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ORIGINAL REPORT

WALKING TASKS ENCOUNTERED BY URBAN-DWELLING ADULTS AND PERSONS WITH INCOMPLETE SPINAL CORD INJURIES

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Objective: **Gait retraining should target the walking skills most needed for independence in the home and community. The main objective of this study was to document the walking tasks most commonly encountered in daily life by able-bodied adults. The study also compared participation in walking tasks between able-bodied adults and persons with incomplete spinal cord injuries.**

Participants: **Convenience sample of 50 able-bodied adults and 16 ambulatory, community-dwelling persons with incomplete spinal cord injuries.**

Methods: **A walking survey was developed, and its content validity and concurrent validity confirmed. Participants used the survey to document the frequency with which walking tasks were encountered during a full waking day.**

Results: **Frequently encountered tasks included walking on smooth and rough surfaces, opening/closing doors and carrying objects. Tasks encountered more than once per day by the majority of able-bodied participants included negotiating obstacles, walking on uneven and sloped surfaces, in crowded environments, narrow spaces, and on steps and stairs. Participants with spinal cord injuries encountered fewer tasks, including many of those frequently encountered by able-bodied participants.**

Conclusion: **The findings identify the important walking tasks for ambulation in the home and community. These tasks should be included in therapy programs aiming to retrain functional walking.**

Key words: walking, community, spinal cord injury.

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INTRODUCTION

Walking independently in the home and community is an important goal for persons who have experienced a mobility-restricting disease or injury, such as a stroke (1) or spinal cord injury. The outcomes of motor retraining are best when the training is specific to the skills needed (2–7). Thus, effective gait retraining must include walking skills that are relevant to daily life. What are the skills needed to walk successfully in the home and community? How often are these tasks encountered? Surprisingly little research has been done to identify these skills. Minimum distance and velocity requirements (8–10), walking on uneven surfaces (1), and the ability to ascend and descend curbs (8) have been identified. Patla & Shumway-Cook (11) proposed 8 dimensions of environmental factors that constitute the requirements of community walking: (*i*) distance; (*ii*) terrain characteristics; (*iii*) temporal characteristics; (*iv*) ambient conditions; (*v*) external physical load; (*vi*) traffic level; (*vii*) attentional demands; and (*viii*) postural transitions. They confirmed the importance of these 8 dimensions by videotaping older adults during community outings (12). What remains unknown, however, is a full account of the walking skills encountered in private and public venues in a waking day. For example, how frequently do we encounter uneven terrain, crowded environments and obstacles? Is performing a secondary task while walking, such as carrying or pushing objects, important? Moreover, how does a limitation in walking ability alter participation in ambulatory activities? Answers to these questions would greatly assist the development of functional gait retraining programs.

One client group that commonly participates in gait retraining is individuals with incomplete spinal cord injuries. Walking is more demanding, both physiologically and cognitively, for persons with incomplete spinal cord injuries compared with able-bodied adults (13–15). Their walking speed and endurance is lower than their able-bodied counterparts (15) and they have greater difficulty adapting their gait to environmental challenges, such as inclines (16) and obstacles (17, 18). Despite these limitations, approximately one-third of persons with spinal cord injuries are estimated to be functional walkers one year post-injury (19). Definitions of a functional or community walker in the literature differ considerably and are typically limited to walking speed and/or distance (8–10, 20). In order to fully prepare individuals with incomplete spinal cord injuries for walking in the community, it would be helpful to have a more complete understanding of what functional walking entails. It would also be beneficial to determine how participation in daily walking tasks differs between persons with incomplete spinal cord injuries and able-bodied adults. If differences exist, these differences might indicate the tasks that are especially challenging for the injured population.

This study had 2 main objectives. First, to determine what walking skills are important for daily ambulation by identifying frequently encountered tasks among able-bodied adults. Secondly, to compare participation in daily walking tasks between able-bodied adults and ambulatory persons with incomplete

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spinal cord injuries. To accomplish this, a walking survey was developed and tested for content validity and concurrent validity. This survey was then distributed to able-bodied adults and persons with spinal cord injuries who were ambulatory. Participants used the survey to document their walking experiences for one day. Commonly encountered walking tasks were identified and compared between the groups.

