Need and use of assistive devices for personal mobility by individuals with spinal cord injury

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Objective: To investigate the provision, use, and unmet need of assistive devices for personal mobility in the Swiss population with spinal cord injury (SCI).
Design: Community survey 2012 of the Swiss Spinal Cord Injury Cohort Study.
Participants: Individuals aged 16 or older with traumatic or non-traumatic SCI residing in Switzerland.
Interventions: Not applicable.
Outcome Measures: Provision, frequency of use, and unmet need (i.e. perceiving the need of a device but it not being provided) of 11 mobility devices were assessed by self-report and analyzed descriptively. Provision of devices was further analyzed by sex, age, SCI etiology, SCI severity, and time since SCI.
Results: Devices reported highest for provision (N = 492; mean age 55.3 ± 15.1 years; 28.9% female) were adapted cars (78.2%) and manual wheelchairs (69.9%). Provision of various devices markedly varied with age and SCI severity (e.g. 34.6% of those aged 76+ had a walking frame compared to 3.1% of those aged 31–45; 50.0% of participants with complete tetraplegia had a power wheelchair compared to 7.6% of those with complete paraplegia). Many devices were mostly used daily (e.g. manual wheelchair) while others were mostly used less frequently (e.g. handbikes). Unmet need was highest for arm braces (53.2% of those in need) and power assisted wheelchairs (47.3%), and lowest for crutches (11.4%) and manual wheelchairs (4.8%).
Conclusion: The devices individuals have or use is largely dependent on their age and SCI severity. While most participants have access to basic mobility devices, there is still a considerable degree of unmet need for certain devices.

Keywords: Assistive devices, ICF, Spinal cord injuries, Mobility limitation, Needs

Introduction

For individuals with spinal cord injury (SCI), optimal mobility—including walking, moving, and moving around using transportation[1,2]—is crucial for participation in many aspects of life, ranging from personal hygiene maintenance to social activity engagement.[3-5] Besides adaptations of the environment and measures to improve an individual's physical capacity, mobility devices (i.e. "products and technology for personal indoor and outdoor mobility and transportation"[2]) can be used to optimize mobility level after SCI and thereby constitute an essential component of successful rehabilitation.[6-8]

So far there has only been limited research into the types of mobility device used among people with SCI. It has been shown that nearly all individuals with SCI depend on mobility devices of some sort (such as crutches, manual wheelchairs or power wheelchairs) and that devices are used in many different combinations.[9] There are currently gaps in research on what devices would be needed by individuals that do not currently have access. This information is essential to determine if current standards of care are being met and to identify potential gaps in provision of products.

Thus, the aims of the present study were to (1) evaluate the provision of mobility devices and their combinations among individuals with SCI in Switzerland; (2) examine the frequency of device use; and (3) identify the perceived need of assistive equipment that participants are not provided with. We hypothesized that provision, frequency of use as well as perceived need vary across the devices under study. Furthermore, we hypothesized that provision of devices varies with sex, age, SCI severity, SCI etiology and time since SCI.

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Methods

Study design and population

The Swiss Spinal Cord Injury (SwiSCI) Cohort Study is an ongoing observational population-based cohort study that included individuals 16 years or older who reside in Switzerland and have been diagnosed with traumatic or non-traumatic SCI. Individuals with congenital conditions (such as spina bifida), new SCI in the context of palliative care, neurodegenerative disorders (such as multiple sclerosis), or Guillain-Barré syndrome, were excluded from the study.[10] SwiSCI was approved by the ethics committee of the Canton of Lucerne and subsequently endorsed by the ethics committees of the Cantons Zürich, Basel-Stadt and Valais. Participants provided written informed consent.

The present study refers to cross-sectional data collected between September 2011 and March 2013 in a nationwide community survey.[10] A mixed-mode design was used that included a combination of paper-based and web-based questionnaires, and telephone interviews as assessment methods. Potential participants (n = 3144) were identified through cooperation with three specialized SCI-rehabilitation centers, the national association for persons with SCI (Swiss Paraplegics Association), and the SCI-specific home care organization ParaHelp. The survey was mailed in consecutive modules. The first two modules were returned by 1549 individuals (constituting a 49% response rate) and included questions on socio-demographic and socioeconomic characteristics, SCI etiology, SCI severity, time since SCI, and functional independence. To limit the burden on participants, three additional thematically specific modules were only mailed to subsamples of these 1549 participants. Participants were randomly assigned to one of these specific modules; 580 individuals were invited to participate in the module containing questions on the use and need of assistive devices. The 492 individuals (85%) who were included in the present study returned this module.

