotion programs for people with SCI.

Traditionally defined as the absence of disease or infirmity, health historically has not been considered attainable for individuals with spinal cord injury (SCI). Consequently, little effort has been put forth to promote health in the SCI population (Brandon, 1985). However, the redefinition of health as "a state of complete physical, mental, and social well-being not merely the absence of disease" (World Health Organization, 2004) has lead to a paradigm shift among health practitioners (Rimmer, 1999; Teague, Cipriano, & McGhee, 1990). In realizing that individuals with SCI are capable of achieving good health but susceptible to secondary chronic conditions (e.g., pain, depression, cardiovascular disease; Bauman & Spungen, 2000; Boekamp, Overholser, & Schubert, 1996; Rintala, Loubser, Castro, Hart, & Fuhrer, 1998), research has begun to examine the effectiveness of health promotion interventions designed exclusively for people with SCI (Patrick, 1997). A major focus of these programs is the promotion of healthy lifestyles including physical activity (Brandon, 1985; Public Health Service, 1998). Among individuals with SCI, there is great need for this type of intervention given this population's high prevalence of sedentary behaviour (Buchholz, McGillivray, & Pencharz, 2003; Dearwater, Laporte, Cauley, & Brenes, 1985; Pentland, Harvey, Smith, & Walker, 1999) despite accumulating evidence demonstrating the numerous physical and mental health benefits of physical activity (e.g., Hicks et al., 2003). Most encouraging, the two existing published studies promoting physical activity for individuals with SCI were successful in eliciting behaviour change (Warms, Belza, Whitney, Mitchell, & Stiens, 2004; Zemper et al., 2003).

SCI-Specific Health Promotion Interventions to Increase Physical Activity

Specifically, Warms and colleagues (Warms et al., 2004) reported increased physical activity in a sample of 12 individuals with SCI following a 6-week lifestyle physical activity intervention. Based on the transtheoretical model of health behaviour change (Prochaska, DiClemente, & Norcross, 1992), the program included: (a) stage-matched written materials discussing physical activity, (b) a 90-minute home visit by a nurse to set goals and develop a personal action plan, and (c) 4 follow-up phone calls (days 4, 7, 14 and 28) for problem solving and renegotiating goals. A limitation of this study was the lack of an attention control group, making it impossible to decipher whether it was the intervention or simply the contact with program staff that elicited behaviour change. Nonetheless, of promise, participants evaluated the program positively suggesting that the physical activity promotion strategies used in the general population (i.e., education, counseling) are acceptable and may be effective for use among individuals with SCI.

Similarly, using educational and counseling strategies known to be effective in other populations, Zemper and colleagues (2003) noted a positive within-group change in physical activity levels among the 23 individuals with SCI who participated in a holistic wellness program emphasizing active living. Rooted in self-efficacy theory (Bandura, 1986), the program included: (a) six workshop sessions with an accompanying manual on health topics (stress management, sexual health, physical activity, nutrition, preventing secondary conditions), (b) an individual counseling session to set personal wellness goals, and (c) follow-up telephone calls to identify problems and develop plans for implementing solutions. To assess the efficacy of this intervention, at 7-months post-intervention physical activity levels for the intervention group were compared to those of a control group (n=20). The comparisons revealed only a nonsignificant trend for increased physical activity in the intervention group. In addition to the small sample size, these nonsignificant findings may have also resulted from the broad focus of the holistic wellness program. By targeting several health behaviours concurrently, the investigators may have diffused participants' attention away from physical activity. A randomized controlled trial examining the efficacy of an SCI-specific intervention solely promoting physical activity would likely increase the potency of the intervention and should lead to more pronounced between-groups differences. Further research is needed to test this hypothesis.

Taken together, it is clear from these two intervention studies (Warms et al., 2004; Zemper et al., 2003) that the physical activity behaviour of individuals with SCI is amenable to change, and that theory-based interventions may be a means of generating this change. However, due to the limitations of the research designs and the multifaceted interventions used in the extant studies, the essential intervention components necessary for eliciting behaviour change remain unclear. Specifically, consistent with Gollwitzer's (1993) action phase model, both interventions had two main components – a motivational component (education session, written materials, problem solving) and a volitional component (planning, goal setting). According to the action phase model, the motivational component serves to provide information and resources to positively influence individuals' inclination to perform the behaviour (i.e., emphasize the benefits) and culminates in the formation of goal intentions. Goal intentions specify a desired end state (I intend to engage in physical activity 3 times per week) and are equivalent to the intentions construct in the theory of planned behaviour. In turn, the volitional component facilitates the translation of goal intentions into behaviour and culminates in the actual performance of the behaviour (Gollwitzer, 1993; Sheeran, 2002). Thus, the volitional component compliments the motivational component without affecting motivation per se. Warms et al. (2004) and Zemper et al. (2003) failed to distinguish between these components, leaving to question which component of the programs impacted behaviour. Identifying the key program components would allow health practitioners to streamline interventions while maximizing effectiveness and minimizing cost.

Emerging evidence suggests a need for volitional interventions to promote physical activity among individuals with SCI. Using the theory of planned behaviour (Ajzen, 1985) as a framework, intentions emerged as the only predictor of behaviour in a sample of people with SCI (refer to dissertation Study 2). To note however, intentions only accounted for a small portion of the variance in physical activity indicating that individuals with SCI have considerable difficulty translating their intentions into behaviour. According to Gollwitzer (1993), to facilitate the translation of intentions into action, individuals should create implementation intentions (a volitional strategy) specifying when, where and how they are going to implement their intentions (e.g., "I intend to engage in physical activity at the gym on Tuesday afternoon after work").

The Efficacy of Implementation Intentions for Promoting Healthy Lifestyle Choices

Forming implementation intentions has been shown to increase the likelihood of performing many health behaviours. For example, compared to a control group, women who wrote down where and what time of day they would perform breast self-examinations over the next month were more likely to enact that behaviour (100% vs. 53%; Orbell, Hodgkins, & Sheeran, 1997). Similarly, participants who specified where and when they planned to take a vitamin C pill every day for the next 3-weeks were more adherent to their daily pill regime than participants who did not form implementation intentions. While these are examples of relatively simple health behaviours, implementation intentions have also been found to increase performance of more complex health behaviours (i.e., behaviours requiring a number of steps for successful goal completion; Sheeran & Orbell, 2000). For example, undergraduate students who planned a healthy diet for one day in the next five days ate more healthfully over the observation period (5 days) compared to students randomized to the control condition (Verplanken & Faes, 1999). Further, Armitage (2004) examined the utility of implementation intentions for reducing dietary fat intake over a prolonged period (1-month). As predicted, participants who recorded their plans for eating a low fat diet (giving particular attention to specific situations in which the plans would be implemented) reduced their fat intake. In contrast, no changes in dietary fat consumption were observed for the control condition. From these findings, it was concluded that as with simple health behaviours, implementation intentions seem to be a useful, low cost means of promoting more complex health behaviours such as healthy eating.

The Efficacy of Implementation Intentions for Promoting Physical Activity

In addition to affecting complex behaviours such as healthy eating, implementation intentions have also been found to bolster physical activity participation. In a preliminary study, participants who received a motivational intervention supplemented with a volitional intervention, reported participating in physical activity more times in a one-week period than participants who received either the motivational interview alone or no intervention whatsoever (Milne, Orbell, & Sheeran, 2002). Arbour et al. (2004) extended these findings by examining the impact of an implementation intentions intervention on middle-aged women's physical activity over a longer period (8-weeks). After viewing a motivational video on the topic of physical activity, the women either recorded their plans for their physical activity over the next 8-weeks (intervention condition) or listed activities mentioned in the video that they thought they might try (control condition). Although no between-groups differences in physical activity behaviour were found at follow-up, the results showed a significant correlation between goal intentions and subsequent physical activity for the intervention group only. Thus, consistent with Gollwitzer's (1993) prediction, women who formed implementation intentions were more likely to enact their goal intentions than those who did not make implementation intentions.

Despite offering support to Gollwitzer's (1993) model, a limitation of these two physical activity and implementation intentions studies is that both investigations examined the impact of a volitional intervention (i.e., implementation intentions) in combination with a motivational intervention (i.e., education). Examining the impact of a volitional intervention alone relative to a motivational or a combined intervention (motivational and volitional) would provide a more stringent test of the efficacy of implementation intentions. To examine this issue, 86 undergraduate students were randomly assigned to one of four conditions (control, volitional intervention only, motivational intervention only, combined intervention) and were asked to try to include two additional physical activity sessions into their existing exercise regime (Prestwich, Lawton, & Conner, 2003). As hypothesized, participants who formed implementation intentions (i.e., the volitional intervention only and combined intervention conditions) reported greater physical activity than those who did not (i.e., the motivational intervention only and control conditions). Although participation in the combined intervention had only a marginally better effect on physical activity in comparison to the volitional intervention alone (i.e., nonsignificant difference in frequency of participation, p=.06), the results of regression analyses revealed that the combined intervention may be important for aiding recall of implementation intentions or increasing commitment to them. These are benefits with potentially important implications for behavioural maintenance (Gollwitzer, 1993).

The Utility of Implementation Intentions for SCI-Specific Physical Activity Interventions

From the extant literature on implementation intentions, it seems that the formulation of implementation intentions is a viable strategy for increasing physical activity behaviour in the general population. Moreover, although not essential for eliciting behaviour change, motivational strategies may be used in conjunction with a volitional intervention to maximize the efficacy of the volitional intervention. Whether these interventions are useful for promoting physical activity in the SCI population has not been determined. The current study examined this possibility. Examining the efficacy of implementation intentions for SCI has great worth given the evidence of a weak physical activity intentions-behaviour relationship in this population (refer to dissertation Study 2) and Gollwitzer's (1993) suggestion that implementation intentions are particularly useful for individuals anticipating hinderances to behavioural enactment. The high prevalence of barriers to physical activity participation in the SCI population (Martin et al., 2002; Zemper et al., 2003) suggests that these individuals are ideal candidates for an implementation intentions intervention.

According to Gollwitzer (1993), implementation intentions foster an optimistic mind-set which facilitates initiation of behaviour for individuals anticipating behavioural barriers. That is, by the time they form implementation intentions, people have already committed to a goal (i.e., formed goal intentions) so they avoid negative thoughts that would undermine their goal pursuits (Gollwitzer & Kinney, 1989). Negative thoughts may be suppressed by construing goal attainment in a positive light, which in turn may yield optimistic perceptions of personal control over the intended outcome. Recent research supports this assertion that implementation intentions enhance perceptions of control. Arbour et al.'s (2004) study showed increased confidence to regulate physical activity behaviour (i.e., scheduling efficacy) in the implementation intentions group but not the control group. The possibility that implementation intentions bolster perceptions of control among individuals with SCI was explored in the present study.

Study Objectives and Hypotheses

Specifically, using a randomized controlled research design, the primary objective of this study was to determine whether the formulation of implementation intentions facilitates the translation of goal intentions into action and culminates in increased physical activity participation among individuals with SCI. Consistent with findings from the general population (Arbour & Martin Ginis, 2004; Milne et al., 2002; Prestwich et al., 2003), it was hypothesized that (a) participants who received a motivational intervention along with an implementation intentions intervention (intervention group) would report greater physical activity at Week 8 compared to participants who received the motivational intervention only (control group), and (b) the intervention group would be more likely to enact their goal intentions (i.e., goal intentions would be a stronger predictor of behaviour in the intervention group than the control group). The secondary objective of this study was to examine whether participation in a volitional intervention increases perceptions of control. In accordance with evidence that implementation intentions foster an optimistic mind-set (Gollwitzer & Kinney, 1989), it was hypothesized that the intervention group would have greater perceptions of control over their physical activity behaviour than the control group .

Method

Participants

Participants were recruited from across North America. Recruitment strategies consisted of advertisements in public (two local newspapers, one local news broadcast) and SCI-related media (three news magazines with national distribution lists, four North

American organizations' web-sites) and personalized e-mails to individuals listed in the consumer database of our SCI research program. Eligibility criteria were self report of: (a) neurological impairment secondary to SCI (i.e., traumatic or nontraumatic SCI), (b) age between 18-65 years, (c) physician's approval to participate in physical activity, (d) manual or power wheelchair use as a primary mode of mobility, (e) no cognitive impairment, (f) ability to speak and read English, (g) access to e-mail, and (h) sedentary lifestyle (i.e., participate in ≤2 bouts of LTPA per week; Rodgers & Gauvin, 1998). The study received approval from the McMaster Research Ethics Board (MREB) and participants provided verbal informed consent in accordance with MREB guidelines.

As described in Figure 1, of the 96 individuals who inquired about the program, 5 refused to participate and 38 did not meet the study inclusion criteria. The remaining 53 were stratified for lesion level and years post injury (≤ or > 10 years) and randomized into either the intervention group (n=26) or the control group (n=27). The demographic characteristics of the participants who were randomized are described in Table 1.

Measures

All measures are included in Appendix C.

Physical activity. Physical activity was assessed using the Physical Activity Recall Assessment for Individuals with SCI (PARA-SCI; Martin Ginis, Latimer, Craven, & Hicks, 2004). The PARA-SCI provides an estimate of total time spent doing mild, moderate and heavy intensity physical activity for the three-day period preceding the interview. Intensity of activities was self-designated by each participant using the PARA-SCI intensity classification system that was provided in written format prior to the interview. Trained research assistants followed a detailed interview protocol to administer the PARA-SCI via telephone.

The research assistant coded each reported physical activity as either physical activity or lifestyle activity. The physical activity category included all activities in the PARA-SCI leisure time physical activity category (i.e., unstructured physical activities that individuals *chose* to do during their *free time*) plus all activities involving continuous manual wheeling (e.g., active transport). All other activities were classified as lifestyle activity (e.g., self-care, household chores). An average daily physical activity score was calculated by tallying the number of minutes of physical activity reported across the moderate and heavy intensity categories and dividing by the number of days surveyed (i.e., three). This measure corresponded with the goals of the intervention (increasing moderate to heavy intensity physical activity). Although PARA-SCI lifestyle activity data were collected, because these activities were not targeted by the intervention, they were not included in this study. The PARA-SCI has demonstrated adequate test-retest reliability (ICC >.41; Martin Ginis et al., 2004). Construct validity has been demonstrated through significant correlations of PARA-SCI scores with fitness parameters and extreme group comparisons (refer to dissertation Study 1).

Perceived behavioural control. PBC was assessed using three items assessing the controllability aspect (beliefs about the extent to which performing the behaviour is up to the actor) and three assessing the self-efficacy aspect (perceived ease or difficulty of performing the behaviour) of PBC. These items, adapted from research by Armitage and Conner (1999), have demonstrated reliability and a single factor structure in the SCI-specific physical activity domain (refer to dissertation Study 2). All items were rated on a 7-point scale. Controllability-related items were: (a) "How much personal control do you feel you have over whether you participate in moderate to heavy physical activity for at least 30 min 3 days per week over the next 4 weeks?" (1=*very little control*/ 7=*complete control*), (b) "Whether or not I participate in moderate to heavy physical activity for at least 30 min 3 days per week over the next 4 weeks is entirely up to me." (1=*strongly disagree*/7=*strongly agree*), and (c) "How much do you feel that whether you participate in moderate to heavy physical activity for at least 30 min 3 days per week over the next 4 weeks is beyond your control?" (1=*very much so*/7=*not at all*). Self-efficacy related items were: (a) "If it were entirely up to me, I am confident that I would be able to participate in moderate to heavy physical activity for at least 30 min on most days in the next week." (1=*strongly disagree*/7=*strongly agree*), (b) "To what extent do you see yourself as being capable of participating in moderate to heavy physical activity for at least 30 min 3 days per week over the next 4 weeks?" (1=*very unlikely*/7=*very likely*), and (c) "How confident are you that you will be able to participate in moderate to heavy physical activity for at least 30 min 3 days per week over the next 4 weeks?" (1=*very unsure*/7=*very sure*). The internal consistency of this PBC measure was adequate at all measurement points as indicated by Cronbach alpha coefficients ($\alpha > .85$; Nunnally, 1978).

Intentions. Intentions were measured using two items rated on a 7-point scale. The two items were: a) "I will try to do at least 30 minutes of moderate to heavy physical activity 3 days per week over the next 4 weeks."(1=*definitely false*/7=*definitely true*) and,

b) "I intend to do at least 30 minutes of moderate to heavy physical activity 3 days per week in the forthcoming month." (1=*extremely unlikely*/7=*extremely* likely). These items have been used in previous research in the physical activity domain in a variety of clinical populations (e.g., Courneya, Friedenreich, Sela, Quinney, & Rhodes, 2002) including individuals with SCI (Latimer, Martin Ginis, & Craven, 2004; refer to dissertation Study 2).