METHODS

Development of the walking survey

A focus group was formed to develop a walking survey. Six able-bodied adults were invited to participate. The study aimed to include at least one adult from each decade between the ages of 20 and 65 years, and a mix of sedentary and non-sedentary careers. Together with the 2 authors, the focus group consisted of 8 able-bodied adults aged 23–57 years. The professions represented in the focus group included engineering, university professorship, laboratory technology, physiotherapy, physiotherapy studies, teaching and graduate studies.

Survey development was an iterative process and all members were involved at each stage. Focus group members were instructed to design a survey similar to a walking log or diary that a participant carried to record his/her walking experiences for a full day. The objectives were to ensure the survey was complete with minimal redundancy, easy to understand and easy to use. A guide to survey development was consulted (21). To create an item pool, each group member documented every walking task they performed over a 2-day period. This was done in the winter and the spring, since terrain characteristics vary with the season. The initial item pool consisted of approximately 60 walking tasks. The items were then revised to remove redundancy and ambiguity, and to facilitate accurate quantification. Redundancy was defined as a walking task that required documenting in more than one of the 60 walking tasks. Ambiguity was defined as difficulty in deciding where to document a particular task. Items were removed or regrouped by consensus. Examples of tasks that were removed or regrouped included the following. Walking tasks related to weather conditions (i.e. rain, snow, ice, wind) were replaced by descriptors that focused on the changes to the walking surface (e.g. slippery, soft, deep). These descriptors focused on the effect of the weather on walking. Walking and turning was difficult to quantify, because minor changes in walking direction occur all the time. How much change would qualify as a turn? How could this be standardized? Similarly, walking and talking was difficult. Would walking while uttering a word, sentence or an entire conversation all be the same? After removing these and other items, the first walking survey was constructed, this included approximately 50 tasks.

Participants were asked to document the number of times each task was performed, using the revised survey. Four able-bodied adults used the survey for one day. They were asked: (*i*) to consider how the survey could be improved; (*ii*) to document walking tasks they encountered that were not included on the survey; and (*iii*) document tasks encountered that caused confusion as to where on the survey they should be recorded. The able-bodied volunteers then provided verbal feedback to the researchers. The format and content of the walking survey was revised based on this feedback. Major recommendations included: (*i*) group similar items into one task (i.e. rather than having walking on linoleum and walking on hardwood flooring as separate tasks, consider both as walking on a smooth surface); and (*ii*) specify frequency categories rather than listing the exact number of times each task was encountered. The able-bodied adults reported encountering a few walking tasks not included on the survey; however, these were attention tasks (i.e. walking and talking, walking and listening to music) that the focus group had knowingly excluded. They reported no difficulty in deciding where an encountered task should be recorded, and no redundancy was found. The process of obtaining feedback from able-bodied adults was repeated until there were no further suggestions for improvement. Four iterations were required. Different able-bodied adults were recruited to provide feedback at each stage. The survey was also used by one volunteer with an incomplete spinal cord injury, who provided further suggestions on the wording of open-ended questions.

The final walking survey consisted of 27 tasks divided into 5 categories: (*i*) walking surfaces; (*ii*) doors; (*iii*) skilled tasks; (*iv*) intersections; and (*v*) steps (Appendix). Four categories were logical groupings (walking surfaces, doors, intersections and steps). The skilled tasks category was a collection of tasks that either challenged walking balance or involved walking while performing a secondary motor task. Additional information about many items was requested (Appendix). Four frequency ratings were used. Gender, age, and walking aids used were documented.