Measures

Mobility devices

Provision, frequency of use, and unmet need (i.e. perceiving the need of a device but it not being provided) of mobility devices were assessed by self-report. In accordance with the ICF (code e120), mobility devices were defined as "products and technology for personal indoor and outdoor mobility and transportation."[2] The following devices were investigated in the present study: crutches (devices that transfer weight from the legs to the upper body and are held by each arm), walking frame (devices with a supporting frame to hold with both arms, and wheels to aid in walking), manual wheelchair (wheelchair designed to be propelled by the user, by pushing with both hands, on the hand rims of the wheels), power wheelchair (wheelchair powered by electricity), power assisted wheelchair (electrical wheel hub for a manual wheelchair that supports the propelling movement; for a better understanding, the brand name "e-motion" was given as an example in the questionnaire), wheelchair tractor (electrical tracking device designed to be coupled to a manual wheelchair; the brand name "Swiss-trac" was given as an example), sport wheelchair (wheelchair designed for sport participation), handbike (device that either has its own rigid frame or is attached to a manual wheelchair and has an arm crank propulsion mechanism), arm brace (orthoses designed to modify functional characteristics of the upper limbs), leg brace (orthoses designed to modify functional characteristics of the lower limbs), and adapted vehicle (within family).

Individuals were asked if they were provided with the device (yes/no) at the time of questionnaire. Frequency of use was assessed for all devices except the adapted vehicle in the following categories: less than once per month/1–3 times per month/1–6 times per week/daily.

"Total need" for a device was defined as either having the device (i.e. "met need") or not having the device but perceiving the need (i.e. "unmet need"). To assess the unmet need, those who stated not having a certain device were asked about their need for it (I have no need/I have a need). The unmet need for an adapted vehicle was assessed in the following categories: I have no need/ I don't have it, because I cannot afford it/ I don't have it because of other reasons.

Other measures

Sex, age (at questionnaire), SCI etiology (traumatic/non-traumatic), lesion level (paraplegia/tetraplegia), completeness (complete, i.e. no function or sensation below the level of the injury/incomplete, i.e. some function or sensation below the level of the injury), and time since injury were assessed by self-report. The information on level and completeness of injury was combined to define categories of severity: tetraplegia complete/tetraplegia incomplete/paraplegia complete/paraplegia incomplete. Independence in moving around moderate distances (10–100 m) was assessed by using the self-report version of the Spinal Cord Independence Measure (SCIM-SR) [11] and categorized into: wheelchair/walking.

Statistical analyses

Statistical analyses were performed using Stata Version 13.1 (StataCorp LP, College Station, Texas, USA).

Basic statistical procedures were used to describe the study population as well as provision, frequency of use and unmet need of mobility devices in the total sample. Bivariable analyses were performed to evaluate the provision of devices in subgroups defined by sex, age (5 groups), SCI severity (4 groups), SCI etiology (2 groups), and time since injury (4 groups). Confidence intervals for proportions of participants having a device were computed assuming an approximate t-distribution on the logit-scale. Chi-square tests were used to identify group differences. The level of significance was set at $P \leq 0.05/55$ (using the Bonferroni correction for multiple comparisons, i.e. dividing the significance level by the number of tests being conducted).

Combined usage of devices was quantified for all device pairs by means of the binary Lance-Williams nonmetric dissimilarity measure.[12] These measures were then projected in two dimensions using multidimensional scaling and mapped as a bubble plot. The bubble size is proportional to total number of participants who are provided with the device. A close proximity of a mobility device on the chart, relative to all others, indicates the same individuals are using the respective devices.

Results

This study included 492 participants (28.9% female). The average age of participants was 55.3 (±15.1) years. Instances of traumatic injuries were higher among males at 83.0% compared to females at 60.7%. Almost 70% of participants had paraplegia with 39.1% with incomplete paraplegia and 30.1% with complete (see Table 1).