Scheduling self-efficacy. Scheduling self-efficacy was measured using three items rated on a 10-point scale (1=*not confident*/10=*completely confident*). Participants indicated their confidence to engage in a 30 min bout of moderate to heavy intensity physical activity one, two and three times per week over the next three weeks. This hierarchical measurement protocol follows the standard protocol for assessing task self-efficacy (Bandura, 1986) and is the recommended format for the physical activity domain (McAuley & Mihalko, 1998). This scale has been used in previous physical activity research (Arbour & Martin Ginis, 2004; Rodgers, Hall, Blanchard, McAuley, & Munroe, 2002). These items demonstrated adequate internal consistency in this investigation ($\alpha > .85$).

Barrier self-efficacy. Barrier self-efficacy was assessed using nine items rated on a 10-point scale (1=*not confident*/10=*completely confident*). Participants indicated their confidence to overcome salient barriers to physical activity participation. The salient barriers were identified from information gathered from focus groups with individuals with SCI (Latimer et al., 2004; Martin et al., 2002) and are consistent with barriers reported in other clinical populations (Courneya et al., 2002). The 9 barriers were: (a) feeling tired or fatigued, (b) becoming very busy and having limited time, (c) having transportation difficulties, (d) not having someone to assist with exercise activities, (e) being unable to afford a gym membership or exercise equipment, (f) not having access to a proper facility, (g) experiencing pain or soreness, (h) encountering bad weather, and (i) having health or medical problems. Each item was preceded by the statement *"Assuming you were very motivated, how confident are you that you will do moderate-heavy intensity leisure time physical activity for at least 30 min on most days in the next month even if…"* This item stem has been used previously in the physical activity domain (Blanchard et al., 2003). The internal consistency of this scale was adequate at all time points ($\alpha > .91$).

Procedure

This study used a randomized controlled design. Physical activity, intentions and PBC were assessed pretest and 8 weeks later via telephone interview. Scheduling and barrier self-efficacy were assessed via e-mail survey at Weeks 1 and 5. Baseline measures of self-efficacy were gathered at Week 1 so that participants had mastery experiences to draw on when estimating their level of efficacy (Rejeski et al., 2003).

As a motivational intervention, one-week prior to pretesting, participants were mailed a "Physical Activity Toolkit" (refer to Appendix C). The toolkit included: (a) a pamphlet outlining different types of physical activities individuals with SCI might enjoy, (b) a rubber resistance band, (c) a picture-based instruction guide for using the resistance band, and (d) a safety tip sheet. At the beginning of the pretest interview, participants were asked if they had reviewed these materials and whether they had any questions.

Participants who had not read the necessary materials were guided through the toolkit's contents by the interviewer. Among individuals with SCI, lack of knowledge about physical activity and access to exercise equipment have been identified as major barriers to physical activity (Martin et al., 2002). Thus, the purpose of the toolkit was to ensure that all participants had at least a basic knowledge of physical activity before beginning the intervention and to bolster motivation. Furthermore, preceding implementation intentions with a motivational intervention has been found to increase the effectiveness of volitional strategies (Prestwich et al., 2003).

For the pretest and Week 8 interviews, participants were e-mailed a question guide that included a copy of the intentions and PBC questionnaire items, the definition and examples of physical activity, and the PARA-SCI intensity classification system. Participants were asked to have these materials available to refer to during each interview. The interviewer began by reviewing the definition and examples of physical activity printed on the question guide. Physical activity was defined as *"all of the activities that you choose to do during your free time that require physical exertion (Bouchard & Shephard, 1994) and wheeling that you do for periods of 10-minutes or longer."* Examples of physical activity included exercise, sport, wheeling to work and wheeling around the block with the dog. Examples of non-physical activity included physiotherapy, stretching, shopping, cleaning, and activities of daily living. Participants were also reminded that although the questions referred to 30 minutes of activity, these minutes did not have to be continuous; they could be accumulated throughout the day in shorter 10-minute bouts (Dunn et al., 1999). The interviewer answered any questions concerning the physical activity definition, then read each of the PBC and intentions items and recorded participants' responses. Next, the interviewer reviewed the intensity classification system and answered any questions relating to the system. Participants then completed the PARA-SCI.

Intervention

Intervention condition. At pretest, after completing the questionnaires, participants were asked to formulate implementation intentions for the next 4-weeks. Specifically, participants were asked to schedule three 30 min bouts of moderate to heavy intensity physical activity per week. For each bout, participants indicated where and when they planned to partake in physical activity as well as the specific type, intensity and duration of the activity planned (i.e., formulated implementation intentions). The interviewer recorded the participants' responses on a calendar. Participants were e-mailed a copy of the calendar and asked to post it in a visible spot in their homes. Participants also received a physical activity logbook. The accompanying directions instructed participants to record the details of their physical activity (date, activity type, duration, intensity) for the next 4-weeks. For some individuals, having to refer to a calendar with a recorded physical activity schedule may induce self-monitoring (e.g., checking off completed activities on calendar). Self-monitoring has been found to motivate physical activity behaviour (Noland, 1989). Thus, to control for this potentially confounding behaviour, all participants were required to track their physical activity in a logbook. Participants were contacted again at Week 4 and were asked to update their implementation intentions for the next 4-weeks. Arbour et al. (2004) suggest that to ensure that implementation intentions remain relevant throughout an 8-week intervention, participants should be encouraged to modify their plans to reflect their mastery experiences of overcoming barriers and performing exercise tasks. Participants were e-mailed a copy of their updated physical activity calendar and a new logbook.

Control condition. At pretest, after completing the questionnaires, participants verbally listed the activities that they thought they might try over the course of the next 4-weeks. The interviewer recorded these responses on a note page that included the 4-week calendar. Previous research demonstrates that completing this task is appropriate for the control condition as it does not affect their physical activity behaviour or cognitions but takes similar time and effort as the implementation intentions task completed by the intervention group (Arbour & Martin Ginis, 2004). Participants were e-mailed a copy of this note page and asked to post it in a visible spot in their homes. Again, to control for the potential influence of self-monitoring, similar to the intentions condition, participants also received a physical activity logbook with accompanying instructions to record the details of their physical activity (date, activity type, duration, intensity) for the next 4-weeks. Participants were contacted again at Week 4. After listing the activities they thought they might try, participants were sent an updated notes page and a new logbook.

In summary, participants in both the control and intervention groups received a motivational intervention. Following the motivational intervention, the control group was afforded all of the same opportunities as the intervention group to interact with the interviewer and to monitor their physical activity, but did not receive the implementation intentions intervention. Thus, unlike the previously tested SCI physical activity interventions (Warms et al., 2004; Zemper et al., 2003), from our research design it was possible to determine whether the central aspect of the intervention -- implementation intentions -- was efficacious.

Analyses

To ensure that randomization was effective, baseline comparisons of the intervention and control groups were performed using separate analyses of variance (ANOVA) for continuous data and chi-squares for categorical data. To examine the effects of the intervention on the primary (physical activity) and secondary (intentions, PBC, scheduling and barrier self-efficacy) outcome variables, the data were submitted to separate analyses of covariance (ANCOVA) controlling for baseline values. ANCOVA is advocated for examining treatment effects in randomized experiments (Cronbach & Furby, 1970). ANCOVA reduces measurement error (i.e., increases statistical power) compared to ANOVA on simple difference scores while allowing for the essential question to be examined – whether groups differ following the intervention (Norman, 1989). All analyses were conducted on the baseline-adjusted post-intervention measures (see Table 2). For ease of interpretation, baseline-adjusted change scores have also been presented for each study measure.

To examine the effects of the intervention on the strength of the intentions-behaviour relationship, separate prospective, hierarchical multiple regression analyses were conducted for the intervention and control groups. According to Ajzen (1985), behaviour is determined by individuals' intentions and PBC. This hypothesis is strongly supported in the physical activity domain (e.g., Hagger, Chatzisarantis, & Biddle, 2002) and is at least partially supported in the SCI literature (Latimer et al., 2004; refer to dissertation Study 2). Given this evidence, intentions and PBC were examined as predictors of physical activity. For each group, physical activity at Week 8 was regressed on pretest intentions (Step 1) and PBC (Step 2). The order of variable entry was based on previous research examining the predictive capabilities of intentions and PBC in the SCI-specific physical activity domain (Latimer et al., 2004; refer to dissertation Study 2).

Results

Study Attrition and Intervention Adherence

Of the 53 participants initially randomized, 49 completed the pretest and Week 8 interviews (see Figure 1). Among the 4 participants lost to attrition, two dropped out due to personal illness, one withdrew from the study due to lack of time and one could not be contacted at Week 4. All except one participant returned their Weeks 1 and 5 self-efficacy questionnaires. The one participant who did not return the Week 1 self-efficacy questionnaire was removed from only the self-efficacy related analyses.

With this being an efficacy trial, only data from participants who maintained fidelity to the intervention were included in the final analysis (Flay, 1986). For this reason, from the 49 participants remaining at follow-up, twelve were removed from the sample including: (a) six individuals who reported activity-restricting injuries (shoulder pain due to exercising [n=3], neck pain [n=2], and dislocated rib [n=1]), (b) five individuals who failed to keep a logbook, and (c) one individual who traveled from a winter climate at pretest to a summer climate at Week 8. In sum, nine individuals either were excluded or withdrew from the control group and seven individuals were excluded from the implementation intentions intervention group thus leaving a final sample of 37 participants (control n=18, intervention n =19). The demographic characteristics of the participants who withdrew from the trial or were excluded from the efficacy analyses were not different from the characteristics of the 37 individuals included in the final sample (ps>.05).

Representativeness and Randomization Checks

The demographic characteristics of the participants included in the efficacy analyses are presented in Table 1. In summary, participants were 21 women and 16 men with incomplete (43.2%) or complete (54.1%) paraplegia (64.9%) or quadriplegia (32.4%). Separate chi square analyses revealed that the participant distribution for sex, $\chi^2(1)=34.27, p<.001$, but not injury characteristics, $ps>.05$, was significantly different from the distribution observed in the general population of individuals with SCI (Canadian Paraplegic Association, 2000). Whereas more women (56.8%) than men (43.2%) enrolled in the intervention, in the general population, the majority of individuals with SCI are male (81%). The absence of between-groups differences in demographic and pretest study measures ($p<.05$) indicated that randomization was successful.

Primary Outcomes

Treatment effects. To test the hypothesis that implementation intentions would have a positive effect on physical activity, an ANCOVA (controlling for pretest values) was conducted on Week 8 physical activity. As predicted, at Week 8, participants in the intervention condition reported greater physical activity than the control condition, $F(1,34)=4.60, p=.04, d=.71$. The adjusted change data presented in Table 2 indicate that this difference reflects an increase in physical activity in the intervention group and a decrease in physical activity in the control group over the duration of the trial.

Predicting physical activity. Bivariate correlations between pretest intentions and PBC and Week 8 physical activity are reported in Table 3. Separate analyses were conducted for each group. Overall, for the intervention group, intentions (r=.48, p=.04), but not PBC (r=.24, p=.31), were significantly correlated with physical activity. For the control group, neither intentions nor PBC were significantly related to physical activity (ps>.05).

To test the hypothesis that the intentions-behaviour relationship would be stronger for the intervention group compared to the control group, separate hierarchical regression analyses were conducted for each group with pretest intentions and PBC entered as predictors of Week 8 physical activity. As expected, intentions emerged as a significant predictor of behaviour in the intervention group but not the control group. Results indicated that for the intervention group, intentions accounted for 22.6% of the variance in physical activity, $F_{change}(1,17)=4.97$, p=.04, whereas PBC did not add any unique variance to the prediction of behaviour. Further inspection of the beta weights indicated that only intentions were a significant independent predictor of physical activity, β=.69, p=.05. For the control group, neither intentions nor PBC explained significant variance nor were they significant independent predictors of behaviour.

Secondary Outcome Analyses

In a series of secondary analyses examining the effects of the implementation intentions intervention on intentions and control beliefs, separate ANCOVAs (controlling for baseline) were performed on each secondary outcome variable (intentions, PBC, scheduling and barrier self-efficacy). These analyses revealed main treatment effects on intentions, $F(1,33)=4.73$, $p=.04$, $d=.73$, and scheduling self-efficacy, $F(1,32)=4.41$, $p=.04$, $d=.71$. Both intentions and scheduling self-efficacy were higher at follow-up in the intervention condition compared to the control condition. Inspection of adjusted mean change scores indicated that between-groups differences for intentions reflect a trend towards a greater decrease in intentions in the control group than in the intervention group across the trial. The data further suggest that between-groups differences at Week 5 reflect a decrease in scheduling efficacy for the control group and an increase for the intervention group from Week 1 to Week 5. No significant main effects emerged for the PBC or barrier self-efficacy measures (ps>.05).

Discussion

The present study offers evidence of the efficacy of an implementation intentions intervention for promoting physical activity among individuals with SCI. The volitional intervention strengthened the goal intentions-behaviour relationship and resulted in greater physical activity participation. These findings are consistent with existing research demonstrating the important role of implementation intentions in health promotion programs (e.g., Armitage, 2004; Prestwich et al., 2003) and have implications for increasing physical activity levels among the predominantly sedentary SCI population.

The implementation intentions intervention improved the prediction of physical activity by goal intentions. Specifically, pretest goal intentions accounted for a significant

22.6% of the variance in Week 8 physical activity behaviour in the intervention group. By contrast, goal intentions were not a significant predictor of behaviour in the control group. Despite having the best of intentions, without forming implementation intentions, individuals in the control condition were unable to translate their goal intentions into action. These results support the notion that among individuals with SCI, intentions are not sufficient to promote behaviour. In further support of the utility of implementation intentions among individuals with SCI, the significant treatment effect observed for physical activity at 8-weeks favored the intervention group. In combination, these two findings emphasize that initiatives promoting physical activity are likely to be more efficacious when they incorporate volitional strategies such as implementation intentions.

In addition to demonstrating the efficacy of implementation intentions for promoting physical activity participation (the primary study objective), the present study also lends some support to Gollwitzer's (1993) suggestion that implementation intentions increase perceptions of control over the intended behaviour (the secondary study objective). Implementation intentions had a favorable effect on scheduling self-efficacy, leading the intervention group to report greater confidence to schedule their physical activity than the control group. Also, there was a tendency for the intervention group to have higher barrier self-efficacy and perceived behavioural control than the control group. As indicated from the large effect sizes (Cohen, 1992), these trends might have emerged as significant with a larger sample. These findings suggest that volitional strategies might be used in practical situations to help individuals with SCI increase their perceived ability to manage the numerous factors impeding physical activity participation -- particularly scheduling constraints.

Further, the positive perceptions of control over physical activity elicited from the formation of implementation intentions may be important in sustaining motivation. At 8-weeks, the implementation intentions group had stronger goal intentions than the control group. Inspection of the baseline-adjusted difference scores indicated a trend towards a greater decrease in intentions in the control group compared to the intervention group. This observation is consistent with evidence that implementation intentions do not change goal intentions (Milne et al., 2002; Sheeran & Orbell, 1999) but may be important in preventing their decrement over an extended period (Gollwitzer & Kinney, 1989). Given the challenge of maintaining behaviour change in many health promotion programs, these findings highlight the potential value of incorporating volitional strategies into long-term interventions to ensure continued motivation and commitment to perform the target behaviour.

With the present study offering many positive results supporting the efficacy of implementation intentions for SCI, it is important to put these findings in perspective. First, despite being one of the largest randomized controlled trials of physical activity behaviour involving individuals with SCI (Martin Ginis & Hicks, in press), the study sample was small and not representative of the gender distribution of the SCI population. Further, in being an efficacy trial, only individuals who maintained fidelity to the intervention remained in the analyses. Thus, generalizing the study's findings to the larger SCI population may be premature. A further investigation is required with a larger, representative sample of individuals with SCI that utilizes intention-to-treat analyses.

Secondly, although these findings hold promise for behaviour change, it is unclear whether the greater physical activity reported in the intervention group compared to the control group corresponds with greater health. However, with evidence of a positive association between moderate to heavy intensity physical activity participation and physical fitness among individuals with SCI (refer to dissertation Study 1), it is likely that greater physical activity translated into improved health. To test this prediction, future investigations of implementation intentions-based interventions should also assess health outcomes.

A third more practical concern was the finding that 3 individuals reported activity-limiting injuries due to their participation in the recommended thrice weekly 30-minute bouts of physical activity. From these events we learned that when intervening among sedentary individuals with SCI, a progressive approach to physical activity prescription is warranted (i.e., slowly progress over an extended period to bouts lasting 30-minutes). In addition, there would be value in holding an introductory meeting to review proper exercise techniques and safety prior to initiating the trial.

Evidently, with much still to be learned regarding physical activity interventions among individuals with SCI, the present study begins to provide evidence of the utility of implementation intentions in a health promotion program exclusively for people with SCI. The favorable effects of the volitional intervention on the intentions-behaviour relationship and on physical activity behaviour, contribute to the accumulating evidence of the efficacy of implementation intentions to promote physical activity. The findings of increased perceptions of control over physical activity and sustained intentions in the intervention group, further emphasize the importance of incorporating volitional strategies into health promotion interventions for individuals with SCI. Using the results of this study as a foundation, research must be undertaken to determine whether an implementation intentions based physical activity intervention for individuals with SCI leads to improved health and quality of life – the primary objective of all health promotion strategies (Rimmer, 1999).