Able-bodied adults and those with incomplete spinal cord injuries were given identical surveys, with the exception of 2 additional questions for spinal cord-injured individuals. These participants were asked the level of his/her injury and what he/she felt limited his/her ability to walk in the community. Informed consent was implied by participants voluntarily completing the survey. Surveys were completed anonymously. Ethical approval was obtained from the Health Research Ethics Board of the University of Alberta and Capital Health, Edmonton.

Content validity and concurrent validity of the walking survey

To assess content validity, the walking of 3 able-bodied adults was videotaped by a researcher (KEM). Two adults were videotaped during all walking episodes for 14 hours and the third was videotaped during a 4-hour shopping trip. The video was reviewed by the same researcher to identify walking tasks encountered by the participants that were not included in the survey.

To assess concurrent validity, a researcher (KEM) shadowed 5 able-bodied adults (3 for a 14-hour period and 2 for a 9-hour period). These participants and the researcher independently completed a walking survey based on the participant's walking. We assumed that the researcher was the more reliable rater, since she was: (*i*) able to concentrate fully on the participants' walking, whereas the participants were concentrating on their normal day-to-day activities; (*ii*) involved in the development of the survey and familiar with its content and format; and (*iii*) licensed as a physical therapist and trained in the observation of movement. The survey completed by the able-bodied participant was compared with that completed by the researcher and the agreement between the 2 was calculated. Agreement (expressed as a percentage) was the number of survey items for which the participant and researcher chose the same frequency rating divided by the total number of items on the walking survey. The agreements calculated for each of the 5 able-bodied participants were averaged. This process was repeated for each survey category separately. Weighted kappa coefficients using linear weights were calculated to ensure the observed agreements were not due to chance alone (22, 23).

Participants and data collection

Participants in both the able-bodied and spinal cord-injured groups were samples of convenience. Able-bodied adults were recruited through presentations to community groups or e-mail notices sent to acquaintances of the researchers in Edmonton AB and Ottawa ON, Canada. To be included in the study, able-bodied participants must have reported being free of any disease, injury or condition affecting walking ability. Participants with incomplete spinal cord injuries were recruited through the Edmonton branch of the Canadian Paraplegic Association and the Center for Ambulatory Research, Rehabilitation and Education at the University of Alberta. To be included as participants, persons with traumatic or non-traumatic, incomplete spinal cord injuries must have reported: (*i*) ambulating daily (with or without walking aids); (*ii*) being able to walk 10 meters without assistance from another person; and (*iii*) having no disease, injury or condition other than the spinal injury that affects their walking. A researcher interviewed potential participants, either in person or over the telephone, to determine if they were eligible for participation. Surveys were only given to those who met the inclusion criteria. When able-bodied adults were given the survey, a researcher noted their careers. This allowed us to determine whether a diversity of careers was represented. Completed surveys were collected continually over one year. Terrain characteristics change with season, so it was important to ensure the different seasons were equally represented. The surveys were dated so that we could ensure that roughly the same number of surveys from able-bodied participants was collected in all 4 seasons.

Fifty able-bodied adults (24 men, 26 women, mean age: 41.5 years (standard deviation (SD) 12.8), age range 22–64 years) completed walking surveys, out of 56 given out, so the rate of return was 89%. All able-bodied participants lived in urban centers and 80% were employed (full- or part-time). They represented a diverse range of careers, such as accountant, mechanic, and small business owner. Of those unemployed, 10% were retired, 6% were students and 4% were caring for their children. The age categories and number of participants (in brackets) are as follows: 21–30 years [15], 31–40 years [8], 41–50 years [11], 51–60 years [12] and 61–65 years [4]. The number of surveys completed in each season (in brackets): spring [8], summer [16], fall [15] and winter [11].

Of the 20 persons with incomplete spinal cord injuries given walking surveys, 16 returned completed surveys (80% rate of return). Subject characteristics for this group are shown in Table I. Forty percent of participants with incomplete spinal cord injuries were employed. All but one lived in an urban setting. The number of surveys completed by spinal cord-injured participants in each season (in brackets): spring [1], summer [4], fall [6] and winter [5].