Table 2a and 2b present the proportion of individuals provided with each mobility device in the total sample as well as by sex, age groups, severity, etiology, and time since injury groups. The most common devices individuals had overall were adapted family vehicles (78.2%), manual wheelchairs (69.9%), and wheelchair tractors (32.7%). There were no significant differences in provision of devices between males and females. Comparing by age, older individuals had the highest proportions of having a walking frame as 34.6% of people 76 years or older had them available; with the next highest proportion being 12.8% of 61–75 year olds and markedly lower rates for the younger age groups (3.1%–6.1%). Sportive devices such as the handbike and sport wheelchair were predominately occupied by the 16–30 and 31–45 year age groups; and decreasing

Table 1 Participants' characteristics

	Total (N = 492) n (%)	Male (N = 350) n (%)	Female (N = 142) n (%)
Age (years)	492 (100)	350 (100)	142 (100)
16–30	29 (5.9)	22 (6.3)	7 (4.9)
31–45	103 (20.9)	77 (22.0)	26 (18.3)
46–60	150 (30.5)	108 (30.9)	42 (29.6)
61–75	175 (35.6)	122 (34.9)	53 (37.3)
76+	35 (7.1)	21 (6.0)	14 (9.9)
SCI etiology	487 (100)	347 (100)	140 (100)
Traumatic	373 (76.6)	288 (83.0)	85 (60.7)
Non-traumatic	114 (23.4)	59 (17.0)	55 (39.3)
SCI severity	488 (100)	346 (100)	142 (100)
Incomplete tetraplegia	105 (21.5)	72 (20.8)	33 (23.2)
Complete tetraplegia	45 (9.2)	38 (10.9)	7 (4.9)
Incomplete paraplegia	191 (39.1)	124 (35.8)	67 (47.2)
Complete paraplegia	147 (30.1)	112 (32.4)	35 (24.7)
Time since SCI (years)	480 (100)	343 (100)	137 (100)
<1	8 (1.7)	4 (1.2)	4 (2.9)
1–5	121 (25.2)	80 (23.3)	41 (29.9)
6–10	85 (17.7)	59 (17.2)	26 (19.0)
11–15	61 (12.7)	44 (12.8)	17 (12.4)
16–20	49 (10.2)	37 (10.8)	12 (8.8)
21–25	42 (8.8)	33 (9.6)	9 (6.6)
26–30	36 (7.5)	26 (7.6)	10 (7.3)
31–35	25 (5.2)	18 (5.3)	7 (5.1)
36+	53 (11.0)	42 (12.2)	11 (8.0)
Moving around moderate distances (10-100m)	466 (100)	332 (100)	134 (100)
Wheelchair use	275 (59.0)	198 (59.6)	77 (57.5)
Walking	191 (41.0)	134 (40.4)	57 (42.5)

SCI: Spinal cord injury.