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Table 1

Participant Demographic Characteristics

	All Participants Enrolled (*n*=53)	Participants Included in the Efficacy Analyses (*n*=37)	
		Intervention	Control
Age	*M*=40.61 ± 10.89	*M*=40.94 ± 10.85	*M*=40.89 ± 11.56
Years post injury	*M*=19.34 ± 19.79	*M*=19.94 ± 15.54	*M*=15.73 ± 11.82
Gender			
Female	*n*=27 (51%)	*n*=10 (56%)	*n*=11 (58%)
Male	*n*=26 (49%)	*n*=8 (44%)	*n*=8 (42%)
Level†			
Paraplegia	*n*=34 (64%)	*n*=12 (67%)	*n*=12 (63%)
Tetraplegia	*n*=18 (34%)	*n*=6 (33%)	*n*=6 (32%)
Completeness†			
Incomplete	*n*=26 (49%)	*n*=12 (67%)	*n*=8 (42%)
Complete	*n*=24 (45%)	*n*=6 (33%)	*n*=10 (53%)
Mode of Mobility			
Power chair	*n*=13 (24%)	*n*=3 (17%)	*n*=5 (26%)
Manual chair	*n*=40 (76%)	*n*=15 (83%)	*n*=14 (74%)

Note. †Missing cases (*n*=1)

Table 2

Raw and Adjusted Means for Physical Activity and Secondary Outcome Measures

	All participants (*n*=49)		Participants included in efficacy analyses (*n*=37)				
	Adjusted Time 2	*d*	Time 1	Time 2	Adjusted Time 2	*d*	Adjusted Change
Physical Activity		0.40				0.71	
CO (min/day)	43.51 ± 67.21		45.72 ± 48.81	40.78 ± 56.18	43.66 ± 71.70*		-19.86 ± 71.70
II (min/day)	70.55 ± 67.12		80.37 ± 79.96	97.79 ± 81.31	95.06 ± 71.63		31.55 ± 71.63
Intentions		0.10				0.73	
CO	11.28 ± 2.68		12.82 ± 1.29	11.71 ± 2.08	11.69 ± 1.39*		-1.11 ± 1.39
II	11.56 ± 2.68		12.79 ± 1.65	12.68 ± 1.60	12.70 ± 1.39		-0.11 ± 1.39
PBC		0.16				0.57	
CO	33.93 ± 6.46		36.82 ± 4.75	35.41 ± 5.36	35.10 ± 4.16		-1.28 ± 4.01
II	34.98 ± 6.46		36.58 ± 5.48	37.58 ± 4.49	37.49 ± 4.16		0.89 ± 4.01

(*table continues*)

Table 2 (*continued*)

Raw and Adjusted Means for Physical Activity and Secondary Outcome Measures

	All participants (n=49)		Participants included in efficacy analyses (n=37)				
	Adjusted Time 2	*d*	Time 1	Time 2	Adjusted Time 2	*d*	Adjusted Change
Scheduling SE		0.35				0.71	
CO	24.15 ± 4.06		26.47 ± 3.91	24.25 ± 6.78	24.45 ± 3.79*		-2.32 ± 3.79
II	25.57 ± 4.05		26.95 ± 4.02	27.32 ± 3.67	27.15 ± 3.79		0.38 ± 3.79
Barrier SE		0.15				0.47	
CO	61.3 ± 11.26		56.34 ± 18.96	57.37 ± 20.75	61.06 ± 10.01		0.07 ± 10.01
II	64.97 ± 11.24		65.11 ± 16.16	69.00 ± 12.08	65.89 ± 9.98		4.89 ± 9.98

Note. Values for all of the participants who completed the 8-week trial (n=49) were included for descriptive purposes only and are not discussed in the manuscript. CO= control condition, II=implementation intentions condition, SE= self-efficacy. Time 1 – intentions and PBC were measured at pretest, self-efficacy was measured at Week 1; Time 2 – intentions and PBC were measured at Week 8, self-efficacy was measured at Week 5.

*p<.05.

Table 3

Bivariate Correlations Between Week 8 Physical Activity and Pretest Intentions and PBC

	Physical Activity	Pretest Intentions
Control		
Pretest intentions	-0.03	
Pretest PBC	-0.20	0.85**
Intervention		
Pretest intentions	0.48*	
Pretest PBC	0.24	0.76**

Note. $^*p \leq .05$, $^{**}p < .01$.

Table 4

Hierarchical Linear Regression Models Predicting Week 8 Physical Activity in the Control and Intervention Conditions

Predictor	R^2adj	ΔR^2	ß	*t*
Control condition				
Pretest intentions	-.07	.01	.50	1.04
Pretest PBC	-.02	.11	-.62	-1.30
Intervention condition				
Pretest intentions	.18	.23*	.69	2.07*
Pretest PBC	.16	.03	-.28	-.84

Note. *p<.05, **p<.01.

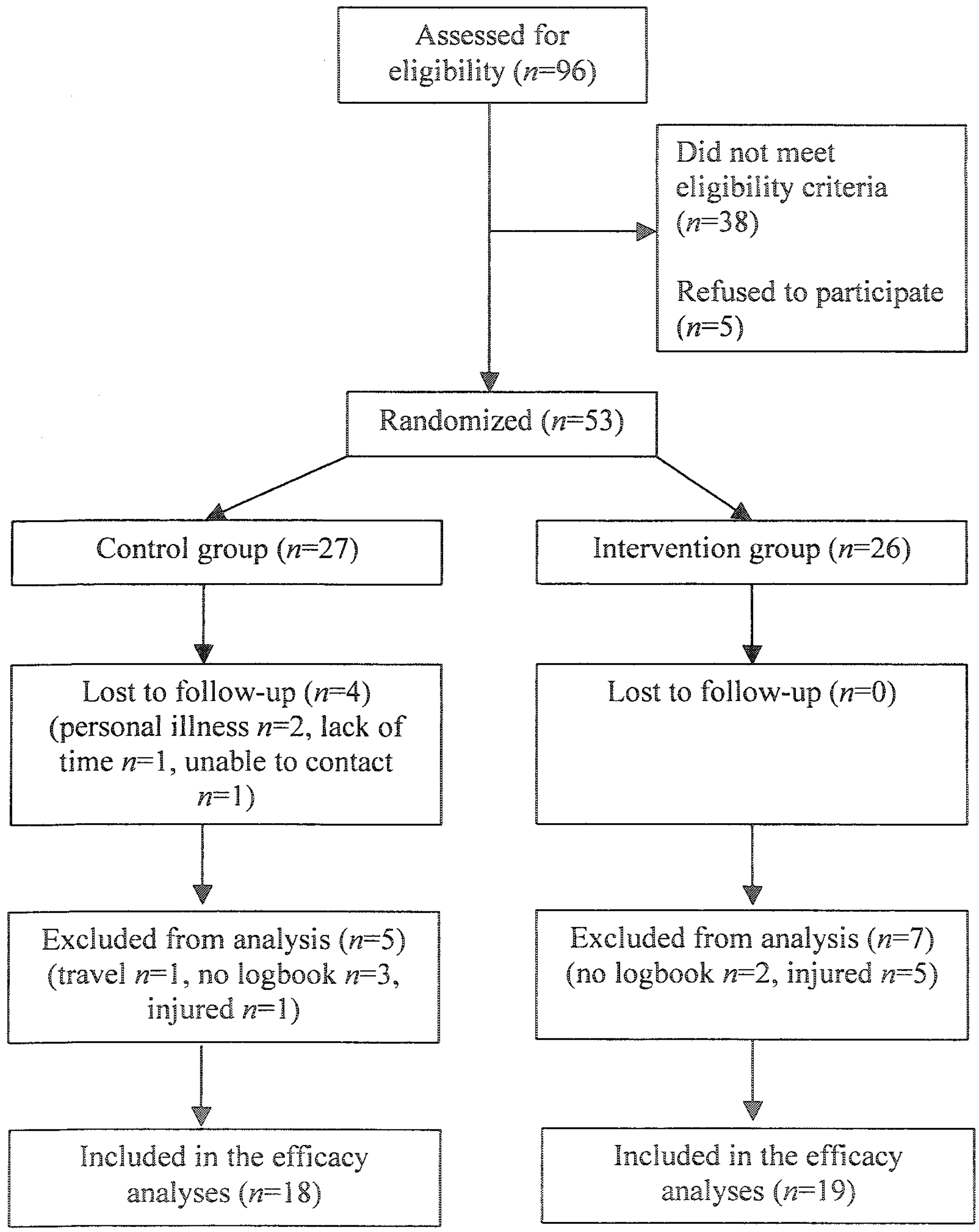

Figure 1. The flow of participants through each stage of the implementation intentions intervention randomized controlled trial.

CHAPTER 5

General Discussion

The inactive lifestyle of the majority of individuals with SCI is a serious health concern. Consequently, developing interventions to promote physical activity is a research priority. Using a systematic approach, the purpose of this dissertation was to identify theory-based determinants of physical activity and to apply these findings to the development of an intervention promoting physical activity for people with SCI. In addition to having practical implications, the three dissertation studies contribute to an improved understanding of measurement issues and the advancement of psychosocial theory and models within the domain of physical activity and SCI.

9.0 Contributions to Advancing Measurement in the Physical Activity Domain

9.1 Measurement of physical activity

Research within the domain of physical activity and SCI has been limited by the lack of a valid and reliable measure of physical activity for use in the SCI population. To resolve this limitation, Study 1 examined the construct validity of the PARA-SCI (Martin Ginis, Latimer, Craven, & Hicks, 2004)– a reliable, SCI-specific physical activity measure. The results supported the construct validity of the LTPA PARA-SCI category but not the cumulative and lifestyle activity categories. These findings contribute to physical activity and SCI research in two ways.

First, they establish the validity of a reliable method for assessing the frequency, intensity and duration of LTPA among individuals with SCI. Now that a self-report physical activity assessment tool is available, SCI-specific physical activity research can progress. For example, longitudinal investigations can now be conducted to examine physical activity patterns and their relation to health outcomes. Such prospective epidemiological data will provide a strong and necessary foundation for developing SCI-specific physical activity guidelines.

A second contribution of the Study 1 findings is that they challenge the belief that lifestyle activity should be considered a significant source of physical activity which contributes to the physical fitness of individuals with SCI. As shown in Figure 1, lifestyle activity does indeed constitute a substantial portion of the physical activity performed by individuals with SCI. However, Study 1 determined that as it is currently defined (i.e., *"all reported physical activities that are not considered LTPA"*), lifestyle activity is only minimally related to fitness. Thus, while the PARA-SCI measure of lifestyle activity is useful for describing how individuals with SCI allocate their time throughout the day, it has little value as an index of fitness-enhancing activity levels.

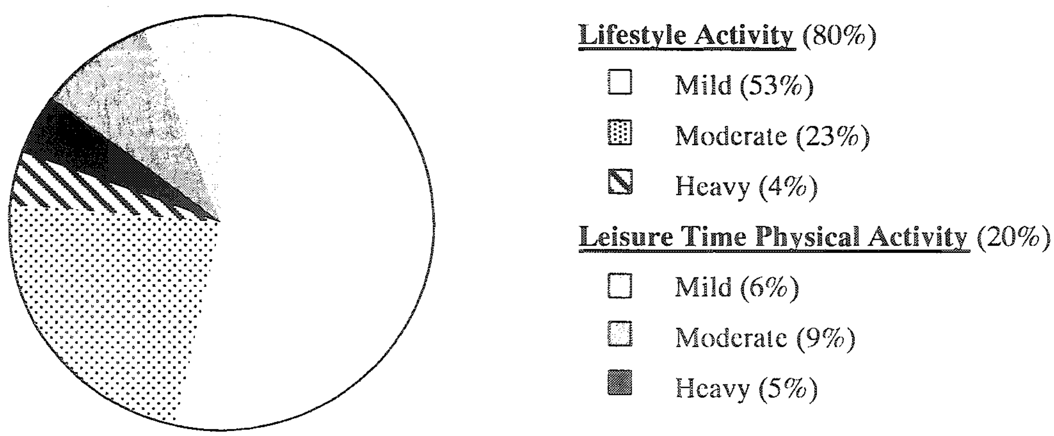

Figure 1. Proportion of total cumulative activity spent engaged in mild, moderate and heavy intensity lifestyle activity and LTPA. Values are from data included in dissertation Study 1 (n=158).

Taken together, the findings from Study 1 contribute to the advancement of physical activity and SCI research by suggesting that: (a) LTPA should be the primary focus of studies aimed at understanding the fitness benefits of physical activity in the SCI population, and (b) the PARA-SCI is a psychometrically sound tool for measuring LTPA behaviour. Studies 2 and 3 demonstrated the application of these important findings to the advancement of knowledge regarding physical activity determinants and interventions in the SCI population.

9.2 Measurement of the theory of planned behaviour constructs

Using the LTPA PARA-SCI category as the primary outcome measure, Study 2 identified determinants of physical activity among individuals with SCI in the context of the theory of planned behaviour (TPB). Attitudes, subjective norms and PBC each emerged as unique predictors of physical activity intentions. The results of Study 2 substantially improved upon the findings from a preliminary SCI and TPB investigation in which only PBC emerged as a significant predictor of intentions among individuals with tetrapelgia (Latimer, Martin Ginis, & Craven, 2004). The improved prediction of intentions in Study 2 may be attributable to the use of direct measures of the TPB constructs. The use of direct measures avoided the measurement constraints associated with composite belief-based measures (i.e., using direct measures prevents the measurement-related attenuation of the strength of the TPB relationships).

Further, Study 2 established intentions as the sole TPB determinant of physical activity behaviour. This finding is in contrast to the results from the Latimer et al. (2004) study in which intentions did not predict physical activity whatsoever. The improved prediction of physical activity by intentions in Study 2 speaks to the importance of ensuring correspondence between measures. Specifically, the Latimer et al. investigation assessed LTPA using a modified version of a generic physical activity scale. This modified scale failed to capture many types of LTPA performed by individuals with SCI. As a result, the action element of the intentions measure (i.e., intent to perform all types of LTPA) was not correspondent with the action element of the behavioural outcome measure (i.e., performance of only *some* types of LTPA). In contrast, dissertation Study 2 used a SCI-specific measure of physical activity that captured all types of LTPA, thus ensuring correspondence between the action element of the intentions and behavioural outcome measures. Increasing the correspondence between the intentions and behaviour measures likely strengthened the statistical relationship between intentions and behaviour (Ajzen & Timko, 1986).

Interestingly, in Study 2, PBC did not emerge as a significant predictor of physical activity. The failure of the PBC construct to predict behaviour is consistent with reports from TPB investigations in other clinical populations (e.g., Blanchard et al., 2003; Courneya, Blanchard, & Laing, 2001) yet it is in opposition to the results from the preliminary Latimer et al. (2004) study. The conflicting findings from Study 2 and the Latimer et al. study might be due to differences in the research designs employed. Specifically, Study 2 employed a prospective research design (i.e., LTPA was measured one-week after measuring PBC) whereas the Latimer et al. study employed a cross-sectional research design (i.e., LTPA and PBC were measured concurrently). Unlike in a cross-sectional TPB study, in a prospective TPB study, it is possible that between the assessment of PBC and LTPA, participants experience unexpected barriers to participation. Because PBC is a function of beliefs about the *presence* of factors that may facilitate or impede performance, unexpected barriers that were *not present* at baseline may alter individuals' PBC and their behavioural trajectory. Consequently, as shown in Study 2, baseline PBC may fail to predict later physical activity behaviour. This measurement constraint suggests a need to modify PBC measures when prospectively testing the PBC-behaviour relationship among individuals with SCI.

In summary, Study 2 enhances our understanding of (a) the centrality of using well-constructed, correspondent measures of theoretical variables and behaviour, and (b) the impact of the research design in a theory-based examination of physical activity determinants. In addition to advancing knowledge regarding the measurement of TPB constructs, Study 2 contributes to the physical activity and SCI literature by identifying theory-based determinants of physical activity among individuals with SCI. Furthermore, establishing the predictive capabilities of the TPB among people with SCI has important implications for advancing psychosocial theory and models within the physical activity domain.

10.0 Contributions to Advancing Psychosocial Theory and Models in the Physical Activity Domain

An advantage of conducting theory-driven, physical activity research in the SCI population is that it can help to advance the theory itself (Reid, 1989). Successfully applying a theory to the behaviour of a special population broadens the evidence base supporting the theory. Thus, in corroborating the tenets of the TPB for predicting physical activity intentions, the Study 2 findings extend empirical support for the TPB in the physical activity domain. By contrast, findings contrary to the TPB tenets highlight limitations of the theory and provide direction for examining alternative processes underlying behaviour (Crocker, 1993). For example, Study 2 only provided modest support for the TPB's ability to predict physical activity behaviour in the SCI population. In particular, the poor predictive validity of intentions was highlighted as a weakness of the TPB. In turn, evidence of a weak intention-behaviour relationship provided direction for Study 3.