Participants were given verbal and written instruction by a researcher prior to completing the walking survey. They were instructed to document tasks performed only when walking (i.e. not when standing or jogging). To ensure accuracy, participants were asked to complete the survey throughout the day (i.e. document after each walking experience). Participants were asked to complete the survey on a typical day, such as a working day. Persons with incomplete spinal cord injuries who were receiving rehabilitation services were asked to complete the survey on a non-therapy day, so that gait exercises would not influence survey results. Surveys were completed anonymously. Participants were given a postage-paid return envelope.

Data analysis of walking surveys

Walking surveys completed by the able-bodied participants were used to identify frequent and moderately frequent walking tasks. A frequent walking task was defined as a task performed ≥ 10 times/day by ≥ 50% of able-bodied participants. A moderately frequent walking task was defined as a task performed ≥ 1 time/day by ≥ 75% of able-bodied adults. These definitions were adopted because we wished to identify: (*i*) walking tasks that are encountered many times/day; and (*ii*) walking tasks that, although not encountered many times, are important because most able-bodied adults encounter them at least once/day. Frequency ratings for each survey item were compared between spinal cord-injured and able-bodied adults with the χ^2 test (24). The 2 groups were not matched for demographics. The parameters most likely to differ between these groups are age and gender, with the spinal cord-injured typically younger and predominantly male. Thus, the mean age was compared for the 2 groups using an independent *t*-test. In addition, to determine if there were gender differences we compared the results from able-bodied men and women using a χ^2 test. Significance was set at $p < 0.05$ for all statistical tests. Mean values are reported with one SD.

Table I. *Characteristics of participants with spinal cord injury*

Subject	Age (years)	Gender	Injury level	Walking aid
1	52	M	Cervical	Walker/cane
2	45	M	Thoracic	None
3	43	M	Cervical	2 canes
4	47	M	Lumbar	1 cane
5	59	M	Cervical	1 cane
6	78	M	Cervical	1 cane
7	33	M	Cervical	None
8	40	M	Thoracic	1 cane
9	47	F	Cervical	None
10	40	M	Cervical	Walker
11	34	M	Cervical	Walker
12	64	M	Thoracic	None
13	75	F	Thoracic	Walker
14	29	M	Cervical	Forearm crutches
15	48	M	Cervical	Forearm crutches
16	35	F	Thoracic	Walker (outdoors only)
Average	48.1			
SD	14.5			

SD: standard deviation.

RESULTS

Content validity and concurrent validity of the walking survey

Video-recordings indicated that the walking survey encompassed most of the walking tasks encountered by able-bodied individuals. Tasks that were encountered, but not included in the survey, were: (*i*) walking in a dimly lit environment (2 participants encountered 4 times); (*ii*) walking in wind (one subject encountered twice); (*iii*) walking and talking (all 3 participants); and (*iv*) walking and turning (all 3 participants). As mentioned in the Methods section, the focus group excluded turning while walking, walking and talking, and walking in wind from the survey. In 3 of the 4 times that a dimly lit environment was encountered, the environment could have been lit up by turning on a light. For this reason, this task was not included on the survey.

The average agreement between the surveys completed by the subject and the researcher was 81.5 ± 5.0%. The average agreement for each survey category differed (Fig. 1) and ranged from 68.0 ± 8.4% for the skilled tasks category to 100 ± 0% for the intersections category. Average agreement was above 83% for all categories except for the skilled tasks. For this category the participants tended to select a lower frequency

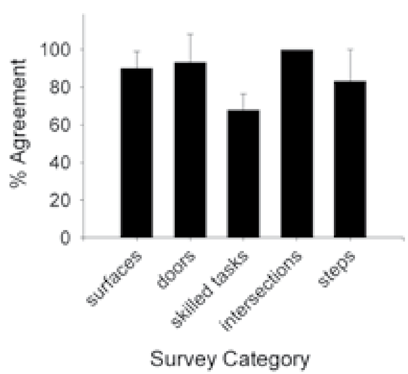

Fig. 1. Concurrent validity of the walking survey. A researcher shadowed 3 participants for a full day and 2 participants for a 9-hour period. Agreement was measured as the number of items in which the subject and researcher chose the same frequency category, expressed as a percentage. Error bars represent 1 standard deviation (SD).

