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RESEARCH PAPER

Determinants of handbike use in persons with spinal cord injury: results of a community survey in Switzerland

Ursina Arnet[1,2], Timo Hinrichs[1,2], Veronika Lay[1], Sue Bertschy[1,2], Heinz Frei[3], and Martin W. G. Brinkhof[1,2] for the SwiSCI study group

[1]*Swiss Paraplegic Research, Nottwil, Switzerland,* [2]*Department of Health Sciences and Health Policy, University of Lucerne, Lucerne, Switzerland, and* [3]*Swiss Paraplegic Association, Nottwil, Switzerland*

Abstract

Purpose: To examine the prevalence and determinants of handbike use in persons living with spinal cord injury in Switzerland. *Method*: A population-based cross-sectional survey in Switzerland. *Results*: The crude prevalence of handbike use among the 1549 participants was 22.6%, varying between 25.3% in men and 17.7% in women. Prevalence was higher in complete than in incomplete spinal cord injury (SCI) (41.5% versus 11.9% in paraplegia, 25.6% versus 11.1% in tetraplegia). Multivariable analysis of handbike use confirmed differences with lesion characteristics and gender and showed a decline with age, lowest rates in the low-income group, variation with language, but no association with level of education or cause of spinal cord injury. In total, 45.8% of users reported to engage in handcycling at least once a week. Frequent contextual reasons for refraining from handcycling were: no interest (26%); inability due to disability (20%); unfamiliarity with the handbike (19%) and financial constraints (14%). *Conclusions*: Conditional on the major determinants that include demographic factors and lesion characteristics, main barriers involve contextual factors that can principally be overcome. Our findings thus suggest scope for promoting handcycling as a means towards a healthy and more physically active lifestyle in persons living with SCI.

Keywords

Hand cycle, hand bike, mobility, physical fitness, spinal cord injury

History

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➤ Implications for Rehabilitation

- Handcycling is an effective means of improving health and quality of life of persons with a spinal cord injury.
- Persons with the following traits are most likely to use the handbike: persons younger than 62 years, with a complete paraplegia, who are German-speaking (vs. French/Italian) and having a middle or high net income.
- Indicated reasons for not using a handbike varied by SCI characteristics and included disinterest, inability related to the level of impairment, unfamiliarity and financial costs.
- Barriers that involve the above mentioned contextual factors can principally be overcome by targeted policy or information campaigns.

Introduction

Use of the handbike facilitates persons with spinal cord injury (SCI) to engage in a healthy and more physically active lifestyle, which may in turn increase participation, social integration and quality of life [1]. Compared with the manual handrim wheelchair, the handbike is a more efficient device for outdoor mobility, sports and exercise [2], allowing people with limited physical capacity to propel over longer distances and for a longer duration without experiencing excessive fatigue or discomfort [3]. The use of the handbike is also less straining to the shoulder joint than the use of a manual handrim wheelchair [4] and might prevent the occurrence of shoulder pain. In persons with spinal cord injury (SCI), regular handbike training may result in significant gains and improvements in arm strength [5] as well as handcycling and handrim wheelchair capacity [6]. Routine upper extremity exercise may thus foster overall fitness and lower the risk of secondary health conditions, such as cardiovascular disease [7], pressure ulcers [8], obesity [9] and type 2 diabetes [10]. High levels of physical activity have further been associated with less pain, fatigue and depression in persons living with SCI [11].

To effectively promote handcycling as a means to increase physical activity, overall health and wellbeing in the SCI community, detailed information regarding patient traits as well as contextual facilitators and barriers that influence handbike-use are needed. Relevant patient traits may particularly include demographic and socioeconomic factors as well as lesion characteristics that determine physical capacity. Potential barriers may include lack of knowledge, physical constraints, time constraints, unsuitable environment or financial costs. Available

Address for correspondence: Ursina Arnet, Swiss Paraplegic Research, Guido A. Zächstrasse 4, 6207 Nottwil, Switzerland. Tel: +41 41 939 65 99. E-mail: ursina.arnet@paraplegie.ch

evidence from two population-based studies indicates that there is potential to increase handbike use in SCI. Biering-Sorensen et al. found that only 7.2% of persons with a chronic, traumatic SCI (10–45 years after injury) used a handbike in East Denmark, with highest usage among younger persons [12]. A multicenter cohort study among predominantly wheelchair bound persons with SCI in the Netherlands reported that 64% of the SCI patients got acquainted with handcycling during rehabilitation, whereas 1 year after rehabilitation, handbike use had decreased to 29% [13]. Persons who used the handbike were younger, had lower walking ability and all had a lesion level below C4.