Specifically, Study 3 examined the efficacy of implementation intentions for strengthening the physical activity intentions-behaviour relationship. The randomized controlled trial findings indicated that indeed, implementation intentions enhance the TPB intentions-behaviour relationship. This finding has important implications for the TPB insofar as it advocates an expansion of the theory to include a volitional component that maximizes the predictive validity of intentions.

In addition, Study 3 has implications for the expansion of the action phase model (Gollwitzer, 1993). Findings of increased perceived behavioural control over physical activity challenge the hypothesis endorsed by numerous researchers (e.g., Milne, Orbell, & Sheeran, 2002) that implementation intentions cause individuals to relinquish personal control of their physical activity behaviour to external cues. According to the action phase model, specifying where and when one will perform the intended behaviour creates contextual cues. When these cues are encountered, they automatically prompt the performance of the intended behaviour. However, Study 3 demonstrated that implementation intentions actually led to *greater* perceptions of personal control. Therefore, counter to the "external control hypothesis," it may be that implementation intentions foster increased perceptions of *personal* control over behaviour. Increased perceptions of *personal* control should result in a general cognitive orientation that favours the initiation of goal directed behaviour such as physical activity (i.e., greater confidence to perform aspects of the behaviour; Bandura, 1986). Further research is needed explore these competing hypotheses.

In summary, taken together, the findings from Studies 2 and 3 contribute to a better understanding of strengths and limitations of using the TPB to predict physical activity in the SCI population. They also raise questions concerning the role of perceived control over the intended behaviour in the action phase model.

11.0 CONTRIBUTIONS TO ADVANCING PRACTICE

In addition to making substantial contributions to the advancement of measurement, theory and models within the physical activity domain, the three dissertation studies also have important implications for guiding practice. In accordance with findings from Study 1, individuals with SCI should be encouraged to partake in a physical activity regime that includes structured bouts of moderate to heavy intensity LTPA. The trend in the general population is to promote a physical activity regime centering around lifestyle activity (Dunn et al., 1999). However, with little evidence to indicate that lifestyle activity is associated with fitness benefits in the SCI population, a lifestyle activity approach is not advocated at this time.

Realizing the importance of advocating a LTPA physical activity approach, results of Study 2 suggest that targeting TPB variables may be a means of increasing people's intentions to engage in LTPA. Specifically, to bolster the intentions of those with poor intentions, health practitioners should target subjective norms (e.g., encourage physicians to recommend LTPA), attitudes (e.g., highlight benefits of participation), and PBC (e.g., provide detailed "how to" information; Olson & Zanna, 1987). Emerging evidence supports the effectiveness of such TPB-based interventions (Jones, Sinclair, & Courneya, 2003).

The greatest implications for practice come from Study 3. First, Study 3 emphasizes the benefits of rooting interventions in theory. As demonstrated in Study 3, using a theory to guide practice directs the focus of the intervention to key relationships between theoretical constructs and behaviour. Refining the intervention to target a specific TPB relationship resulted in positive behaviour change. Second, the results of Study 3 support the notion that among individuals with SCI, good intentions are not sufficient to promote physical activity participation. To facilitate the translation of intentions into action, individuals should be encouraged to form implementation intentions. The formulation of implementation intentions leads to greater physical activity participation and perceived control and may be important for sustaining intentions. Therefore, initiatives promoting physical activity are likely to be more efficacious when they incorporate volitional strategies such as formulating implementation intentions.

12.0 Future Directions

Having made several advances in the areas of physical activity measurement, theory and practice, the directions for future SCI and physical activity research are countless. However, a central focus of future research should be to study the impact of physical activity on the health and quality of life of individuals with SCI. For example, research should use the PARA-SCI to establish the association between physical activity and the prevention of secondary health conditions in the SCI population. Further, trials examining the efficacy and effectiveness of physical activity interventions for individuals with SCI should incorporate indices of health as a primary outcome. A clear demonstration of the role of physical activity in the health promotion of individuals with SCI would hopefully lead health practitioners to place increased emphasis on physical activity in the management of SCI.

13.0 Conclusion

In conclusion, the three studies in this thesis deepen our understanding of physical activity behaviour among individuals with SCI and provide evidence of the efficacy of implementation intentions for increasing physical activity. The studies emphasize the importance of using well-constructed measures of theoretical constructs and valid assessments of physical activity for identifying determinants of physical activity. The results are also a testament to the value of using theory as a foundation for developing efficacious physical activity interventions for people with SCI. In advancing physical activity measurement, theory and practice, the findings from this thesis enable researchers and health practitioners to pursue an agenda striving to promote the health of individuals with SCI through physical activity participation.

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Appendix A

The PARA-SCI

Appendix A.1 - PARA-SCI Phone Script

Introduction
Hi,

It is _______________ calling from the McMaster Research study. Are you ready to do your interview today? Do you have the materials that we gave/sent/e-mailed to you. (*If not, ask participant to get them. It they cannot get them, they cannot do the interview*).

- To start off, I am going to ask you a few questions about you. These questions are being asked so that we can describe the sample of people who participate in our study.

Physical Activity
The next set of questions that I will be asking you refer to the physical activities you have engaged in during the last 3-days. We will be starting with yesterday and going back 3 days. Please remember, this is a recall of actual activities for the 3-days, not a history of what you usually do. Also, keep in mind that physical activity includes any activity that required physical effort. That means I am interested in all of the activities you did in a day including the activities you did getting ready in the morning, at work, around the home and during your leisure time. For example, your day might include activities such as transferring, getting dressed and wheeling to the shopping mall.

Intensity Guidelines
- I will also ask you to categorize the intensity of each physical activity you did into one of four groups, mild, moderate, heavy or nothing at all. Each of these intensities is described on the colourful sheet you received the other day. *(review each definition)*. Notice that this sheet also provides a description of how your might feel at each intensity of activity.
- According to these definitions, what would be an example of a moderate physical activity for you personally?

☐ The nothing at all category (light green): should include activities that even when you are doing them you do not feel like you are working at all.

■ The mild activity category (dark blue) should include activities that require very light physical effort. You should feel like you are working a little bit but overall you shouldn't find yourself working too hard.

☐ The moderate activity category (yellow) should include activities that require some physical effort. You should feel like you are working somewhat hard but you should feel like you can keep going for a long time.

- The heavy activity category (red) should include physical activities that require a lot of physical effort. You should feel like you are working really hard (almost at your maximum) and can only do the activity for a short time before getting tired. These activities can be exhausting

Setting the Stage

Today is ___________(i.e., Monday), so yesterday was _________(i.e., Sunday). Think about what you did (Sunday) morning.

Morning

- What time did you wake up at?
- Tell me about your morning routine. After you opened your eyes what was the first thing you did?
- What other activities did you do that required you to be physically active?
- What did you do after your morning routine? Think about what you usually do. Did you do anything unusual? (follow decision tree)

Afternoon

- Tell me about your afternoon
- What did you do for lunch? (follow decision tree)
- What did you do after lunch? Think about what you usually do. Did you do anything unusual? (follow decision tree)

Evening

- What did you do for dinner? (follow decision tree)
- What did you do after dinner? Think about what you usually do. Did you do anything unusual? (follow decision tree)
- Well me about your evening routine. What activities did you do that required you to be physically active?

Tips for facilitating recall

- Outings: Did you leave your home?
- Weather: What was the weather like outside?
- Health/Illness: How were you feeling?
- Holidays: It was *[insert holiday]* yesterday. Did you do anything special?

Intensity

Did that activity make you feel similar to how you feel when you are *[give example of moderate intensity activity identified earlier]*, or is easier or harder?
Using the chart you have been given, how would you rate the intensity of that activity?

Duration

How long did you work at that intensity?
How much of that time was spent sitting still or taking breaks?

At the End of Each Day Ask
Are there any physical activities that you might have forgotten? Did you have to take any trips to the bathroom during your day (*only ask this question if the participant indicated that toileting is a physical activity during the morning routine or if he/she has to transfer onto the toilet each time*). Did you do any physical activity at work? any other recreational or sport activities? housework or gardening? Were there any other activities you might have done?

Activities Often Forgotten

- Transfers
  - Consider chunking transfers together e.g., how hard are you working to get into your car? How many times did you get in when you were running errands? Record number of transfers x time
- Bathroom trips
- Childcare
- Grocery shopping
- Cleaning
  - Sweeping/vacuuming
  - Laundry
  - Watering plants
  - Making the bed
  - Taking garbage and recycling out

Morning routine and evening routine Day 2 & Day 3
Compared to the morning/evening routine you just described (Day 1), were there any differences in your morning/evening routine (Day 2 & Day 3)? If no differences, do not go through the morning or evening routine again. Indicate on recording sheet same as Day 1.

On the Last Day of Recall Ask
Take a moment to think back over the course of the past 3-days, can you think of any activities that you may have forgotten?

At the End of the Interview
Remind the participant of his/her next scheduled appointment. Ask the participant to hold onto study materials for the next interview.

Appendix A.2 - PARA-SCI Intensity Classification System

	NOTHING AT ALL	MILD	MODERATE	[illegible]
How hard are you working?				
	ıcludes activities ıat even when you re doing them, ou do not feel like ou are working at ll.	ıcludes physical ctivities that require ou to do very light ork. You should feel ke you are working a ttle bit but overall you rouldn't find yourself orking too hard	ıcludes physical ctivities that require ɔme physical effort. 'ou should feel like you re working somewhat ard but you should feel ke you can keep going ɔr a long time.	[illegible]
How does your body feel?				
Breathing & Heart rate		tays normal or is only a ttle bit harder and/or ıster than normal	loticeably harder and faster than normal but NOT extremely hard or fast	[illegible]
Muscles	Everything is normal	eel loose, warmed-up nd relaxed. Feel normal emperature or a little bit 'armer and not tired at ll	eel pumped and 'orked. Feel warmer ıan normal and starting ɔ get tired after awhile.	[illegible]
Skin		lormal temperature or is nly a little bit warmer nd not sweaty	ı little bit warmer than ormal and might be a ttle sweaty	[illegible]
Mind		'ou might feel very lert. Has no effect on oncentration	equire some ɔncentration to ɔmplete	[illegible]

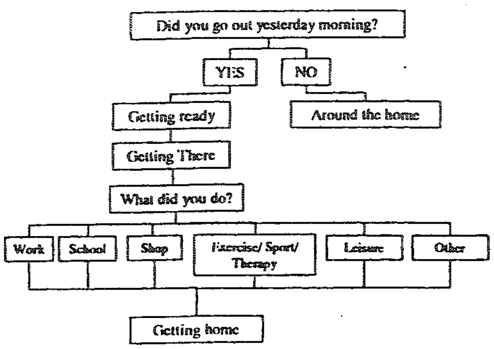
Appendix A.3 - PARA-SCI Interview Protocol – Flowcharts

Morning Afternoon Night

Morning

- Tell me about your morning routine

☐ Dressing ☐ Transferring
☐ Personal Hygiene ☐ Bathing
☐ Bladder & Bowel Management ☐ Breakfast



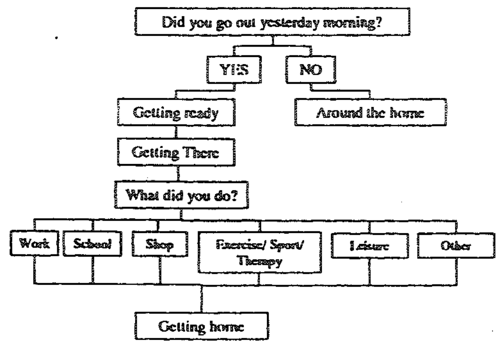
Morning Afternoon Night

Afternoon

Tell me about your lunch yesterday

☐ Lunch

- What did do after lunch?



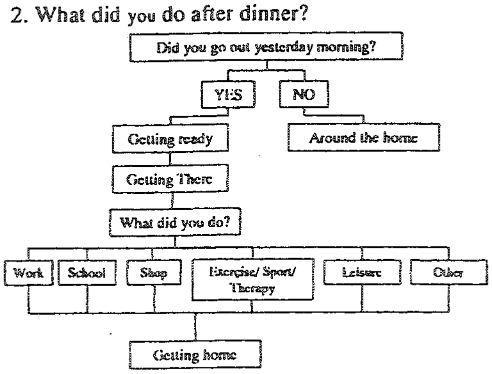
Morning Afternoon Night

Night

1. Tell me about your dinner yesterday

☐ Dinner

2. What did you do after dinner?



3. Tell me about your evening routine

☐ Dressing ☐ Transferring
☐ Personal Hygiene ☐ Bathing
☐ Bladder & Bowel Management ☐ Positioning

Morning Afternoon Night

Getting ready

☐ Dressing (shoes & jacket)
☐ Getting Items (bags, papers)

•Getting Ready •Getting there •Getting Home •Around the Home

•Work •School •Shop •Exercise/ Sport/ Therapy •Leisure •Other

Morning Afternoon Night

Getting there

- ☐ Opening doors
- ☐ Closing doors
- ☐ Transfers
- ☐ Wheeling
- ☐ Preparing chair for transport
- ☐ Dressing/undressing
- ☐ Walking
- ☐ Climbing stairs
- ☐ Driving

Cue

-How did you get there (e.g., drive bus, wheel)

•Getting Ready •Getting there •Getting Home •Around the Home

•Work •School •Shop •Exercise/ Sport/ Therapy •Leisure •Other

Morning Afternoon Night

Getting Home

- ☐ Opening doors
- ☐ Closing doors
- ☐ Transfers
- ☐ Wheeling
- ☐ Preparing chair for transport
- ☐ Dressing/Undressing
- ☐ Walking
- ☐ Climbing stairs
- ☐ Driving

•Getting Ready •Getting there •Getting Home •Around the Home

•Work •School •Shop •Exercise/ Sport/ Therapy •Leisure •Other

Morning Afternoon Night

Shopping

- ☐ Opening doors
- ☐ Closing doors
- ☐ Transfers
- ☐ Wheeling
- ☐ Walking
- ☐ Climbing stairs
- ☐ Getting items
- ☐ Loading & unloading items

•Getting Ready •Getting there •Getting Home •Around the Home

•Work •School •Shop •Exercise/ Sport/ Therapy •Leisure •Other

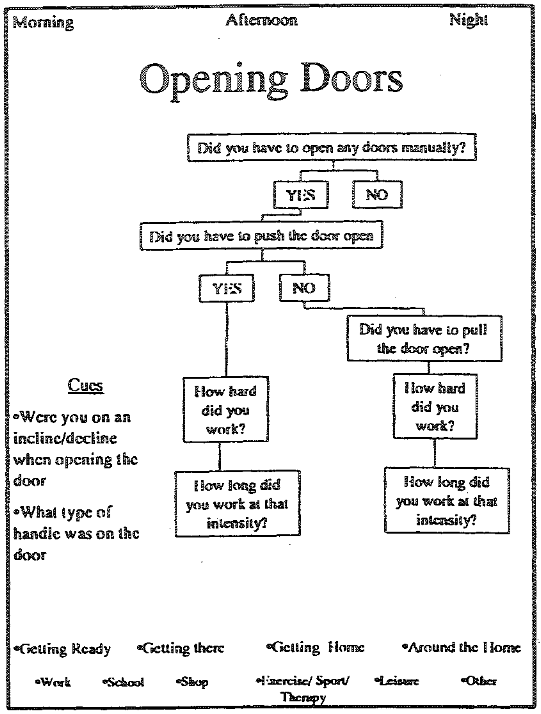
Morning Afternoon Night

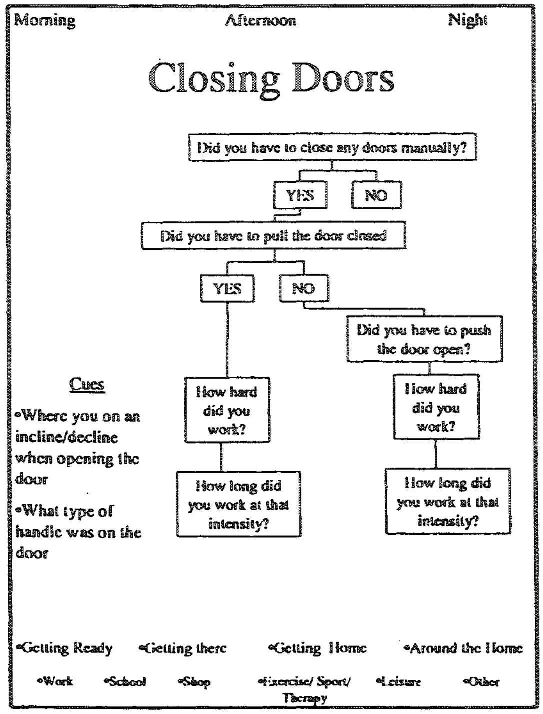
Around the home

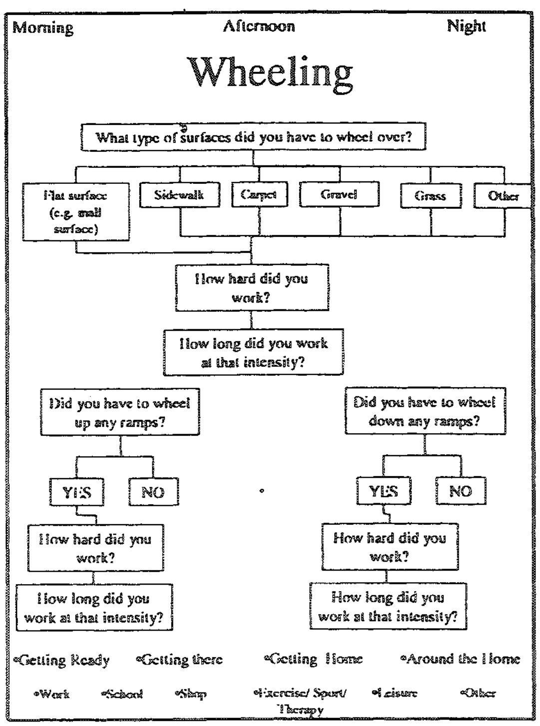
- ☐ Meal preparation
- ☐ Cleaning
- ☐ Outdoor work
- ☐ Maintenance (Home & wheelchair repair)
- ☐ Pet care
- ☐ Child care

