

## ORIGINAL ARTICLE

# Activities of daily living performed by individuals with SCI: relationships with physical fitness and leisure time physical activity

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**Study Design:** Cross-sectional.

**Objectives:** To examine patterns of participation in activities of daily living (ADL) and fitness-related factors associated with these patterns among individuals with spinal cord injury (SCI).

**Setting:** Centre for Health Promotion and Rehabilitation at McMaster University, School of Kinesiology and Health Studies at Queen's University.

**Methods:** Forty-eight participants completed the Physical Activity Recall Assessment for People with Spinal Cord Injury (PARA-SCI) and a fitness test assessing cardiovascular fitness ( $VO_{2max}$  and peak power output (Po)). The most commonly reported ADL were extracted from the PARA-SCI data for analysis.

**Results:** Women tended to spend more time participating in domestic and personal care ADL than men. Compared to individuals with tetraplegia, individuals with paraplegia tended to spend more time transferring, cleaning and preparing food and less time wheeling, toileting and dressing. Fitness and participation in leisure time physical activity (LTPA) were associated with certain ADL. Participants with higher levels of fitness spent more time partaking in ADL wheeling and cleaning. Moreover, greater time spent participating in moderate- and heavy-intensity LTPA was positively correlated with time spent engaged in certain ADL.

**Conclusion:** By identifying common ADL performed by individuals with SCI, the study findings begin to provide direction for developing strategies to optimize ADL participation. Future research should examine fitness as a way to help individuals with SCI optimize their ADL participation.

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**Keywords:** spinal cord injury; activities of daily living; fitness; leisure time physical activity

## Introduction

To fully understand the impact of a disability, it is essential to understand how daily functioning is affected.<sup>1</sup> Spinal cord injury (SCI) substantially alters activity patterns.<sup>2</sup> For example, men with SCI spend more time partaking in personal care activities and less time engaged in work-related activities than men without an SCI.<sup>2</sup> Although it has been established that SCI affects participation in activities of daily living (ADL),<sup>2–4</sup> it remains to be determined whether there is variation in patterns of ADL within the SCI population. Past studies have not considered the influence of sex or level of injury (paraplegia and tetraplegia) on ADL despite being known factors affecting physical functioning.<sup>5</sup> Moreover, research has not examined participation in mobility-related ADL (for example, transfers and wheeling)—activities particularly relevant to the SCI population. A thorough under-

standing of ADL patterns are needed to develop strategies for optimizing ADL participation and community integration.

The primary purpose of this study was to examine differences between sexes and injury levels in ADL participation including mobility-related activities that require physical exertion. It was hypothesized that there would be differences in ADL participation between sexes as well as level of injury. Specifically, it was expected that women would participate in more ADL, which involved domestic activities (for example, cleaning and food preparation) and personal care activities (for example, toileting and grooming). This hypothesis is based on the notion that women traditionally tend to complete more domestic activities than men. It was also expected that individuals with tetraplegia would spend more time in personal care ADL and less time in more active ADL such as mobility activities (for example, wheeling and transferring). These relationships were hypothesized because individuals with tetraplegia tend to have less residual function than individuals with paraplegia.<sup>5</sup> As a result of reduced function, some ADL take longer to complete. Also, individuals with tetraplegia are less likely

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to use manual wheelchairs as their primary mode of mobility<sup>6</sup> thus reducing the amount of time spent engaged in mobility activities.

The secondary objective of this study was to examine fitness and leisure time physical activity (LTPA; activities that one chooses to do during free time such as resistance training or sporting activities<sup>7</sup>) as potential targets for optimizing ADL participation. A strategy that optimizes ADL participation should increase individuals' capacity to perform ADL that facilitate community integration (for example, mobility activities<sup>7</sup>) and minimize the demands of ADL that interfere with integration (for example, self-care activities).<sup>2</sup> As a preliminary step to establishing fitness and specifically LTPA as a strategy for optimizing ADL, we examined the relationship between ADL and fitness and LTPA.

ADL such as transfers and wheeling are important for community integration.<sup>8</sup> For example, individuals who can transfer independently often are able to get ready in the morning or prepare for bed in the evening without assistance. Being less reliant on assistance from others affords substantial freedom in daily scheduling. However, activities such as transferring and wheeling do require activation of major muscle groups and as a result can be very strenuous.<sup>9,10</sup> The increased strain accompanying these ADL may deter participation and consequently limit opportunities for community integration. However, it has been demonstrated that increased fitness reduces the strain of ADL.<sup>9</sup> Accordingly, increasing fitness may allow individuals with SCI to complete strenuous ADL (for example, mobility activities) with less difficulty and for prolonged periods. Moreover, with increased fitness individuals may become more proficient at performing passive ADL (for example, personal care activities) and require less time to complete this type of activity.