Table II. *Weighted kappa coefficient, standard error of the weighted kappa coefficient and 95% confidence interval (CI) for the 5 able-bodied participants who participated in the testing of concurrent validity of the walking survey. The agreement between subject and researcher was significant ($p < 0.05$) for all comparisons*

Subject code	Weighted kappa coefficient	Standard error	95% CI
CV1	0.87	0.11	0.65–1.09
CV2	0.77	0.13	0.51–1.03
CV3	0.75	0.15	0.46–1.04
CV4	0.87	0.11	0.67–1.08
CV5	0.84	0.11	0.62–1.05

rating than the researcher (94% of cases). This suggested that participants may under-report their encounters with items in skilled tasks. Results from the weighted kappa analysis are reported in Table II. Agreement was significant for all pairs ($p < 0.05$), suggesting that the agreement observed was not due to chance.

Rate of encountering walking tasks

The frequency with which able-bodied individuals encountered each of the 27 items on the survey is displayed in Fig. 2. Tasks that met the criteria of a frequent walking task include walking on rough and smooth surfaces, opening/closing doors and carrying objects while walking. Linoleum, tile and hardwood were the most common smooth surfaces (i.e. reported by at least 10 able-bodied participants). Carpet, grass and concrete were the most common rough surfaces. Able-bodied participants reported carrying a wide variety of objects, with the 2 most common objects weighing greater than 5 lbs (i.e. 2.3 kg) being bags of groceries and backpacks.

Tasks that met the criteria of a moderately frequent walking task are negotiating obstacles, < 6 steps up and down, walking in narrow spaces and crowded environments, ascending 7–14 steps and walking on uneven and sloped surfaces (Fig. 2). Obstacles encountered during walking differed considerably in size, from small obstacles such as door frames and electrical cords, to larger obstacles such as garbage cans and snow banks. In approximately 44% of the reported encounters with ≤ 6 steps, a railing was not available. The most common width reported for a narrow space was 2–3 feet (i.e. 0.6–0.9 m). Commonly encountered uneven surfaces included gravel and dirt paths. A store, such as a grocery or clothing store, was the most frequently reported crowded environment to walk in, followed by a healthcare facility, such as a hospital or dental clinic. Walking on a slippery surface also met the criteria of a moderately frequent task in the winter.

Participants with incomplete spinal cord injuries had fewer encounters with most tasks on the walking survey, especially items in the category of skilled tasks. Significant differences between the 2 groups were found in a number of tasks (Fig. 3). Many of these tasks were identified as frequent or moderately frequent walking tasks for the able-bodied. Fourteen of the 16 participants with incomplete spinal cord injuries felt that their ability to walk was limited. The limiting factors reported (number of subjects reporting in square brackets) included uneven terrain [4], wet or icy surfaces [4], fatigue [2], inability to walk long distances [2], inadequate or the lack of railings [3] or ramps [1], pain [1], poor balance [1], and poor muscle strength [1].

There was no difference ($p > 0.05$) in the mean ages of the able-bodied and spinal cord-injured groups. The groups did differ in gender composition, as 81% of participants with spinal cord injuries were male compared with 48% in the able-bodied group. It is unlikely that this discrepancy affected the comparison of the 2 groups as no significant differences were found when surveys from able-bodied males and females were compared.