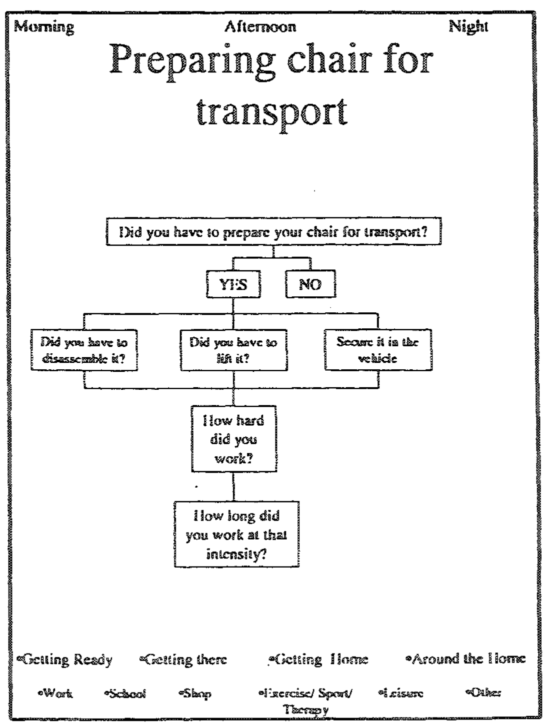
•Getting Ready •Getting there •Getting Home •Around the Home

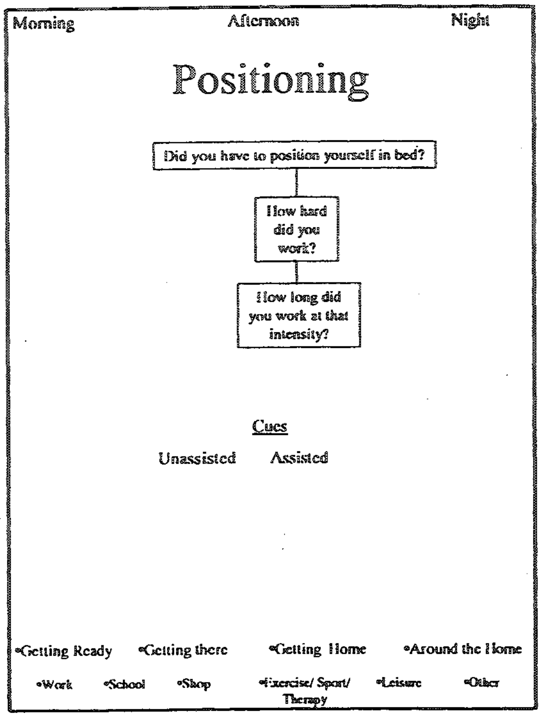
•Work •School •Shop •Exercise/ Sport/ Therapy •Leisure •Other

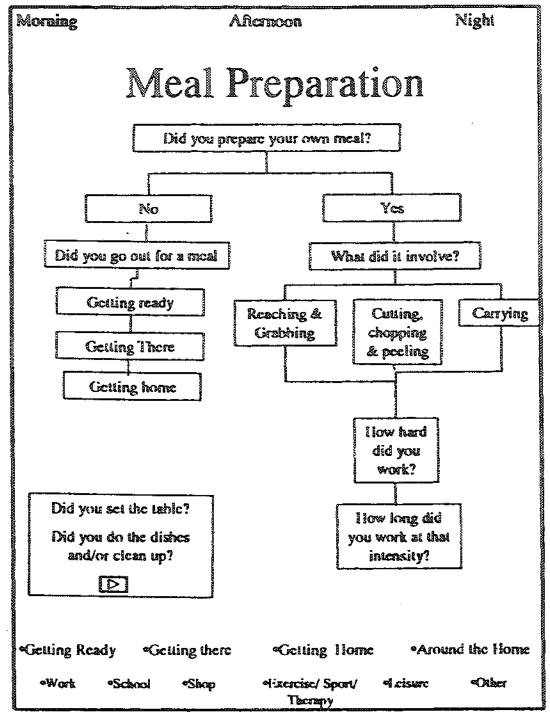

Morning
Afternoon
Night
Opening Doors
Did you have to open any doors manually?
YES
NO
Did you have to push the door open
YES
NO
Did you have to pull the door open?
How hard did you work?
How long did you work at that intensity?
How hard did you work?
How long did you work at that intensity?
Cues
•Were you on an incline/decline when opening the door
•What type of handle was on the door
•Getting Ready
•Getting there
•Getting Home
•Around the Home
•Work
•School
•Shop
•Exercise/ Sport/ Therapy
•Leisure
•Other

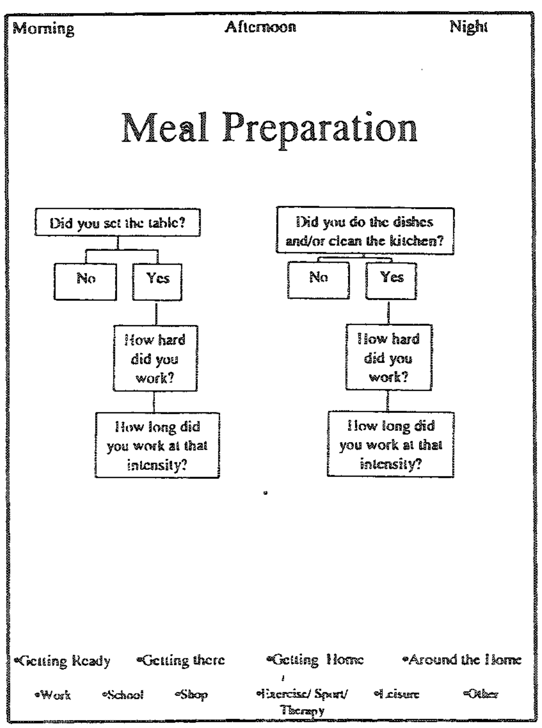

Morning
Afternoon
Night
Closing Doors
Did you have to close any doors manually?
YES
NO
Did you have to pull the door closed
YES
NO
Did you have to push the door open?
How hard did you work?
How long did you work at that intensity?
How hard did you work?
How long did you work at that intensity?
Cues
•Where you on an incline/decline when opening the door
•What type of handle was on the door
•Getting Ready
•Getting there
•Getting Home
•Around the Home
•Work
•School
•Shop
•Exercise/ Sport/ Therapy
•Leisure
•Other

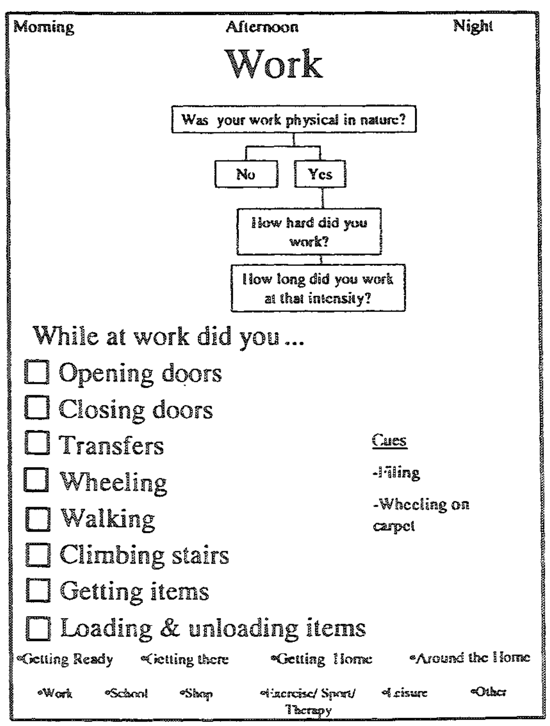

Morning
Afternoon
Night
Wheeling
What type of surfaces did you have to wheel over?
Flat surface (e.g. mall surface)
Sidewalk
Carpet
Gravel
Grass
Other
How hard did you work?
How long did you work at that intensity?
Did you have to wheel up any ramps?
Did you have to wheel down any ramps?
YES
NO
YES
NO
How hard did you work?
How long did you work at that intensity?
How hard did you work?
How long did you work at that intensity?
•Getting Ready
•Getting there
•Getting Home
•Around the Home
•Work
•School
•Shop
•Exercise/ Sport/ Therapy
•Leisure
•Other

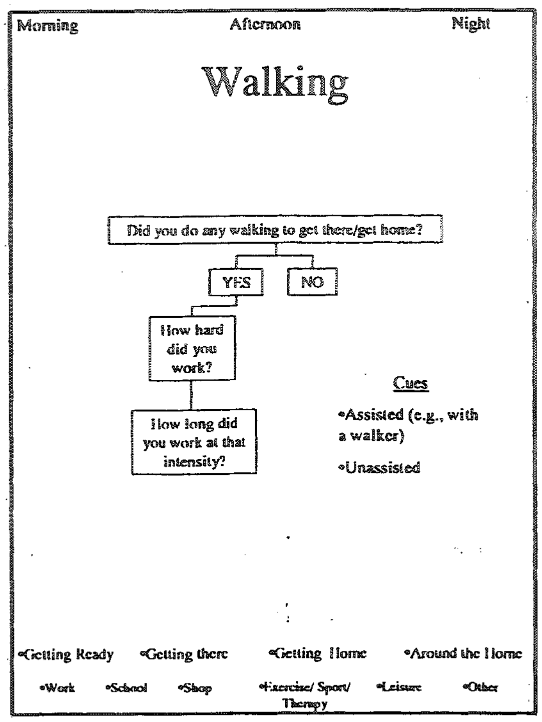

Morning
Afternoon
Night
Preparing chair for transport
Did you have to prepare your chair for transport?
YES
NO
Did you have to disassemble it?
Did you have to lift it?
Secure it in the vehicle
How hard did you work?
How long did you work at that intensity?
•Getting Ready
•Getting there
•Getting Home
•Around the Home
•Work
•School
•Shop
•Exercise/ Sport/ Therapy
•Leisure
•Other

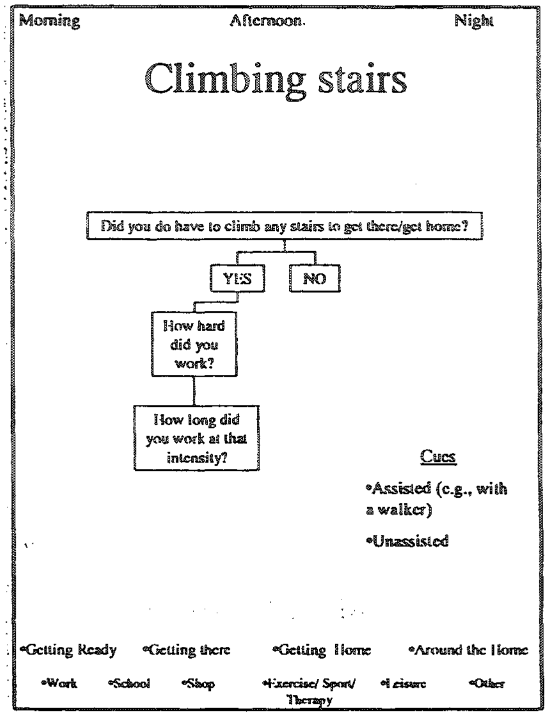

Morning
Afternoon
Night
Positioning
Did you have to position yourself in bed?
How hard did you work?
How long did you work at that intensity?
Cues
Unassisted
Assisted
•Getting Ready
•Getting there
•Getting Home
•Around the Home
•Work
•School
•Shop
•Exercise/ Sport/ Therapy
•Leisure
•Other

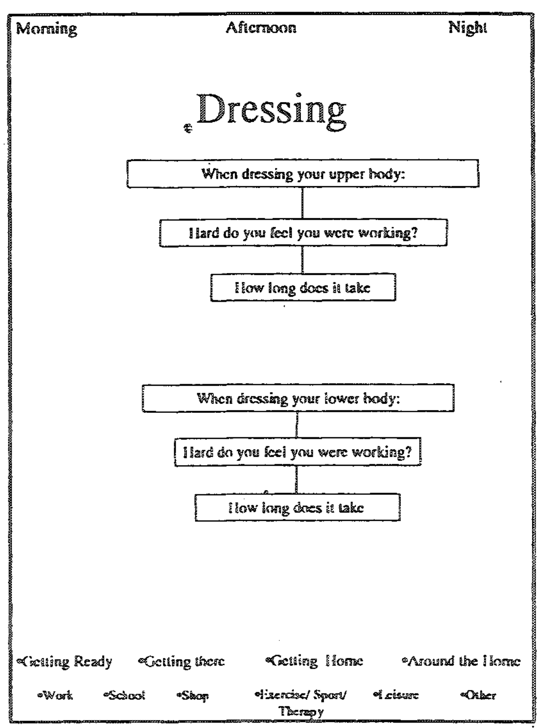

Morning
Afternoon
Night
Meal Preparation
Did you prepare your own meal?
No
Yes
Did you go out for a meal
What did it involve?
Getting ready
Getting There
Getting home
Reaching & Grabbing
Cutting, chopping & peeling
Carrying
How hard did you work?
How long did you work at that intensity?
Did you set the table?
Did you do the dishes and/or clean up?
•Getting Ready
•Getting there
•Getting Home
•Around the Home
•Work
•School
•Shop
•Exercise/ Sport/ Therapy
•Leisure
•Other

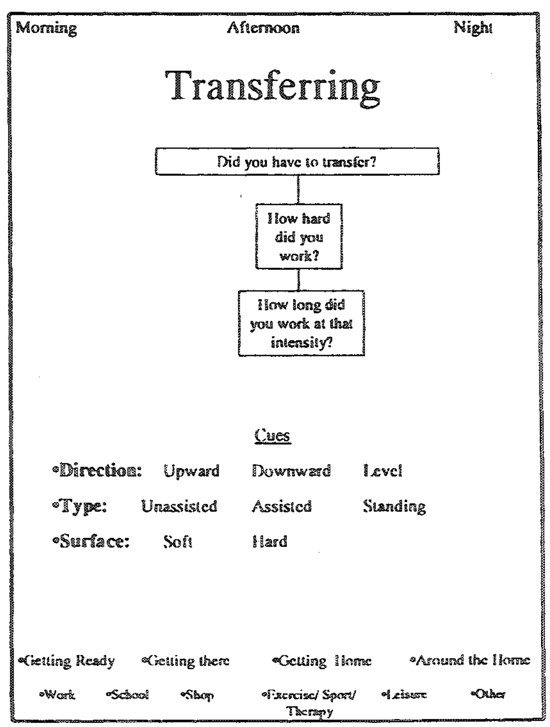

Morning
Afternoon
Night
Meal Preparation
Did you set the table?
No
Yes
How hard did you work?
How long did you work at that intensity?
Did you do the dishes and/or clean the kitchen?
No
Yes
How hard did you work?
How long did you work at that intensity?
•Getting Ready
•Getting there
•Getting Home
•Around the Home
•Work
•School
•Shop
•Exercise/ Sport/ Therapy
•Leisure
•Other