Individuals with SCI are able to augment their physical fitness through LTPA.<sup>11-13</sup> Thus, LTPA may be a way for individuals with SCI to decrease the strain associated with ADL. The current study examined this possibility. It was hypothesized that fitness and LTPA would correlate positively with ADL that require activation of major muscle groups (for example, mobility activities) as it was expected that individuals with higher fitness levels and who do more LTPA would be able to perform such activities for a longer duration. Furthermore it was hypothesized that fitness and LTPA would correlate negatively with passive ADL (for example, personal care activities) as it was expected that with increased fitness and greater LTPA, the time and effort required to complete passive ADL would decrease.

## Materials and methods

### Subjects

This study involved secondary analysis of data from 48 men and women with SCI who participated in a study examining the validity of the Physical Activity Recall for People with Spinal Cord Injury (PARA-SCI). Participants' demographic characteristics are presented in Table 1. Study eligibility

**Table 1** Participant demographic and injury characteristics

Participants	<i>n</i> = 48
Age (year)	39.48 ± 10.98
Years post injury	11.35 ± 9.97
<i>Lesion level</i>	
Paraplegic	29 (60.4%)
Tetraplegic	19 (39.6%)
<i>Completeness of injury</i>	
Complete	28 (58.3%)
Incomplete	20 (41.7%)
<i>Type of mobility</i>	
Manual wheelchair	43 (89.6%)
Power wheelchair	5 (10.4%)
<i>Injury etiology</i>	
Traumatic	39 (81.3%)
Non-traumatic	9 (18.8%)
<i>Education</i>	
High school or less	24 (50.0%)
Postsecondary	24 (50.0%)
<i>Employment status</i>	
Working or student	20 (41.6%)
Not working	28 (58.3%)
<i>Marital status</i>	
Single, divorced or widowed	28 (58.3%)
Married or common Law	20 (41.6%)

requirements were: (a) neurologic impairment secondary to SCI (that is, 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 deficits. Participants were excluded if they had an injury above C5 because they would not have had adequate residual function to perform the fitness tests.<sup>7</sup>

### Activities of daily living

Participants completed the PARA-SCI<sup>14</sup>—a self-report measure of all activities performed over a 3-day recall period. Participants reported the activity type and duration of both ADL and LTPA. Participants classified the intensity of each activity using the PARA-SCI intensity classification system. Consistent with the PARA-SCI protocol (Martin Ginis KA, Latimer AE. PARA-SCI Administration and Scoring Manual. Hamilton, ON, McMaster University. 2008), activities reported to require no physical effort were not recorded. A total ADL score was calculated by summing the time spent engaged in mild-, moderate-, and heavy-intensity ADL. In addition to providing a better representation of ADL participation, combining the three intensity levels also increased statistical power. Finally, only moderate- and heavy-intensity LTPA was analyzed because these LTPA intensities provide the most substantial fitness benefits.<sup>15</sup>

Owing to the variety of reported activities, those which required similar functional movements were clustered. For example, activities involving personal hygiene (for example,

washing face, brushing teeth and brushing hair) were clustered into the 'grooming' category. Only the ADL that  $\geq 25\%$  of the sample participated in were examined. Activities with minimal participation were extremely skewed and had limited statistical power. The ADL analyzed included (a) mobility activities: wheeling and transferring, (b) domestic activities: cleaning and preparing food and (c) personal care activities: grooming, bathing, dressing and toileting.

#### Aerobic fitness

As described elsewhere,<sup>7</sup> a progressive exercise test on a Monark Ergonomic 881E arm ergometer was used to determine maximal oxygen uptake ( $VO_{2max}$ ) and peak workload (Po) achieved at  $VO_{2max}$ .  $VO_{2max}$  is an indicator of aerobic fitness. Po provides an additional indication of aerobic capacity.  $VO_{2max}$  was standardized for the lesion level to account for higher  $VO_{2max}$  among individuals with paraplegia. Po was standardized for sex and lesion level to account for higher Po among men and individuals with paraplegia.

#### Procedure

As described by Latimer *et al.*,<sup>7</sup> participants completed the aerobic fitness test prior to being randomly assigned to a PARA-SCI interview date. Interviews were conducted over the telephone by trained research assistants. Interviews were completed at least 4 days after the fitness test to ensure that it was not included in the 3-day recall. Statistical analyses were computed using the Statistical Package for the Social Sciences (SPSS) v. 14.0. All applicable institutional and governmental regulations concerning the ethical use of human volunteers were followed during the course of this research.