Table 2a Proportions of participants being provided with the respective device in total and stratified by socio-demographic characteristics

	All		Sex				Age at questionnaire (vears)					
Personal mobility device	N	% (CI)	N	Male % (CI)	Female % (CI)	*P*	N	16-30 % (CI)	31-45 % (CI)	46-60 % (CI)	61-75 % (CI)	76+ % (CI)	P
Crutches	436	28.4 (24.4-32.9)	436	26.1 (21.5-31.3)	34.4 (26.5-43.3)	0.084	436	20.7 (9.4-39.5)	23.7 (16.2-33.2)	25.9 (19.2-34.2)	32.4 (25.3-40.5)	43.3 (26.8-61.5)	0.151
Walking frame	424	9.2 (6.8-12.4)	424	6.9 (4.5-10.3)	15.1 (9.7-22.8)	0.008	424	3.4 (0.5-21.5)	3.1 (1.0-9.3)	6.1 (3.0-11.7)	12.8 (8.2-19.4)	34.6 (18.8-54.7)	<0.001*
Manual wheelchair	458	69.9 (65.5-73.9)	458	69.0 (63.8-73.8)	72.1 (63.7-79.2)	0.516	458	72.4 (53.3-85.8)	73.9 (64.2-81.8)	71.5 (63.6-78.3)	69.2 (61.5-75.9)	50.0 (32.5-67.5)	0.153
Power wheelchair	429	14.0 (11.0-17.6)	429	12.6 (9.3-16.8)	17.5 (11.7-25.4)	0.191	429	10.3 (3.3-28.1)	9.4 (4.9-17.1)	12.2 (7.6-19.1)	18.4 (12.9-25.5)	19.2 (8.1-39.2)	0.258
Power assisted wheelchair	419	9.3 (6.9-12.5)	419	7.2 (4.8-10.7)	14.9 (9.4-22.8)	0.016	419	6.9 (1.7-24.3)	9.4 (4.9-17.1)	10.6 (6.4-17.2)	8.8 (5.0-14.8)	8.0 (1.9-27.6)	0.967
Wheelchair tractor	441	32.7 (28.4-37.2)	441	34.2 (29.1-39.6)	28.7 (21.3-37.4)	0.272	441	37.9 (22.1-56.8)	28.6 (20.5-38.4)	30.1 (23.0-38.4)	39.1 (31.6-47.1)	18.5 (7.8-38.0)	0.148
Sport wheelchair	425	16.9 (13.7-20.8)	425	19.4 (15.3-24.2)	10.4 (6.0-17.5)	0.029	425	27.6 (14.2-46.7)	31.6 (23.2-41.5)	16.2 (10.9-23.4)	7.3 (4.0-13.1)	4.0 (0.5-24.4)	<0.001*
Handbike	425	25.2 (21.3-29.5)	425	25.2 (20.6-30.3)	25.2 (18.1-34.0)	0.991	425	39.3 (23.0-58.4)	44.9 (35.3-54.9)	24.2 (17.7-32.3)	13.4 (8.7-20.1)	4.0 (0.5-24.4)	<0.001*
Arm brace	420	5.2 (3.5-7.8)	420	4.3 (2.5-7.2)	7.8 (4.1-14.4)	0.144	420	6.9 (1.7-24.3)	5.1 (2.1-11.9)	5.3 (2.5-10.8)	4.4 (2.0-9.5)	8.0 (2.0-27.6)	0.945
Leg brace	429	12.6 (9.8-16.1)	429	12.8 (9.5-17.0)	12.1 (7.3-19.4)	0.844	429	20.7 (9.4-39.5)	17.3 (11.0-26.2)	12.7 (8.0-19.5)	8.4 (4.8-14.2)	8.0 (1.9-27.6)	0.164
Adapted vehicle within family	481	78.2 (74.2-81.6)	481	79.6 (75.0-83.5)	74.6 (66.7-81.2)	0.234	481	82.8 (64.2-92.8)	79.2 (70.1-86.1)	79.8 (72.6-85.6)	79.2 (72.3-84.7)	58.8 (41.6-74.1)	0.084