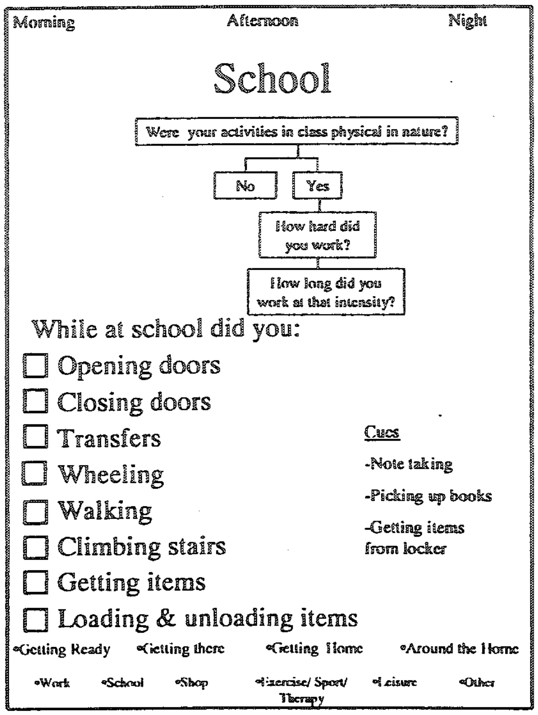

Morning
Afternoon
Night
Work
Was your work physical in nature?
No
Yes
How hard did you work?
How long did you work at that intensity?
While at work did you ...
Opening doors
Closing doors
Transfers
Wheeling
Walking
Climbing stairs
Getting items
Loading & unloading items
Cues
-Filing
-Wheeling on carpet
•Getting Ready
•Getting there
•Getting Home
•Around the Home
•Work
•School
•Shop
•Exercise/ Sport/ Therapy
•Leisure
•Other

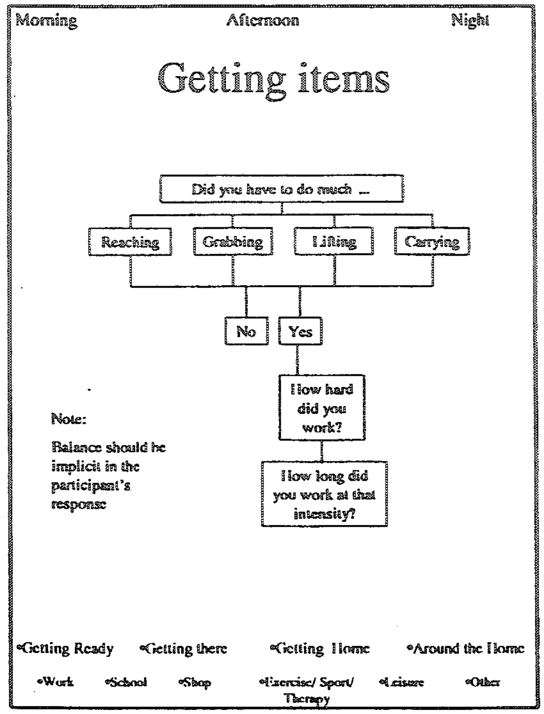

Morning
Afternoon
Night
Walking
Did you do any walking to get there/get home?
YES
NO
How hard did you work?
How long did you work at that intensity?
Cues
•Assisted (e.g., with a walker)
•Unassisted
•Getting Ready
•Getting there
•Getting Home
•Around the Home
•Work
•School
•Shop
•Exercise/ Sport/ Therapy
•Leisure
•Other

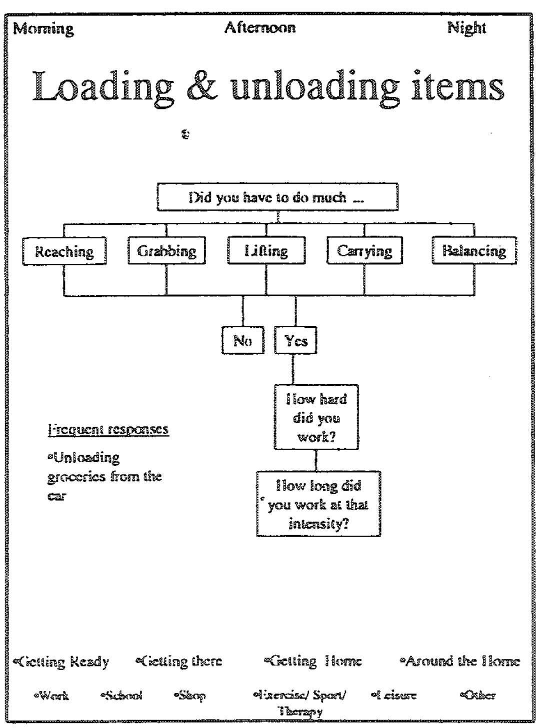

Morning
Afternoon
Night
Climbing stairs
Did you do have to climb any stairs to get there/get home?
YES
NO
How hard did you work?
How long did you work at that intensity?
Cues
•Assisted (e.g., with a walker)
•Unassisted
•Getting Ready
•Getting there
•Getting Home
•Around the Home
•Work
•School
•Shop
•Exercise/ Sport/ Therapy
•Leisure
•Other

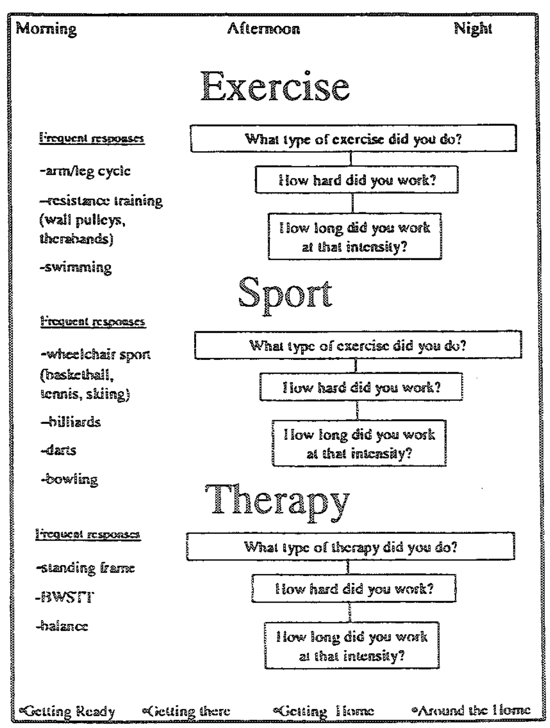

Morning
Afternoon
Night
Dressing
When dressing your upper body:
Hard do you feel you were working?
How long does it take
When dressing your lower body:
Hard do you feel you were working?
How long does it take
•Getting Ready
•Getting there
•Getting Home
•Around the Home
•Work
•School
•Shop
•Exercise/ Sport/ Therapy
•Leisure
•Other

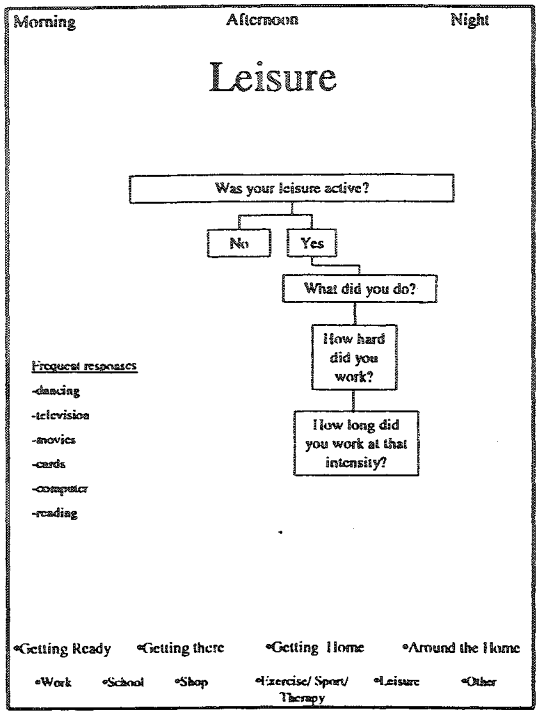

Morning
Afternoon
Night
Transferring
Did you have to transfer?
How hard did you work?
How long did you work at that intensity?
Cues
•Direction: Upward Downward Level
•Type: Unassisted Assisted Standing
•Surface: Soft Hard
•Getting Ready
•Getting there
•Getting Home
•Around the Home
•Work
•School
•Shop
•Exercise/ Sport/ Therapy
•Leisure
•Other

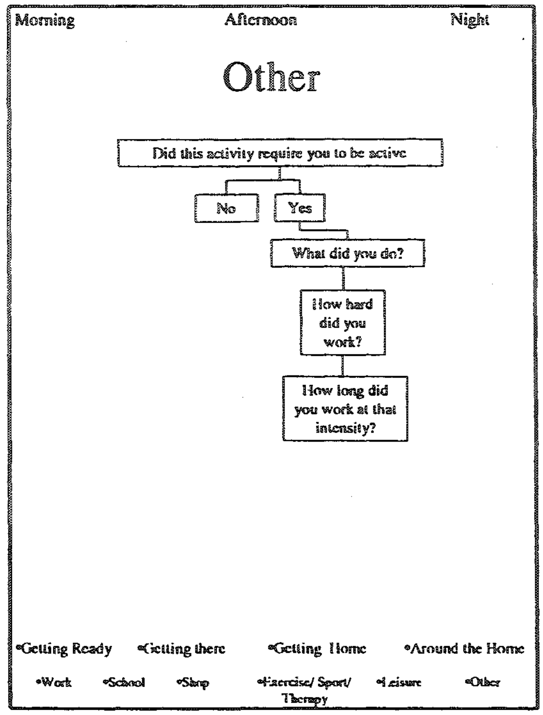

Morning
Afternoon
Night
School
Were your activities in class physical in nature?
No
Yes
How hard did you work?
How long did you work at that intensity?
While at school did you:
Opening doors
Closing doors
Transfers
Wheeling
Walking
Climbing stairs
Getting items
Loading & unloading items
Cues
-Note taking
-Picking up books
-Getting items from locker
•Getting Ready
•Getting there
•Getting Home
•Around the Home
•Work
•School
•Shop
•Exercise/ Sport/ Therapy
•Leisure
•Other

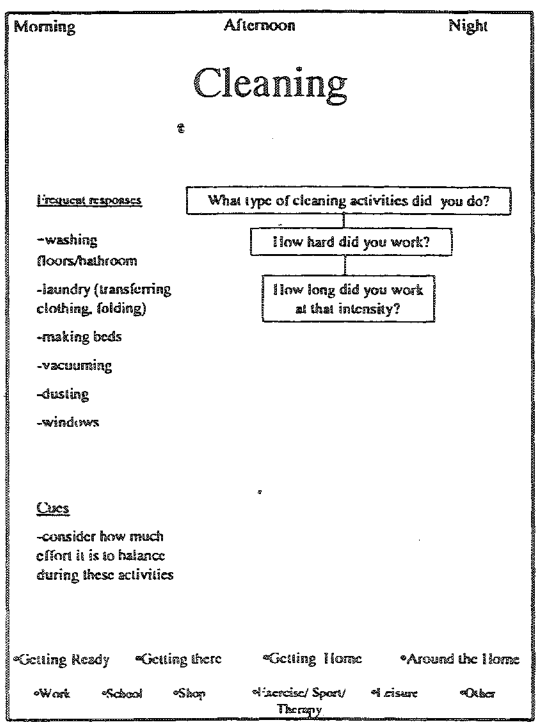

Morning
Afternoon
Night
Getting items
Did you have to do much ...
Reaching
Grabbing
Lifting
Carrying
No
Yes
How hard did you work?
How long did you work at that intensity?
Note:
Balance should be implicit in the participant's response
•Getting Ready
•Getting there
•Getting Home
•Around the Home
•Work
•School
•Shop
•Exercise/ Sport/ Therapy
•Leisure
•Other

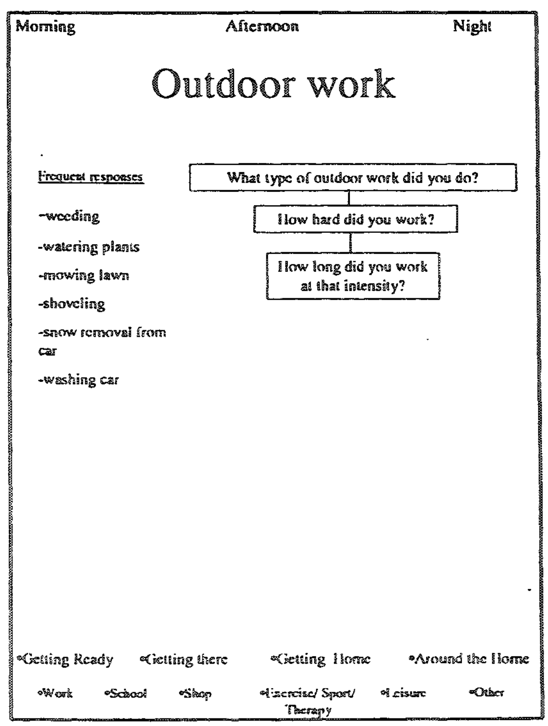

Morning
Afternoon
Night
Loading & unloading items
Did you have to do much ...
Reaching
Grabbing
Lifting
Carrying
Balancing
No
Yes
How hard did you work?
How long did you work at that intensity?
Frequent responses
•Unloading groceries from the car
•Getting Ready
•Getting there
•Getting Home
•Around the Home
•Work
•School
•Shop
•Exercise/ Sport/ Therapy
•Leisure
•Other

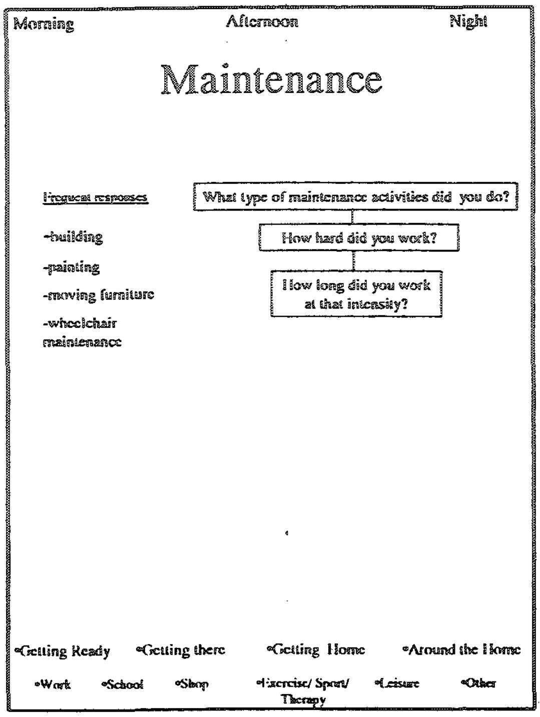

Morning
Afternoon
Night
Exercise
Frequent responses
-arm/leg cycle
-resistance training (wall pulleys, therabands)
-swimming
What type of exercise did you do?
How hard did you work?
How long did you work at that intensity?
Sport
Frequent responses
-wheelchair sport (basketball, tennis, skiing)
-billiards
-darts
-bowling
What type of exercise did you do?
How hard did you work?
How long did you work at that intensity?
Therapy
Frequent responses
-standing frame
-BWSTT
-balance
What type of therapy did you do?
How hard did you work?
How long did you work at that intensity?
•Getting Ready
•Getting there
•Getting Home
•Around the Home

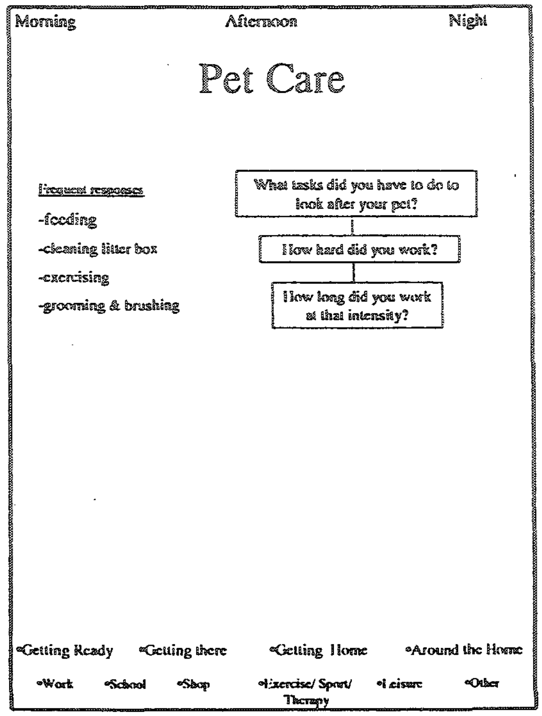

Morning
Afternoon
Night
Leisure
Was your leisure active?
No
Yes
What did you do?
How hard did you work?
How long did you work at that intensity?
Frequent responses
-dancing
-television
-movies
-cards
-computer
-reading
•Getting Ready
•Getting there
•Getting Home
•Around the Home
•Work
•School
•Shop
•Exercise/ Sport/ Therapy
•Leisure
•Other