#### Statistical analysis

Two separate MANOVAs were conducted to determine if ADL participation differed by sex and injury level. Cohen's *d*

effect sizes were calculated for each between-groups comparison. Effect sizes were classified as small ( $d = 0.20-0.49$ ), medium ( $d = 0.50-0.79$ ) or large ( $d \geq 0.80$ ).<sup>16</sup>

Pearson's bivariate two-tailed correlations were computed to examine the relationships between ADL, LTPA and fitness.

## Results

#### ADL participation

Time spent participating in each ADL is reported in Table 2. The multivariate effects testing for differences in ADL participation between men and women and individuals with paraplegia and tetraplegia were not significant. However, for the majority of ADL, effect sizes for the between-groups comparisons were small to medium sized. For sex, small effects emerged for all ADL except mobility activities and bathing. Women tended to spend more time engaged in domestic and personal care activities than men. For lesion level, small to medium effects emerged for all ADL except grooming and food preparation. Individuals with paraplegia tended to spend more time transferring, cleaning and preparing food, whereas individuals with tetraplegia tended to spend more time wheeling, toileting and dressing.

#### Fitness and ADL

Fitness variables were positively correlated with certain ADL. Increased  $VO_{2max}$  was associated with increased participation in cleaning and wheeling ( $r_s > 0.32$ ,  $P_s < 0.05$ ). Po was associated with cleaning ( $r_s = 0.49$ ,  $P_s < 0.01$ ). Correlations are presented in Table 3.

#### LTPA and ADL

Moderate- and heavy-intensity LTPA were positively correlated with wheeling, dressing, and toileting ( $r_s > 0.26$ ,  $P_s < 0.05$ ). Correlations are presented in Table 3.

**Table 2** Additional demographic information and means for all ADL (min/day) for sex and lesion level

	Total (n = 48)		Sex		Lesion level		
		Women (n = 13)	Men (n = 35)	Effect size	Paraplegia (n = 29)	Tetraplegia (n = 19)	Effect size
<i>Mobility activities</i>							
Wheeling	26.21 ± 34.99	29.39 ± 36.84	25.03 ± 34.75	0.12	21.88 ± 29.62	32.81 ± 41.88	0.30
Transferring	14.27 ± 18.91	13.35 ± 14.99	14.61 ± 20.36	0.07	16.17 ± 20.36	11.36 ± 16.53	0.26
<i>Domestic activities</i>							
Cleaning	11.93 ± 22.30	20.26 ± 30.47	8.85 ± 17.98	0.47	14.18 ± 23.26	8.50 ± 20.88	0.26
Food preparation	19.40 ± 45.57	32.68 ± 54.04	14.47 ± 41.77	0.38	22.02 ± 41.88	15.38 ± 45.85	0.19
<i>Personal care activities</i>							
Grooming	7.36 ± 13.75	10.38 ± 17.17	6.24 ± 12.34	0.28	7.25 ± 16.07	7.52 ± 9.59	0.02
Bathing	0.64 ± 2.02	0.77 ± 1.88	0.59 ± 2.08	0.09	0.31 ± 1.68	1.14 ± 2.01	0.45
Dressing	13.89 ± 13.44	16.78 ± 11.47	12.82 ± 14.03	0.31	11.15 ± 12.43	18.06 ± 14.18	0.51
Toileting	15.80 ± 22.75	19.38 ± 28.78	14.45 ± 20.40	0.20	11.79 ± 19.62	21.88 ± 26.21	0.43

Note. The ADL not analyzed due to limited reporting included: animal care, driving, eating, doing laundry, doing dishes, yard work, physiotherapy, child care, carrying, lifting, opening/closing a door, repairing, building, packing, desk work, lifestyle activities (for example, knitting, reading, watching TV), walking, stair climbing and positioning.

Small effect sizes ( $d = 0.20-0.49$ ), medium effect sizes ( $d = 0.50-0.79$ ), large effect sizes ( $d \geq 0.80$ )

**Table 3** Relationships between fitness measures and ADL

ADL	VO <sub>2max</sub> standard residual (n = 48)	Po standard residual (n = 48)	Moderate and heavy LTPA (n = 73)
<i>Mobility activities</i>			
Transferring	-0.08	-0.05	0.15
Wheeling	0.32*	0.24	0.32**
<i>Domestic activities</i>			
Cleaning	0.42**	0.49**	0.05
Food preparation	0.19	0.23	0.10
<i>Personal care activities</i>			
Grooming	-0.04	0.04	0.06
Bathing	0.01	0.10	0.08
Dressing	0.08	0.06	0.26*
Toileting	0.11	0.24	0.32**

\* $P < 0.05$ , \*\* $P < 0.001$ .