Table 2b Proportions of participants being provided with the respective device stratified by severity of injury, etiology of injury and time since injury

	Severity						Etiology				Time since injury (years)					
Personal mobility device	N	Paraplegia incomplete % (CI)	Paraplegia complete % (CI)	Tetraplegia incomplete % (CI)	Tetraplegia complete % (CI)	P	N	Traumatic % (CI)	Non-Traumatic % (CI)	P	N	0-5 % (CI)	6-15 % (CI)	16-25 % (CI)	26+ % (CI)	P
Crutches	432	50.0 (42.4-57.5)	7.6 (4.1-13.6)	31.2 (22.5-41.4)	2.6 (0.3-16.5)	<0.001*	432	24.1 (19.8-29.0)	42.7 (33.1-52.8)	<0.001*	427	40.2 (31.6-49.3)	28.2 (21.2-36.4)	23.4 (15.2-34.2)	20.4 (13.5-29.6)	0.008
Walking frame	420	16.3 (11.3-22.8)	2.3 (0.7-6.9)	11.0 (6.0-19.3)	0.0 -	<0.001*	420	5.5 (3.5-8.6)	22.6 (15.2-32.3)	<0.001*	415	18.1 (12.1-26.2)	9.1 (5.2-15.4)	4.1 (1.3-12.1)	3.2 (1.0-9.5)	0.001
Manual wheelchair	454	55.1 (47.7-62.3)	95.0 (89.9-97.6)	56.7 (46.6-66.3)	82.5 (67.3-91.5)	<0.001*	453	71.7 (66.7-76.1)	64.0 (54.1-72.8)	0.140	447	60.5 (51.4-68.9)	57.7 (49.2-65.7)	75.6 (65.1-83.8)	89.9 (82.6-94.3)	<0.001*
Power wheelchair	425	7.6 (4.3-12.9)	7.6 (4.1-13.7)	17.6 (11.0-26.9)	50.0 (35.4-64.6)	<0.001*	425	13.0 (9.8-17.1)	18.1 (11.5-27.3)	0.211	418	16.1 (10.3-24.1)	9.9 (5.8-16.3)	9.2 (4.4-18.2)	19.4 (12.7-28.5)	0.103
Power assisted wheelchair	415	5.1 (2.6-9.9)	10.0 (5.9-16.5)	15.4 (9.3-24.4)	10.8 (4.0-25.8)	0.061	415	9.8 (7.0-13.6)	7.9 (3.8-15.7)	0.576	410	13.5 (8.3-21.3)	4.7 (2.1-10.2)	11.1 (5.6-20.8)	10.0 (5.4-17.7)	0.128
Wheelchair tractor	437	22.9 (17.1-29.9)	48.6 (40.4-56.9)	24.7 (17.0-34.6)	36.8 (23.0-53.3)	<0.001*	436	32.5 (27.7-37.6)	32.0 (23.4-41.9)	0.928	431	23.5 (16.6-32.1)	28.9 (21.8-37.1)	39.0 (28.7-50.3)	42.3 (33.1-52.0)	0.011
Sport wheelchair	421	10.6 (6.7-16.5)	28.2 (21.2-36.6)	13.0 (7.5-21.7)	15.8 (7.2-31.3)	0.001	421	19.0 (15.1-23.6)	8.9 (4.5-16.9)	0.023	416	9.0 (4.9-16.0)	17.7 (12.1-25.3)	18.7 (11.3-29.2)	23.0 (15.7-32.3)	0.050
Handbike	421	12.7 (8.3-18.9)	44.0 (35.8-52.6)	17.4 (10.9-26.6)	32.4 (19.3-49.1)	<0.001*	421	28.3 (23.6-33.4)	15.2 (9.2-24.2)	0.011	416	16.4 (10.5-24.6)	24.2 (17.7-32.3)	29.2 (19.8-40.8)	31.4 (23.1-41.1)	0.062
Arm brace	416	3.8 (1.7-8.3)	2.3 (0.7-6.9)	7.7 (3.7-15.4)	15.8 (7.2-31.3)	0.006	416	5.5 (3.5-8.6)	4.4 (1.7-11.3)	0.686	411	5.5 (2.5-11.7)	5.4 (2.6-10.9)	1.4 (0.2-9.2)	8.2 (4.1-15.6)	0.282
Leg brace	425	19.3 (13.9-26.1)	8.2 (4.6-14.3)	8.2 (6.7-20.4)	2.6 (0.4-16.9)	0.007	425	12.3 (9.2-16.3)	14.3 (8.4-23.2)	0.610	420	17.0 (11.1-25.1)	13.7 (8.8-20.8)	9.3 (4.5-18.4)	8.8 (4.6-16.2)	0.247
Adapted vehicle within family	477	64.7 (57.5-71.3)	92.5 (86.9-95.8)	76.5 (67.2-83.7)	93.3 (81.0-97.9)	<0.001*	476	80.1 (75.6-83.8)	70.9 (61.7-78.7)	0.043	469	70.2 (61.5-77.4)	73.6 (65.6-80.2)	81.8 (72.3-88.6)	88.6 (81.3-93.3)	0.002