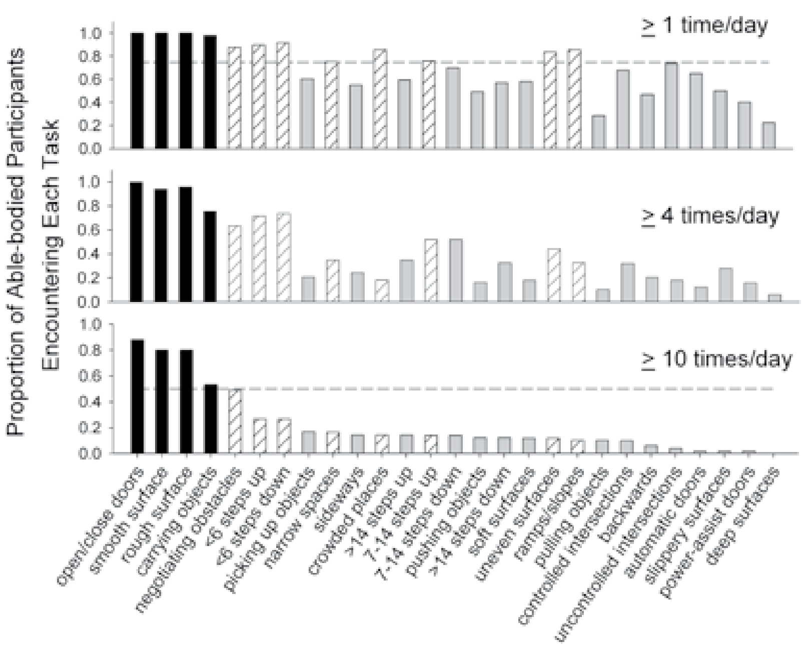

Fig. 2. Rate of encountering walking tasks among able-bodied participants. The proportion of able-bodied participants encountering each task ≥ 10 times/day (bottom graph), ≥ 4 times/day (middle graph) and ≥ 1 time/day (top graph) is displayed. The tasks are listed in the horizontal axis in descending order of frequency for the ≥ 10 times/day plot. A frequent task (*black bars*) was defined as any task that was encountered ≥ 10 times/day by at least 50% of able-bodied participants (*dashed line* in bottom plot indicates 50%). A moderately frequent task (*striped bars*) was defined as any task that was encountered at least once/day by at least 75% of able-bodied participants (*dashed line* in top plot indicates 75%). Grey bars indicate tasks that did not meet the criteria of frequent or moderately frequent tasks. These frequency categories are not mutually exclusive. Participants reporting ≥ 10 encounters with a given task are also included in the proportion of participants reporting ≥ 4 in the middle graph, and ≥ 1 encounters in the top graph in the same task. Hence, the height of the bar for any one category increases from the bottom to the top graph.

Fig. 3. Comparison between able-bodied participants and participants with spinal cord injuries. Walking tasks encountered significantly more frequently by able-bodied participants than participants with incomplete spinal cord injuries are plotted according to the χ^2 value. Black and white bars represent survey items that were significantly different with 99% and 95% confidence, respectively. *Frequent walking tasks and ^moderately frequent walking tasks for able-bodied participants.

Open-ended questions

Some difficulty was encountered with the open-ended questions. For example, in the question regarding maximum distance walked, some participants reported distances, while others reported time spent walking, and still others reported a number with no units. Since the surveys were completed anonymously, the answers could not be clarified with the participants after the fact.

DISCUSSION

This study is the first to describe home and community ambulation for a full waking day among able-bodied adults. It quantified the frequency with which different walking tasks were encountered. Adults with incomplete spinal cord injuries showed less participation in daily walking tasks than the able-bodied adults. Moreover, they showed the greatest differences in tasks that were often encountered by able-bodied participants. These tasks may be especially important to target in retraining.

Important tasks in home and community ambulation

Our results confirm a number of walking tasks previously thought to be important for household and community ambulation. For example, terrain that varies in texture and unevenness, obstacles in the walking path, carrying objects while walking, walking in crowded areas, walking on ramps/slopes and ascending/descending curbs or a small number of steps have been mentioned by others (20, 25). More surprisingly, we found opening and closing doors while walking to be extremely common, and negotiating narrow spaces to be quite common. These tasks have rarely been mentioned in the past. Also surprising was the fact that crossing controlled intersections was a relatively infrequent occurrence. The minimum walking speed necessary for community ambulation (1, 15) has typically been based on the speed needed to cross a controlled intersection safely (8, 10). While we fully agree that walking speed is a useful measure of walking ability, attaining the specific speed to cross a controlled intersection may not be needed very often.