## Discussion

Although it is well established that individuals with SCI spend a great deal of time participating in ADL,<sup>7</sup> variation in ADL participation and factors associated with participation are poorly understood in this population. The current study examined patterns of participation in SCI-specific ADL and whether these patterns were related to fitness and LTPA. We determined that women tended to spend more time participating in domestic and personal care ADL than men. Individuals with paraplegia tended to spend more time transferring, cleaning and preparing food, whereas individuals with tetraplegia tended to spend more time wheeling, toileting and dressing. Interestingly, these patterns of participation were associated with fitness and LTPA. Participants with higher levels of fitness spent more time engaged in ADL wheeling and cleaning. Moreover, participation in moderate- and heavy-intensity LTPA was positively correlated with time spent engaged in certain ADL. These findings provide new insight into ADL participation patterns among individuals with SCI.

The trends in ADL participation for men and women and individuals with paraplegia and tetraplegia were generally consistent with our hypotheses. Although these trends did not reach standard levels of statistical significance, the between-groups effects were small to medium in size,<sup>16</sup> suggesting that differences likely would emerge in a larger sample.

The trends in the data indicated that women spent more time in domestic and personal care activities. This pattern may be attributed to women's tendency to complete more household duties and increased time demands of women's personal care activities such as catheterization. Individuals with paraplegia tended to spend more time transferring and cleaning and less time engaged in personal care activities and wheeling than individuals with tetraplegia. This pattern of findings may be because of greater residual function in individuals with paraplegia, allowing them to transfer more regularly and complete more household chores. Conversely, the increased time spent toileting, bathing and dressing by

individuals with tetraplegia may be a reflection of lower residual function causing balance and coordination tasks to take longer to complete. Also, the increased amount of time that individuals with tetraplegia spent wheeling may be the result of slower wheeling speeds because of limited upper body strength. Taken together, these patterns of participation contribute to our understanding of ADL in the SCI population. They provide insight into ADL that should be targeted to enhance community involvement and overall daily functioning. For example, efforts should be made to reduce time demands of self-care activities for individuals with tetraplegia so that more time can be invested in productive activities.

Our preliminary findings suggest that increasing fitness may be a strategy worth investigating as a means of optimizing participation in strenuous ADL (that is, activities that require activation of major muscle groups). We found a positive relationship between the fitness variables and time spent cleaning and wheeling. It may be that greater fitness enabled participation in strenuous ADL for a longer duration. Additional research is needed to confirm this possibility.

Interestingly, LTPA correlated positively with ADL wheeling. This correlation may reflect that individuals who participate in LTPA spend time wheeling to get to a sport or exercise venue where they engage in LTPA. Alternatively, this relationship may be indicative of the increased fitness associated with greater LTPA participation which subsequently facilitates greater ADL wheeling.<sup>7</sup> Further research should examine whether increased fitness from LTPA participation facilitates ADL wheeling.

Unexpectedly, LTPA correlated positively with toileting and dressing. The correlation between LTPA and toileting may be due to changes in fluid intake common with LTPA participation. Although urine production decreases during LTPA,<sup>17</sup> significant water loss during LTPA<sup>18</sup> may cause active individuals to consume more fluids before and after LTPA to remain hydrated. Higher fluid consumption before and after LTPA may contribute to the greater time spent toileting among active individuals. LTPA may also improve intestinal motility, promoting regularity and therefore increase the time spent toileting.<sup>19</sup> The positive correlations between LTPA and dressing may be due to changing clothes both before and after physical activity or sporting activities.

## Limitations

Despite providing insight into ADL patterns the study was limited. First, the small sample and consequent limited variability in ADL prevented the analyses of many activities performed by individuals with SCI. For example, we expected that there would be a negative relationship between fitness and the time spent in passive ADL activities such as personal care activities. Unfortunately, these hypotheses could not be explored fully due to the limited amount of participation in passive activities classified as a mild intensity of activity or higher. Future studies should attempt to repeat similar analyses with a larger cohort. Second, although results support the validity of the

PARA-SCI for measuring ADL (that is, fitness correlated with strenuous ADL), additional validation is necessary to further confirm that the PARA-SCI is a valid method for reporting ADL participation. Third, other variables such as marital status and level of attendant care should be examined as factors influencing ADL participation. These factors could not be examined adequately in the current study because of the small sample size and the limited demographic data available. Finally, the PARA-SCI captures only ADL with a reported intensity level. Therefore, ADL, which were reported to be of 'no effort', were not analyzed. As a result of this measurement approach, readers should be cautious in comparing the patterns of participation revealed in the current study with patterns reported in other research that did not consider the intensity of the activity.

## Conclusion

This study describes patterns and correlates of ADL participation among individuals with SCI. The study findings suggest that sex, lesion level, fitness and LTPA may be important factors to consider when developing interventions to optimize ADL participation. In particular, LTPA should be investigated as a possible method to increase physical fitness and in turn improve daily functioning in individuals with SCI.

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