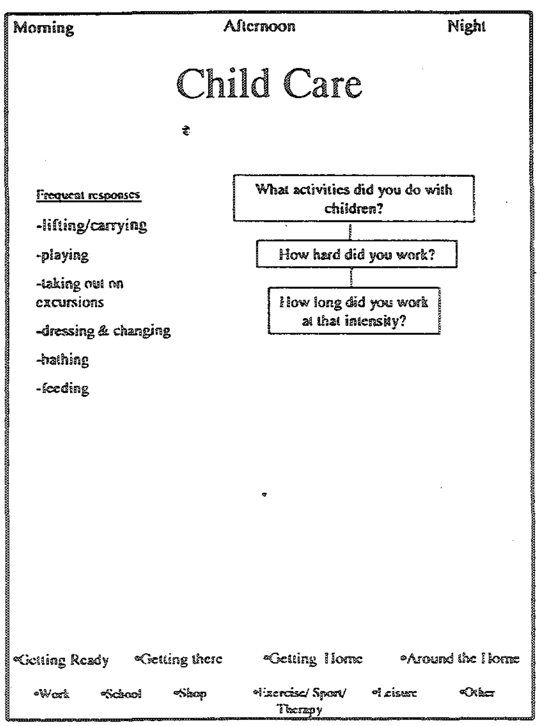

Morning
Afternoon
Night
Other
Did this activity require you to be active
No
Yes
What did you do?
How hard did you work?
How long did you work at that intensity?
•Getting Ready
•Getting there
•Getting Home
•Around the Home
•Work
•School
•Shop
•Exercise/ Sport/ Therapy
•Leisure
•Other

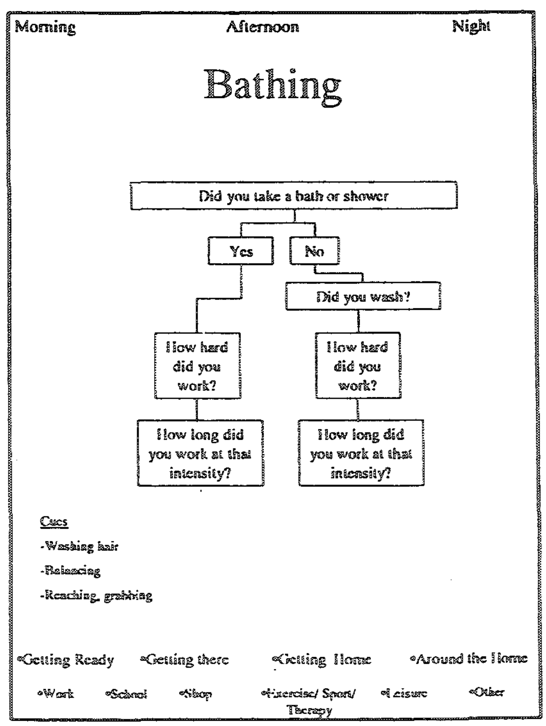

Morning
Afternoon
Night
Cleaning
Frequent responses
What type of cleaning activities did you do?
How hard did you work?
How long did you work at that intensity?
-washing floors/bathroom
-laundry (transferring clothing, folding)
-making beds
-vacuuming
-dusting
-windows
Cues
-consider how much effort it is to balance during these activities
•Getting Ready
•Getting there
•Getting Home
•Around the Home
•Work
•School
•Shop
•Exercise/ Sport/ Therapy
•Leisure
•Other

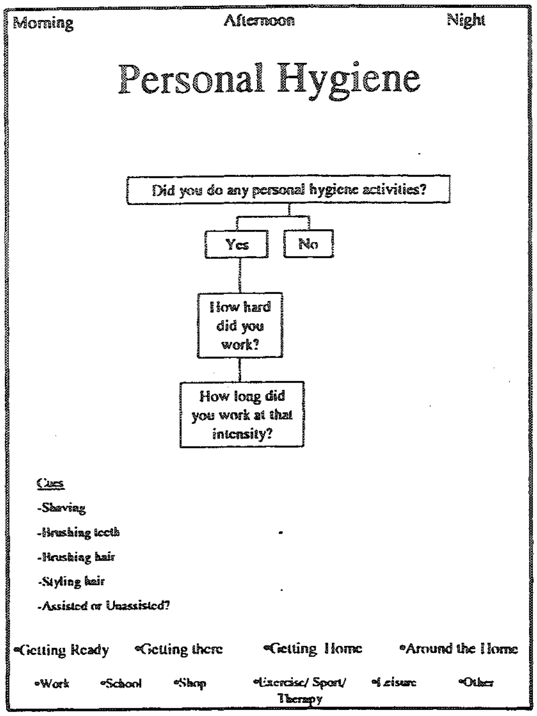

Morning
Afternoon
Night
Outdoor work
Frequent responses
What type of outdoor work did you do?
-weeding
How hard did you work?
-watering plants
-mowing lawn
How long did you work at that intensity?
-shoveling
-snow removal from car
-washing car
•Getting Ready
•Getting there
•Getting Home
•Around the Home
•Work
•School
•Shop
•Exercise/ Sport/ Therapy
•Leisure
•Other

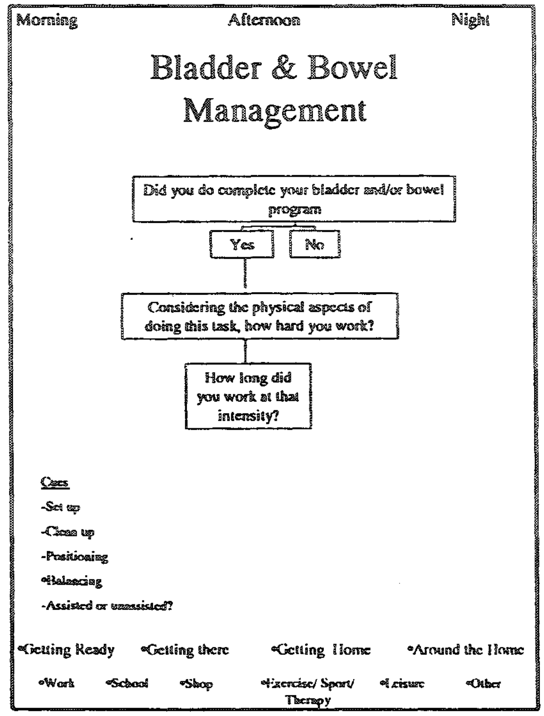

Morning
Afternoon
Night
Maintenance
Frequent responses
-building
-painting
-moving furniture
-wheelchair maintenance
What type of maintenance activities did you do?
How hard did you work?
How long did you work at that intensity?
•Getting Ready
•Getting there
•Getting Home
•Around the Home
•Work
•School
•Shop
•Exercise/ Sport/ Therapy
•Leisure
•Other

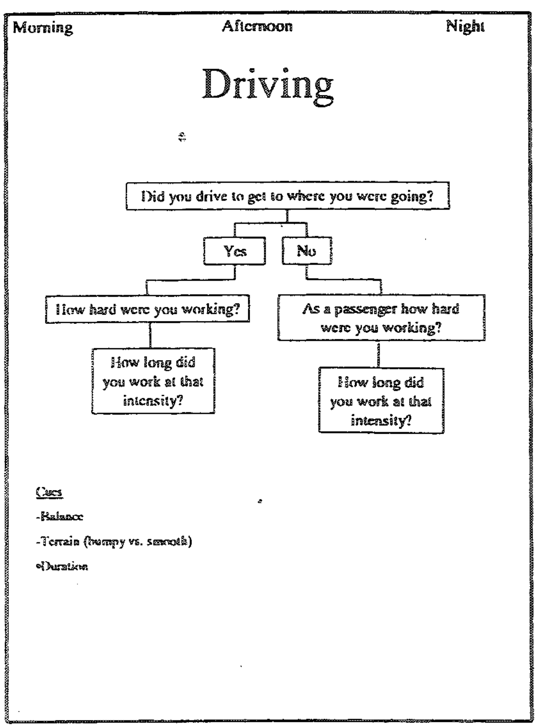

Morning
Afternoon
Night
Pet Care
Frequent responses
-feeding
-cleaning litter box
-exercising
-grooming & brushing
What tasks did you have to do to look after your pet?
How hard did you work?
How long did you work at that intensity?
•Getting Ready
•Getting there
•Getting Home
•Around the Home
•Work
•School
•Shop
•Exercise/ Sport/ Therapy
•Leisure
•Other


Morning
Afternoon
Night
Child Care
Frequent responses
-lifting/carrying
-playing
-taking out on excursions
-dressing & changing
-bathing
-feeding
What activities did you do with children?
How hard did you work?
How long did you work at that intensity?
•Getting Ready
•Getting there
•Getting Home
•Around the Home
•Work
•School
•Shop
•Exercise/ Sport/ Therapy
•Leisure
•Other


Morning
Afternoon
Night
Bathing
Did you take a bath or shower
Yes
No
Did you wash?
How hard did you work?
How long did you work at that intensity?
How hard did you work?
How long did you work at that intensity?
Cues
-Washing hair
-Balancing
-Reaching, grabbing
•Getting Ready
•Getting there
•Getting Home
•Around the Home
•Work
•School
•Shop
•Exercise/ Sport/ Therapy
•Leisure
•Other


Morning
Afternoon
Night
Personal Hygiene
Did you do any personal hygiene activities?
Yes
No
How hard did you work?
How long did you work at that intensity?
Cues
-Shaving
-Brushing teeth
-Brushing hair
-Styling hair
-Assisted or Unassisted?
•Getting Ready
•Getting there
•Getting Home
•Around the Home
•Work
•School
•Shop
•Exercise/ Sport/ Therapy
•Leisure
•Other


Morning
Afternoon
Night
Bladder & Bowel Management
Did you do complete your bladder and/or bowel program
Yes
No
Considering the physical aspects of doing this task, how hard you work?
How long did you work at that intensity?
Cues
-Set up
-Clean up
-Positioning
•Balancing
-Assisted or unassisted?
•Getting Ready
•Getting there
•Getting Home
•Around the Home
•Work
•School
•Shop
•Exercise/ Sport/ Therapy
•Leisure
•Other


Morning
Afternoon
Night
Driving
Did you drive to get to where you were going?
Yes
No
How hard were you working?
As a passenger how hard were you working?
How long did you work at that intensity?
How long did you work at that intensity?
Cues
-Balance
-Terrain (bumpy vs. smooth)
•Duration

Appendix A.4 - PARA-SCI Recording Sheet

DATE OF BIRTH ___/___/___/
dd mm yy

Phone Number:________________ Initials: ☐ ☐ ☐ Interviewer:________________

- For each activity indicate: 1. Duration (min) 2. Intensity: Mild = mild , Mod = moderate, Heavy = heavy, NAA = nothing at all 3. Type: LA or LTPA

Be sure to record the date!			Date:				Date:				Date:			
			Activity	Intensity	Min	Type	Activity	Intensity	Min	Type	Activity	Intensity	Min	Type
Morning routine	Wake up time													
	Transfer													
	Bowel & Bladder Management													
	Bathing													
	Personal Hygiene													
	Dressing	Lower body												
		Upper body												
	Other													

	1				2				3			
	Activity	Intensity	Min	Type	Activity	Intensity	Min	Type	Activity	Intensity	Min	Type
Breakfast												
Morning												
Lunch												
Afternoon												

			1				2				3			
			Activity	Intensity	Min	Type	Activity	Intensity	Min	Type	Activity	Intensity	Min	Type
Dinner														
Evening														
Evening routine	Bedtime													
	Transfer													
	Bowel & Bladder Management													
	Bathing													
	Personal Hygiene													
	Dressing	Lower body												
		Upper body												
	Positioning													
	Other													

Appendix B

Study 2 Materials

Appendix B.1 TPB Questionnaire

Appendix B.1 - TPB Questionnaire

PLEASE READ THE FOLLOWING INSTRUCTIONS CAREFULLY.

We are interested in your opinions regarding leisure time physical activity. Please use the following definition of leisure time physical activity as you respond to these questions:

LEISURE TIME PHYSICAL ACTIVITY includes all of the activities that you choose to do during your free time that require physical exertion.

LEISURE TIME PHYSICAL ACTIVITIES	Activities that are NOT leisure time physical activities
• Exercise • Gardening • Sports • Woodworking • Wheeling around the block with your dog	• Physiotherapy • Cleaning • Stretching • ADLs • Shopping

Please answer the questions below using the scales provided. Indicate your response for EVERY **question by marking on the line. For example**

:__X__: or :__✓__: or :____: or :__/__: or :__O__:
1 1 1 1 1

I think that participating in leisure time physical activity for at least 30 min on most days in the next week would be:

extremely unenjoyable	1	2	3	4	5	6	7	*extremely enjoyable*
extremely harmful	1	2	3	4	5	6	7	*extremely beneficial*
extremely unpleasant	1	2	3	4	5	6	7	*extremely pleasant*

I will try to do at least 30 minutes of leisure time physical activity on most days in the next week

definitely true	1	2	3	4	5	6	7	*definitely false*

How much personal control do you feel you have over whether you participate in leisure time physical activity for at least 30 min on most days in the next week.

very little control :____:____:____:____:____:____:____: *complete control*
1 2 3 4 5 6 7

If it were entirely up to me, I am confident that I would be able to participate in leisure time physical activity for at least 30 min on most days in the next week

strongly disagree :____:____:____:____:____:____:____: *strongly agree*
1 2 3 4 5 6 7

Whether or not I participate in leisure time physical activity for at least 30 min on most days in the next week is entirely up to me

strongly disagree :____:____:____:____:____:____:____: *Strongly agree*
1 2 3 4 5 6 7

I think that participating in leisure time physical activity for at least 30 min on most days in the next week would be:

extremely bad :____:____:____:____:____:____:____: *extremely good*
1 2 3 4 5 6 7

extremely relaxing :____:____:____:____:____:____:____: *extremely stressful*
1 2 3 4 5 6 7

extremely valuable:____:____:____:____:____:____:____: *extremely worthless*
1 2 3 4 5 6 7

Please use the scales below to guide the next set of questions

How much do you feel that whether you participate in leisure time physical activity for at least 30 min on most days is beyond your control?

not at all :____:____:____:____:____:____:____: *very much so*
1 2 3 4 5 6 7

Most people who are important to me <u>think I should</u> participate in leisure time physical activity for at least 30 min on most days in the next week.

strongly disagree :____:____:____:____:____:____:____: *strongly agree*
1 2 3 4 5 6 7

How confident are you that you will be able to participate in leisure time physical activity for at least 30 min on most days in the next week?

very unsure :____:____:____:____:____:____:____: *very sure*
1 2 3 4 5 6 7

I intend to do at least 30 minutes of leisure time physical activity on most days in the forthcoming week

extremely unlikely	: ____ :	____ :	____ :	____ :	____ :	____ :	____ :	*extremely likely*
	1	2	3	4	5	6	7	

To what extent do you see yourself as being capable of participating in leisure time physical activity for at least 30 min on most days in the next week?

very unlikely	: ____ :	____ :	____ :	____ :	____ :	____ :	____ :	*very likely*
	1	2	3	4	5	6	7	

Most people who are important to me <u>approve</u> of me participating in leisure time physical activity for at least 30 min on most days in the next week.

strongly disagree	: ____ :	____ :	____ :	____ :	____ :	____ :	____ :	*strongly agree*
	1	2	3	4	5	6	7	

Appendix C

Study 3 Materials

Appendix C. 1 - Intentions and PBC Questionnaire

We are interested in your opinions regarding physical activity. Please use the following definition of lifestyle physical activity as you respond to these questions:

PHYSICAL ACTIVITY includes all of the activities that you choose to do during your free time that require physical exertion. It also includes all the wheeling you do for periods of 10 minutes or longer.

PHYSICAL ACTIVITIES	Activities that are NOT physical activities
• Exercise • Sports • Wheeling around the block with your dog • Wheeling to work	• Physiotherapy • Stretching • Shopping • Cleaning • Activities of daily living

As you answer the questions below, remember that the 30 minutes of activity do not have to be continuous. You can accumulate 10-minute bouts of activity throughout the day.

I will try to do at least 30 minutes of moderate to heavy physical activity 3 days per week over the next 4 weeks

definitely true :____:____:____:____:____:____:____: *definitely false*
1 2 3 4 5 6 7

How much personal control do you feel you have over whether you participate in moderate to heavy physical activity for at least 30 min 3 days per week over the next 4 weeks.

very little control :____:____:____:____:____:____:____: *complete control*
1 2 3 4 5 6 7

If it were entirely up to me, I am confident that I would be able to participate in moderate to heavy physical activity for at least 30 min 3 days per week over the next 4 weeks

strongly disagree :____:____:____:____:____:____:____: *strongly agree*
1 2 3 4 5 6 7

Whether or not I participate in moderate to heavy physical activity for at least 30 min 3 days per week over the next 4 weeks is entirely up to me

strongly disagree :____:____:____:____:____:____:____: *strongly agree*
1 2 3 4 5 6 7

How much do you feel that whether you participate in moderate to heavy physical activity for at least 30 min 3 days per week over the next 4 weeks is beyond your control?

not at all :____:_____:_____:_____:_____:_____:_____: *very much so*
1 2 3 4 5 6 7

How confident are you that you will be able to participate in moderate to heavy physical activity for at least 30 min 3 days per week over the next 4 weeks?

very unsure :____:_____:_____:_____:_____:_____:_____: *very sure*
1 2 3 4 5 6 7

I intend to do at least 30 minutes of moderate to heavy physical activity 3 days per week in the forthcoming month

extremely unlikely :____:_____:_____:_____:_____:_____:_____: *extremely likely*
1 2 3 4 5 6 7

To what extent do you see yourself as being capable of participating in moderate to heavy physical activity for at least 30 min 3 days per week over the next 4 weeks?

very unlikely :____:_____:_____:_____:_____:_____:_____: *very likely*
1 2 3 4 5 6 7

Appendix C.2 - Self-Efficacy Questionnaire

Please use the scale below to guide your responses to the next set of questions.