CI: 95% confidence interval.
P-values are derived from χ^2 tests.
*Significant at the level of $P \leq 0.0009$.
(using the Bonferroni method to correct for 55 comparisons with a global significance level of $p \leq 0.05$ for Tables 2a and 2b).

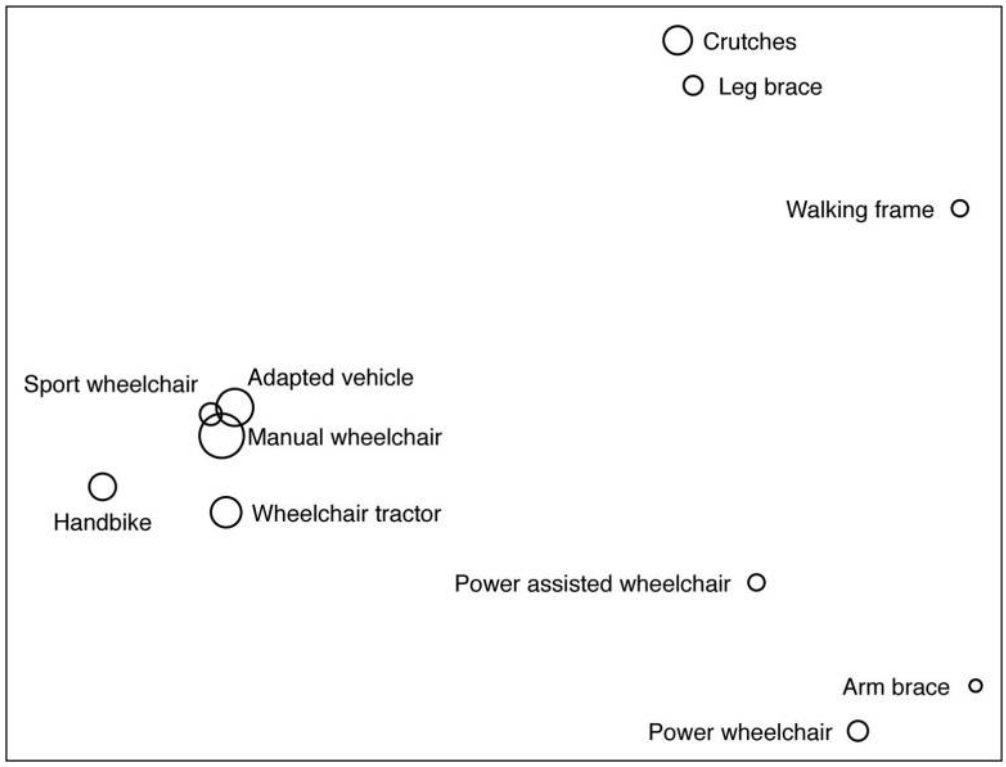

Figure 1 Mobility device combinations. The size of the bubble is proportional to the total number of participants who have the device. Devices in close proximity to each other indicate a high proportion of individuals jointly using those respective devices.

in the older age groups to only 4% of people 76+ having one or the other device. The possession of many of the devices was dependent on lesion level and completeness, e.g. 50.0% of those with complete tetraplegia had a power wheelchair compared to 17.6% of those with incomplete tetraplegia, 7.6% of those with complete paraplegia and 7.6% of those with incomplete paraplegia. Individuals with non-traumatic SCI had higher proportions of having crutches (42.7%) and walking frames (22.6%) compared to participants with traumatic SCI with only 24.1% and 5.5%, respectively. The proportion of individuals with a manual wheelchair showed an increasing trend with time since injury, with 60.5% in the 0–5 years group and 89.9% in the 26 years or older group. Of the 377 participants who answered questions on all 11 mobility devices, 40 (10.6%) had no device, 115 (30.5%) had 1–2 devices, 168 (44.6%) had 3–4 devices, and 54 (14.3%) had 5 or more devices. The median number of devices was 3 (interquartile range: 2 to 4). The most frequent combinations of two devices were: manual wheelchair/adapted vehicle (n = 224; 59.4%), manual wheelchair/wheelchair tractor (n = 111; 29.4%), wheelchair tractor/adapted vehicle (n = 104; 27.6%), manual wheelchair/handbike (n = 95; 25.2%), and handbike/adapted vehicle (n = 92; 24.4%).

Combinations of mobility devices that individuals were provided with are shown in Figure 1. A cluster of devices individuals often had together included an adapted vehicle, a manual wheelchair, and a sport wheelchair. The handbike and the wheelchair tractor were in close proximity to this cluster. Another group of devices concomitantly owned by the same participants included the power wheelchair, the power assisted wheelchair and arm braces. Leg braces, walking frames and crutches were also related in joint usage and less likely used in combination with the other devices.

Frequency of device use is reported in Table 3. Of the individuals that had a manual wheelchair, 83.8% used it on a daily basis. Sixty-one percent of participants used their crutches daily. The devices used for engaging in sports were most often used 1–6 times per week as 47.2% of sport wheelchair users and 40.2% of handbike users reported.

The highest proportions of participants with unmet need (in relation to the total need) were found for arm braces (53.2%), power assisted wheelchairs (47.3%) and sport wheelchairs (36.3%). The device ranked the lowest for unmet need was the manual wheelchair (4.8%) (Table 4). Of the 481 participants who answered the adapted vehicle question, 72 (15.0%) stated they did not need one. Of the remaining 409 participants who expressed a need for an adapted vehicle, 376 stated they have an adapted vehicle (i.e. 91.9% with met need); 12 (2.9%) stated they did not have one because they cannot

Table 3 Frequency of mobility device use

Personal mobility device	N[1]	Frequency of use			
		Daily n (%)	1–6 times a week n (%)	1–3 times a month n (%)	<1 time a month n (%)
Crutches	124	76 (61.3)	19 (15.3)	13 (10.5)	16 (12.9)
Walking frame	39	21 (53.8)	3 (7.7)	3 (7.7)	12 (30.8)
Manual wheelchair	320	268 (83.8)	9 (2.8)	12 (3.8)	31 (9.7)
Power wheelchair	60	30 (50.0)	15 (25.0)	3 (5.0)	12 (20.0)
Power assisted wheelchair	39	17 (43.6)	12 (30.8)	5 (12.8)	5 (12.8)
Wheelchair tractor	144	41 (28.5)	48 (33.3)	31 (21.5)	24 (16.7)
Sport wheelchair	72	9 (12.5)	34 (47.2)	20 (27.8)	9 (12.5)
Handbike	107	6 (5.6)	43 (40.2)	33 (30.8)	25 (23.4)
Arm brace	22	11 (50.0)	3 (13.6)	1 (4.6)	7 (31.8)
Leg brace	54	28 (51.9)	13 (24.1)	5 (9.3)	8 (14.8)

[1] Number of participants who have the respective device at their disposal.