Mobility restrictions limit encounters with specific walking tasks

Persons with mobility restrictions appear to limit their activity to avoid encounters with tasks that are difficult (25). Our results showed that participants with incomplete spinal cord injuries rarely carried objects while walking. They encountered fewer doors, slopes, obstacles and uneven surfaces. Interestingly, these tasks were often encountered by able-bodied participants. This study did not attempt to determine the reasons for these differences between able-bodied and spinal cord-injured subjects. Perhaps limitations in hand function, poor walking balance and use of walking aids made these tasks more difficult for participants with spinal cord injuries. It is also possible that they have found ways to circumvent the need for these tasks.

Limitations in the methodology

First, the survey attempts to measure frequency of encounters only. It did not measure the duration of time participants were engaged in these tasks, nor the distances involved. Second, the survey focused on walking tasks that either challenged balance or involved performing a second motor task. It did not include tasks that required more cognitive involvement (i.e. walking while talking, thinking or searching). Future study of these walking tasks would be helpful in achieving a more complete picture of daily walking. Third, the accuracy with which participants completed the walking survey is unknown. The agreement between subject and researcher was found to be high, however, these 5 participants knew that they were being shadowed and may have put more effort into completing the survey than other participants. The results from the test of concurrent validity suggested that participants under-reported their encounters with items in the category of skilled tasks. Thus, the results are probably too conservative with respect to skilled tasks. Fourth, the content validity and concurrent validity of the survey for persons with spinal cord injuries remains unknown. We cannot be certain that individuals with incomplete spinal cord injuries respond to the survey in the same way as able-bodied participants. Generally, however, there is no reason to believe the walking environment would be dramatically different for those with spinal cord injuries. Fifth, the study did not match participants with incomplete spinal cord injuries with able-bodied participants. To achieve a more specific comparison of participation in walking tasks, participants could be matched for age, gender and, possibly, employment in the future. Sixth, the participants in the study were from urban centers. Therefore, the results cannot be generalized to rural settings where certain walking tasks, such as walking on uneven surfaces, may be more common. Seventh, the surveys were completed anonymously, thus answers could not be clarified after the fact. In the future, it may be better to

Table III. *Comparison of characteristics (%) between the participants with incomplete spinal cord injuries and the Canadian, spinal cord-injured population*

Characteristic	Canadian averages (26)	Our sample
Gender, men	81	81
Tetraplegic (i.e. cervical spinal cord injury)	47.4	62.5
Paraplegic (i.e. thoracic and lumbar spinal cord injury)	46.7	37.5
Urban-dwelling	86	95
Employed	38	40

Canadian averages obtained from nation-wide survey. Tetraplegic and paraplegic proportions do not equal 100% because 5.9% of respondents did not know thier injury level or refused to answer.

remove anonymity by requesting consent to contact participants for further details related to the survey answers. Lastly, it would have been beneficial to include a few additional questions on the survey. For example, a question concerning employment status for all participants and a question concerning time since injury for participants with incomplete spinal cord injuries.

Limitations in sample size

We cannot be sure that our samples accurately represent the able-bodied and ambulatory, spinal cord-injured populations. The sample size of 16 adults with incomplete spinal cord injuries is small, but exhibits similar demographics to the national averages (26) (Table III). None of the spinal cord-injured participants had additional conditions affecting their mobility, so they may be healthier than the general population with incomplete spinal cord injuries. A convenience sample of 50 able-bodied adults from two Canadian cities may not adequately represent the able-bodied population. Nevertheless, this sample size is greater than the sample sizes of able-bodied adults used in previous reports on community ambulation (8, 9, 12, 25). A more extensive study in the future could provide a more accurate picture of daily walking.