1	2	3	4	5	6	7	8	9	10
not at all confident				moderately confident					completely confident

How confident are you that over the next 3 weeks, you will engage in 30 minutes of physical activity ...

(a) once a week	1	2	3	4	5	6	7	8	9	10
(b) twice a week	1	2	3	4	5	6	7	8	9	10
(c) three times a week	1	2	3	4	5	6	7	8	9	10
(d) four times a week	1	2	3	4	5	6	7	8	9	10
(e) five times a week	1	2	3	4	5	6	7	8	9	10

Assuming you were very motivated, how confident are you that you will do physical activity for at least 30 min 3 days/wk in the next 3 weeks even if...

(a) you felt tired or fatigued	1	2	3	4	5	6	7	8	9	10
(b) you got very busy and had limited time	1	2	3	4	5	6	7	8	9	10
(c) you had transportation difficulties	1	2	3	4	5	6	7	8	9	10
(d) you had pain or soreness	1	2	3	4	5	6	7	8	9	10
(e) you did not have help to do the activities	1	2	3	4	5	6	7	8	9	10
(f) you could not afford a gym membership or exercise equipment	1	2	3	4	5	6	7	8	9	10
(g) you did not have access to a proper facility	1	2	3	4	5	6	7	8	9	10
(h) the weather was very bad	1	2	3	4	5	6	7	8	9	10
(i) you had other medical /health problems	1	2	3	4	5	6	7	8	9	10

Appendix C.3 – Physical Activity Toolkit

Congratulations on making the decision to begin to GET ACTIVE YOUR WAY! This Physical Activity Toolkit includes a few tools to help you get started. The kit includes:

1. Physical Activity Brochure. This information pamphlet is jammed full of tips for easy ways to include physical activity into your daily routine. **Please read the pamphlet carefully and decide which tips will work best for you.**

2. Resistance Band and Instruction Sheet. Exercising to build muscle has never been easier! This resistance band is a way to strength train without having to own a full set of weights or to leave your home. **Try the suggested exercises to see which ones you want to do on a regular basis.**

3. Safety sheet. Physical activity is always more enjoyable when you feel comfortable and safe doing it. **Be sure to review each of the safety tips before you begin to get active.**

Remember, the Toolkit is just to help you get started. The opportunities for physical activity are endless. Use your imagination – get active anyway you can!

If you have questions or concerns at any time please contact:

A gym built by you

Equipment does not have to be expensive—be creative and build it yourself!

CANS

- Cans of soup, etc. can be used as weights for muscle endurance exercises. Ensure that the cans are small enough to place your hand around comfortably.

PLASTIC BOTTLES

- Plastic bottles of various sizes can be used for muscle endurance by filling them with sand, pebbles or dry beans. Use these as weights to do arm exercises.

SOCKS

- Fill up a sock up with dry beans and tie the top. You now have a weight that you can use for strength training or for coordination activities.

EQUIPMENT MODIFICATIONS

- Use "grip cuffs," hooks or other assistive devices to help hold a weight (for those with grip impairment). These may be purchased from fitness or rehab specialty stores.

- Another option for aerobic exercise for wheelchair users, is to purchase a stationary bicycle and place it on a table and use the pedals as "arm cranks."

What do the Experts say...

Benefits of regular activity:

- better health
- improved fitness
- better posture and balance
- better self-esteem
- weight control
- stronger muscles
- feeling more energetic
- relaxation and reduced stress
- independent living
- pain management

Health risks of inactivity:

- premature death
- heart disease
- obesity
- high blood pressure
- adult-onset diabetes
- osteoporosis
- stroke
- depression
- colon cancer

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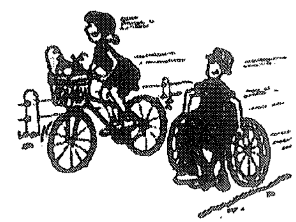

Get Active Your Way

Tips for including physical activity in your daily routine

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How much should I do?

- It is recommended that you accumulate 30 minutes of moderate to heavy intensity physical activity at least 3 days a week
- This goal can be reached by building physical activities into your daily routine. Just add it up in periods of at least 10 minutes each throughout the day.

What should I do?

Endurance Activities

These activities get your heart pumping and your blood flowing. They range from wheeling to organized exercise programs and recreational sports.

Strength Activities

These make you work your muscles against some kind of resistance. They range from lifting weights to pushing open heavy doors.

Get Active Anywhere

At home

- Create a new morning routine. Start your day with 10 minutes of movement indoors or outdoors.
- Park the car 10 minutes away from the store you are going to. Better yet, leave the car at home.
- Parents - play with your kids.
- Dance to your favourite up - beat music for 10 minutes a day.

At school and work

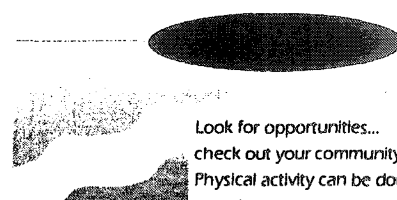
- Have a "moving" meeting - grab your colleague and discuss business while taking a walk/wheel.
- Replace your coffee break with a wheeling break.
- Go for a brisk wheel before lunch for about 10 minutes.
- Choose to take your manual chair rather than your power chair.

At play

- Make a personal or family commitment to try a new activity each season.
- Get in the garden and dig, prune, rake and weed.
- See how many different 10- minute wheeling routes you can find in your neighbourhood.
- Hit a tennis ball with a friend.
- Arrange to meet a couple of friends for a wheel every day at the same time.

On the way

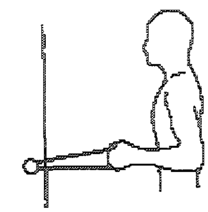
- Wheel to work or school.
- Get off the bus two stops early and wheel home.
- Leave the car in a parking lot 10 minutes from work and wheel the rest of the way.
- If your job involves a lot of driving, plan several short stops in your day. Get out of the car and wheel for 10 minutes or more whenever you can.



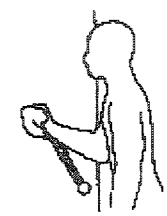
Look for opportunities... check out your community. Physical activity can be done anywhere!

Some exercises for you to try

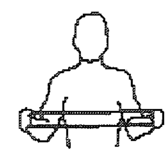
Using the large yellow rubber strip included in your Physical Activity Toolkit, tie the ends of the strip in a knot to form a large circular band. Then try the following exercises:



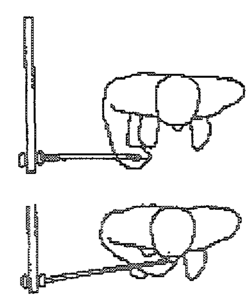
A. Sit in front of a secured door and place one end of the rubber band around the doorknob. Hold the other end of the rubber band in your hand or loop it around your wrist. Keeping your elbow flexed at a 90-degree angle, pull your arm back away from the door against the resistance of the band. Release the tension of the band slowly as you return to the starting position. Repeat this exercise 20 times. DO NOT CAUSE PAIN. DO NOT HOLD YOUR BREATH.



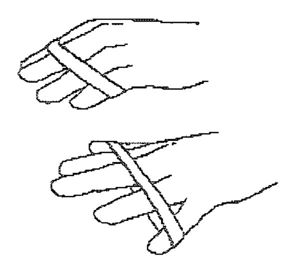
B. Sit with your side next to a secured door. Place one end of the rubber band around a doorknob. Hold the other end of the band in your hand or loop it around your wrist. Push the band forward until you encounter resistance from the band. Slowly release the tension until your arm is in the starting position. This exercise should be repeated 20 times. DO NOT CAUSE PAIN. DO NOT HOLD BREATH.



C. Keeping your elbows by your sides, bent to a 90-degree angle, place the rubber around your hands in front of your body. Try to pull your hands away from each other thereby placing resistance on the band. Slowly release the tension on the band, allowing your hands to resume their starting position. DO NOT CAUSE PAIN. DO NOT HOLD BREATH.



D. Sit with your right side by a securely closed door. You should be approximately 18" away from the door. Place one end of the rubber band around the doorknob and hold the other end in your hand or loop it around your wrist. Keeping your elbow by your side, pull the band toward your stomach. Slowly release the band, allowing your arm to return to the starting position. The elbow must stay on the waist at all times. DO NOT CAUSE PAIN. DO NOT HOLD YOUR BREATH.

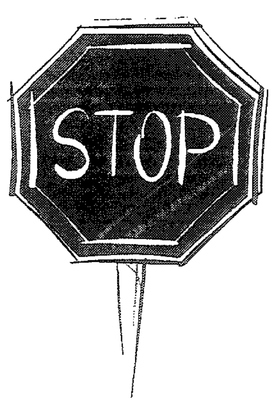


E. Place a wide office rubber band around the tips of all five fingers. Spread the fingers apart from each other as far as you can. Slowly release the tension of the rubber band, returning your hand to its starting position. You should do this at least 50 times a day. Very gradually, work up to 200 finger extensions per day. DO NOT CAUSE PAIN.

Safety First

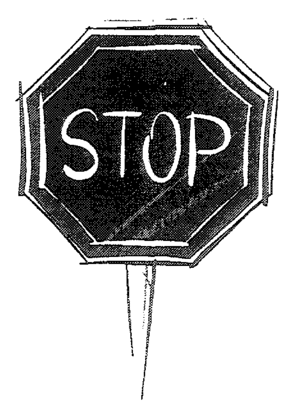
WHEN PARTICIPATING IN ANY TYPE OF PHYSICAL ACTIVITY, IT IS IMPORTANT TO REMEMBER SOME BASIC SAFETY GUIDELINES:

- **Get the OK from you doctor.**
  Inform your Family Physician about your plans for a home exercise program. Your doctor may have some precautions or recommendations for you to consider.
- **Dress the part.**
  Wear comfortable, loose-fitting clothing and shoes.
- **Check your environment.**
  Choose a spot in your home that is spacious and clear of obstacles.
- **Monitor yourself.**
  Exercising alone means being responsible for yourself. Use the talk test throughout your workout - can you talk without gasping for air? If not, it's time to take a break.
- **Pace yourself.**
  Start off your program slowly and progress at an even rate during each workout and between workouts.
- **Warm-Up.**
  Remember to do light endurance work before your strength or flexibility exercises to ensure your muscles are warm.
- **Cool-Down.**
  Complete some gentle stretching and ensure your breathing has returned to normal before you stop.
- **Keep hydrated.**
  Be sure to drink lots of fluids while partaking in activities and after you are done.



When participating in physical activity, it is important to listen to your body. If you experience prolonged muscle and/or joint soreness, stop doing the activity that is causing the pain and consult your physician.

If you feel sign or symptoms of autonomic dysreflexia stop doing the activity immediately and determine the cause of the reaction.



Signs and Symptoms of Autonomic Dysreflexia

- Pounding headache (caused by the elevation in blood pressure)
- Goose Pimples
- Sweating above the level of injury
- Nasal Congestion
- Slow Pulse
- Blotching of the Skin
- Restlessness
- Slow pulse (< 60 beats per minute)
- Hypertension (blood pressure greater than 200/100)
- Flushed (reddened) face – not resulting from participating in physical activity
- Red blotches on the skin above level of spinal injury
- Sweating above level of spinal injury
- Nausea
- Cold, clammy skin below level of spinal injury

What to do if you think you are experiencing autonomic dysreflexia

- Initiate the following treatment quickly to prevent complications.
- Remain in a sitting position, but do a pressure release immediately. You may transfer yourself to bed, but always keep your head elevated.
- Identify and remove the cause
    - Since a full bladder is the most common cause, check the urinary drainage system.
    - Bowel and skin might also be a cause.
- If the symptoms do not go away, consult a physician immediately

Appendix C.4 - Sample Calendar
Implementation Intentions Intervention Condition

Isaac Intervention's *GET ACTIVE YOUR WAY* Calendar of Events
DECEMBER 2003

Sun	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday
The details for each activity are presented in the following order	What: Where When: Duration: Intensity:	16	17	18	19 **Start your logbook**	20
21	22 Wheeling Neighbourhood Morning 30 min Mod-Heavy	23 Aerobics At home Morning 30 min Heavy	24 Aerobics At home Morning 30 min Heavy	25	26 **Complete & return e-mail survey**	27
28	29 Swim Hotel Afternoon 30 min Moderate	30 Theraband Hotel Evening 30 min Moderate	31 Wheeling Neighbourhood Morning 30 min Heavy			

Be sure to keep on track! Please remember to keep you logbook up to date.

JANUARY 2004

Sun	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday
				1	2	3
4	5 Wheeling Neighborhood Morning 20 min Mod-Heavy Aerobics Living room Morning 10 min Moderate	6	7 Wheeling Neighborhood Morning 20 min Mod-Heavy Aerobics Living room Morning 10 min Moderate	8	9 Wheeling Neighborhood Morning 20 min Mod-Heavy Aerobics Living room Morning 10 min Moderate	10
11	12 Wheeling Neighborhood Morning 20 min Mod-Heavy Aerobics Living room Morning 10 min Moderate	13	14 Wheeling Neighborhood Morning 20 min Mod-Heavy Aerobics Living room Morning 10 min Moderate	15	16 **Touch Base Telephone Interview 10:00 a.m.**	17

Be sure to keep on track! Please remember to keep you logbook up to date.

Appendix C.4 - Sample Calendar
Control Condition

Colleen Control's *GET ACTIVE YOUR WAY* Calendar of Events
DECEMBER 2003

Sun	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday
A few activities you might try to do in the next 4 weeks: ▪Weights ▪Extra wheeling ▪Exercise ball ▪Swimming		16	17	18	19 **Start your logbook**	20
21	22	23	24	25	26 **Complete & return e-mail survey**	27
28	29	30	31			

Be sure to keep on track! Please remember to keep you logbook up to date.

JANUARY 2004

Sun	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday
				1	2	3
4	5	6	7	8	9	10
11	12	13	14	15	16 **Touch Base Telephone Interview 10:00 a.m.**	17

Be sure to keep on track! Please remember to keep you logbook up to date.

Appendix C.5 - Logbook Instructions

Tracking Your Progress

> ***LIFESTYLE PHYSICAL ACTIVITY includes all of the activities that you choose to do during your free time that require physical exertion. It also includes all the wheeling you do for periods of 10 minutes or longer. Lifestyle physical activity does not include activities such as physio, shopping, stretching, cleaning and other activities of daily living***

Instructions

At the end of each day please record a few details about the lifestyle physical activities you did over the course of the day. Did you choose to do several short bouts or one long bout? Whatever it may be, please keep track of it in the logbook included below. If you are not active on a particular day simply place an X in the box that says "*none*."

For each activity please provide the following information

- What – what type of activity did you did (e.g., wheeling, theraband exercises)?
- When – what time did you do the activity at?
- Where – where did you participate in this activity (e.g., home, community center)?
- Duration – how many minutes did you do the activity for?
- Intensity – based on the colorful intensity definition sheet, how hard were you working? If the intensity changed during the activity please indicate how many minutes you spent at each intensity.

AT THE END OF 4-WEEKS YOU WILL BE ASKED TO RETURN YOUR LOGBOOK TO AMY VIA E-MAIL.

If you have any questions please contact

Appendix C.6 - Sample Logbook Page

Isaac's Daily Activity Log - Week 1

Friday December 19, 2003 None ☐

Details	Activity 1	Activity 2	Activity 3	Notes
What				
Duration	Minutes	minutes	minutes	
Intensity				
Other:				

Saturday December 20, 2003 None ☐

Details	Activity 1	Activity 2	Activity 3	Notes
What				
Duration	Minutes	minutes	minutes	
Intensity				
Other:				

Sunday December 21, 2003 None ☐

Details	Activity 1	Activity 2	Activity 3	Notes
What				
Duration	Minutes	minutes	minutes	
Intensity				
Other:				

Monday December 22, 2003 None ☐

Details	Activity 1	Activity 2	Activity 3	Notes
What				
Duration	Minutes	minutes	minutes	
Intensity				
Other:				

Tuesday December 23, 2003 None ☐

Details	Activity 1	Activity 2	Activity 3	Notes
What				
Duration	Minutes	minutes	minutes	
Intensity				
Other:				