Table 4 Unmet need for personal mobility devices

Personal mobility device	Total need[1] (met + unmet) N	Unmet need n (%)
Crutches	140	16 (11.4)
Walking frame	58	19 (32.8)
Manual wheelchair	336	16 (4.8)
Power wheelchair	83	23 (27.7)
Power assisted wheelchair	74	35 (47.3)
Wheelchair tractor	183	39 (21.3)
Sport wheelchair	113	41 (36.3)
Handbike	145	38 (26.2)
Arm brace	47	25 (53.2)
Leg brace	79	25 (31.6)

[1] Sum of participants who have the respective device at their disposal (i.e. "met need") and those who don't have the device at their disposal but state that they would need it (i.e. "unmet need").

afford it, and 21 (5.1%) stated they did not have one for other reasons (i.e. 8.1% with unmet need).

Discussion

This study showed that the adapted vehicle is the most available mobility device in individuals living with SCI in Switzerland, with the manual wheelchair being second ranked. The assistive mobility equipment individuals had was largely dependent on their age and SCI severity. Basic mobility devices, such as the manual wheelchair or crutches, were used daily by the majority of their owners, while devices for leisure activities, such as the sport wheelchair, or devices to cover longer distances, such as the wheelchair tractor, were used less frequently. Findings suggest that despite a low unmet need for basic devices such as manual wheelchairs or crutches, there is considerable unmet need for some supplementary devices such as power assisted wheelchairs.

Switzerland has a comprehensive system for the provision of assistive devices. In brief, financial coverage is ensured by a complex network of social insurances, including accident insurance, old age insurance, invalidity insurance, health insurance (mandatory for every Swiss resident), and military insurance (for members of the military).[13] Responsibility of the respective institution is regulated by federal law and determined by various factors such as etiology of SCI, age, profession and level of employment.[14] Cost coverage includes teaching proper use of a device, and repair and replacement of damaged devices. For individuals who have not reached retirement age (men 65 years, women 64 years), devices that are needed for maintaining or improving earning capacity, for attending school or further professional training are usually covered by invalidity insurance. Depending on the cost of the device, they are either provided temporarily or permanently; used devices are recycled and redistributed by specialized depots. Health insurers cover the costs of basic devices,[15] if none of the other institutions are paying. All institutions provide devices according to the principle that the device has to be "appropriate" and "economical". This often means that part of the costs of elaborate devices or devices that are primarily designed for leisure activities (such as sport wheelchairs) have to be paid by the users.

For some supplementary devices such as the handbike, the Swiss Paraplegic Foundation offers personalized financial support.[16]

Nearly 80% of study participants had an adapted vehicle at the time of data collection, with the highest proportions among those with complete lesions (complete paraplegia: 93%; complete tetraplegia: 93%). Similar to our results, a Danish survey of individuals with SCI found that 85% had their own car.[9] An older Dutch study (published in 1997) showed that 51% of individuals with SCI had an adapted vehicle.[17] A survey of SCI patients treated by the Southeastern Michigan Spinal Cord Injury System (published in 1989) showed at that time only 27% of participants had their own car or van.[18] The high provision of adapted vehicles in our study may reflect their high importance for community integration and employment.[19] Though it may also reflect limited availability of appropriate public transportation services.

We found a lower proportion of individuals with a manual wheelchair (70%) than previous surveys of individuals with SCI in the Netherlands (82%)[17] and in Denmark (84%).[9] The reason for the lower proportion in our study is unknown. Besides differences in participant recruitment and characteristics, changes in prescription practices might play a role as both the Dutch and the Danish study were published more than 10 years ago. An Australian study on prescription of mobility and self-care devices to individuals with SCI between injury and discharge from the rehabilitation hospital showed that manual wheelchairs and pressure-relieving cushion for the wheelchair were the two most commonly prescribed devices.[7]

In line with earlier studies,[9,17] the use of mobility devices was largely dependent on SCI severity. Manual wheelchairs were primarily used by individuals with complete paraplegia, whereas power wheelchairs were mainly used by individuals with complete tetraplegia. Those with an incomplete lesion predominantly used crutches, walking frames, and leg braces. As reported (and discussed) previously, handbikes were predominantly used by individuals with complete paraplegia.[20] Older age was an indicator for lower rates of having sportive devices such as the handbike and the sport wheelchair. This is in line with previous reports on decreasing sports participation with increasing age not only in people with SCI.[21] We found higher proportions of older individuals having walking frames than their younger counterparts. This is probably because SCIs of older adults tend to have a non-traumatic etiology and to be incomplete rather than complete.[22] In consequence, older adults are more likely to be able to walk than their younger counterparts.