In conclusion, this study is the first to identify walking tasks that are encountered in a full waking day by able-bodied adults and ambulatory persons with incomplete spinal cord injuries. The survey was shown to have good content validity and concurrent validity. We suggest that walking tasks commonly encountered by able-bodied adults should be regular components of functional gait training programs for persons with mobility restrictions.

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APPENDIX. Walking survey given to participants with spinal cord injuries.
Questions 1–5 ask how many times you performed a particular walking task during the day. There are 4 options: none, 1–3 times, 4–9 times, and 10 or more (≥ 10) times. Put an X under the appropriate column for each task.

1. Walking Surfaces
Record surfaces you walked on that you found to be smooth, rough, slippery, soft, uneven or deep. Describe the surface under the “Specific Surface” column. For example, “hardwood floor that had just been mopped” describes a slippery surface.

Surface	None	1–3 times	4–9 times	≥ 10 times	Specific surface
a. Smooth (e.g. linoleum, tile, hardwood)					
b. Rough (e.g. carpet, concrete, grass)					
c. Slippery (e.g. wet floor, ice, packed snow)					
d. Soft (e.g. sand, thick carpet, gym mat)					
e. Uneven (any surface that is not level, e.g. gravel, dirt path)					
f. Deep (e.g. long grass, several inches of snow or water)					

2. Doors

Door type	None	1–3 times	4–9 times	≥ 10 times
a. Doors that you opened/closed (e.g. push/pull, sliding)				
b. Automatic (e.g. automatically open as you walk towards them)				
c. Power-assisted (e.g. wheelchair accessible, button controlled)				

3. Skilled Walking Tasks

Walking task	None	1–3 times	4–9 times	≥ 10 times	
a. Ramp/slope (up or down)					
b. Walking backwards					
c. Walking sideways					
d. Crowded environment (e.g. mall, grocery store)					Where?
e. Narrow space (e.g. narrow hall, alley)					Approximate width of walking space?
f. Carrying object(s) while walking					List object(s) greater than 5 lbs:
g. Pushing object while walking					What object(s)?
h. Pulling object while walking					What object(s)?
i. Bending over to pick up object(s) while walking					List object(s) greater than 5 lbs:
j. Over/around obstacle(s) (e.g. any object on ground, door frame)					What obstacle(s)?

4. Intersections

Intersection type	None	1–3 times	4–9 times	≥ 10 times
a. Controlled (e.g. traffic lights, pedestrian lights, crosswalk)				
b. Uncontrolled (e.g. no lights or crosswalk)				

5. Steps

In the "Railing" column indicate the number of times a railing was available for use, even if you did not use it. For example, if you performed 5a) 4 times throughout the day, but the steps had a railing only 2 of the 4 times, enter "2" under "Railing".

Steps	None	1–3 times	4–9 times	≥ 10 times	Railing
a. 6 steps or less up (e.g. curb, steps to porch)					
b. 6 steps or less down (e.g. curb, steps from porch)					
c. 7–14 steps up (e.g. 1 flight of stairs)					
d. 7–14 steps down (e.g. 1 flight of stairs)					
e. Greater than 14 steps up (e.g. 2 or more flights)					
f. Greater than 14 steps down (e.g. 2 or more flights)					

g. Were any steps higher than the average step height (approximately 20 cm)? If so, how many of these steps did you come across?

6. Estimate the maximum distance you walked at one time without a rest.

7. Did you use a walking aid (e.g. cane, walker, walking stick, etc.) to complete any walking tasks? If yes, what aid was used for which task?

8. What do you think limits your ability to walk in the community?

9. At what spinal level (e.g. T10, L2, etc.) is your injury?

10. With the exception of your spinal injury, do you have any disease, condition or injury that affects your ability to walk? If yes, what disease, condition or injury?

11. What is your age?

12. Are you male or female?