The device with the highest percentage of people using it daily was the manual wheelchair (84%), which can be seen in other research as well.[23] This highlights the necessity of proper wheelchair skills training, optimal adjustment and regular maintenance. However, education on the proper use and skill practice often remain limited, and the resulting deficits in wheelchair skills can lead to reduced community mobility.[23] Studies have also found frequent device use with certain equipment that has not been sized adequately, or been poorly maintained or not used properly, can lead to 30–50% of individuals not continuing the use of their device.[24-27] Besides changes in physical capacity or environmental factors, this might contribute to proportions of participants using devices less than once a month while others use them daily (e.g. walking frames daily used by 54% and less than once per month by 30%).

Our study revealed low unmet need for basic mobility devices such as manual wheelchairs (5%) and crutches (11%). On the other hand there were high unmet needs for wheelchair tractors (21%), sport wheelchairs (36%), and handbikes (26%). These could all be considered as supplementary devices, which are not absolutely necessary to perform basic mobility tasks such as moving around indoors or short distances. Healthcare professionals might therefore not focus on these devices when making their prescriptions, especially not during the primary rehabilitation after the SCI. Furthermore, despite the known health benefits of regular leisure time activity,[28,29] these devices are less likely to be covered by third party payers than the more basic devices (see above). A study in the US of cases where requests for assistive devices (deemed necessary by health professionals) were denied to SCI patients by third party payers, found that the two most common reasons given for denials were: not being covered by the insurance policy (38%) and not being medically necessary (30%).[8] An earlier analysis of barriers for handbike use in the Swiss SCI population revealed that for 14.3% of those without a handbike it was considered too expensive.[20] We also found a very high unmet need for the power assisted wheelchairs (47%). This is a relatively new and (still) relatively costly device. Proportions of individuals having this device may increase within the upcoming years, as not only individuals with tetraplegia, but also individuals with paraplegia and limited upper body strength (e.g. older adults) might profit. We do not have a plausible explanation for the high unmet need for arm braces (53%) in our sample; compared to the other devices this is a

rather low priced device. The unmet need for adapted vehicles among our participants seemed to be rather low (8%); only 2.9% of those in need stated that they could not afford it. This might reflect the efforts spent to offer widespread, sponsored vehicle adaptations to people with SCI in Switzerland.[30] In general, data on access to assistive mobility equipment among individuals with SCI are scarce, which makes international comparisons difficult. One of the few existing studies was conducted in the United States.[31] The nationwide survey of people with cerebral palsy, multiple sclerosis or spinal cord injury found that over half of the respondents needed to obtain or replace assistive equipment in the past 12 months. Nearly one third of those who reported a need did not obtain the equipment every time it was needed.

Strengths and limitations

Limitations include that the study completely relied on self-report and thereby focuses on the lived experience of people with SCI. There might be a gap between the individual's and the provider's or payer's view on which devices are needed or indicated. Definitions of the different mobility devices were wide and encompassed a multitude of products without further specification. Measures of severity of injury and frequency of device use were crude. The study did not collect information on who had provided the device and covered the costs, on when the device had been provided, on how often device need had been re-assessed by providers, or on permanency of provision. The study used a cross-sectional design, therefore individual changes over time are not reflected, and effects of age and time since injury might also be cohort effects. To investigate changes in device use with age and time since injury longitudinal studies would be needed.

Conclusions

The present study is the first to deliver data on the use and perceived need of mobility devices by people with SCI in Switzerland by analyzing a large nationwide sample. Presented data will serve as a reference base for future studies. The majority of individuals had a mobility device of some sort. The devices individuals were provided were largely dependent on their age and SCI severity. Although it appears the majority of individuals had access to basic mobility devices, there are still individuals who perceive unmet needs. Further research on reasons and consequences of unmet need and into identifying how access to assistive devices can be improved is necessary for optimizing mobility in individuals with SCI.

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Disclaimer statements

Contributors All authors contributed to conception and design of the present study. JF performed the statistical analyses. All authors interpreted the data. JF and TH drafted the manuscript. All authors critically revised the manuscript and gave final approval of the version to be published.

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Ethics approval SwiSCI was approved by the ethics committee of the Canton of Lucerne (the location of the main study center) and subsequently endorsed by the ethics committees of the Cantons Zürich, Basel-Stadt and Valais.

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