The aim of this study was to examine the prevalence and determinants of handbike use in Switzerland. Specifically, we evaluated: (1) the rate of handbike users, (2) the association between demographic and socioeconomic factors as well as lesions characteristics and handbike use, and (3) barriers for handcycling among non-users.

Methods

Study design and sample

Data used for this study originate from a community survey as part of the Swiss Spinal Cord Injury (SwiSCI) cohort study. SwiSCI is a population-based cohort study that includes persons who are 16 years or older, diagnosed with traumatic or non-traumatic SCI and permanently residing in Switzerland. People with congenital conditions leading to SCI, with new SCI in the context of palliative care, with neurodegenerative disorders or Guillain-Barré syndrome were excluded. Details on the overall study design and recruitment procedures have been reported elsewhere [14]. The SwiSCI study was formally approved by the leading ethics committee of the Canton of Lucerne (the location of the main study center, ethics registration number 11042) and subsequently endorsed by the ethics committees of the Cantons Zürich, Basel-Stadt and Valais, who are liable for the other three participating rehabilitation centers.

The community survey had a modular structure [14] and was conducted between late 2011 and early 2013. Subjects could complete the survey by paper- or web-based questionnaire or by telephone interview. The basic questionnaire, which contained the identifying question regarding handbike use, was answered by 1549 out of all 3144 eligible subjects, implying an overall response rate of 49.3%. Information regarding the frequency of handbike use was collected in a random sample of 492 subjects, who completed a further module with questions on the provision of health services (HSR module). To obtain more detailed information regarding lesion characteristics than available through the self-report in the survey, we obtained medical record data that were available for a total 297 survey participants whose SCI occurred between 1 January 2005 and 31 December 2009.

Variables

All variables were assessed by self-report. Subjects were classified into ''handbike users'' and ''non-users'' by asking the question ''Are you using a handbike?'' Education was measured as total years of formal education and grouped into four categories: ''compulsory schooling'' ($\leq$9 years), ''vocational training'' (10–12 years), ''secondary education'' (13–16 years) and ''university education'' ($\geq$17 years) [15]. Net equivalent household income was calculated based on the self-report of disposable income, household size and number of adults and children [16]. We grouped net equivalent household income into categories ''low'' (<3500 CHF), ''middle'' (3500–4643 CHF) and ''high'' (>4643 CHF), based on raw data tertiles. Lesion characteristics were classified into ''paraplegia, incomplete'', ''paraplegia, complete'', ''tetraplegia, incomplete'' and ''tetraplegia, complete''. SCI cause was grouped into ''traumatic'' and ''non-traumatic''. The non-users were asked for the reasons for not using a handbike. Six answers were pre-defined (multiple answers possible) and individual reasons could be given under ''other'' (free text).

For subjects who participated in the SwiSCI medical record study, we included detailed information on lesion characteristics, the score of the ASIA impairments scale (AIS) and lesion level as predictor variables. Lesion level was grouped according to the sports classes of the Union Cycliste Internationale (UCI) into ''H1'' (C6 or above), ''H2'' (C7-Th3), ''H3'' (Th4-Th10) and ''H4'' and ''H5'' (Th11 or below). Subjects who included in the HSR module were asked about how many times they use their handbike, provided that they have a handbike. Answers were categorized into ''less than once a month'', ''1–3 times per month'', ''1–6 times per week'' and ''daily''.

Statistical analysis

Statistical analyses were performed with STATA version 13 (StataCorp LP, College Station, TX). Descriptive statistics are presented on the complete case data and comprise totals and percentages for categorical variables, and medians and interquartile ranges for continuous variables. Multivariable logistic regression analysis on the binary outcome ''handbike use'' was used to evaluate associations with selected predictor variables, testing significance using likelihood ration test. Categorical variables included gender, education, income, language, lesion characteristic and SCI cause and results are reported as odds ratios (ORs) with 95% confidence intervals (CIs). For the continuous variables age and time since injury, we allowed flexible modelling through the use of fractional polynomials by the Stata command *mfp* [17].

We also produced a classification tree using the R-package ''rpart'' (R 3.1.0), aiming to derive at the tree of best size with the lowest misclassification rate for an individual not included in the original data. Classification trees are a non-parametric method to recursively partition the data (categorical or continuous) into more ''pure'' nodes, based on splitting rules [18]. First, the single variable is found which best splits the data into two groups (using the Gini index), then this process is applied separately to each sub-group recursively. Afterwards the tree is cut back (''pruned'') using cross-validation.

To account for potential bias due to unit non-response (i.e. non-participation of eligible subjects), we used inverse probability weights as sampling weights in regression analysis [19,20]. The sampling weights were derived from a propensity score analysis on the non-response, which was associated to membership of the Swiss Paraplegic Association and time since injury, but not related to age, gender, lesion characteristics and language (unpublished data, MB). The mean-standardized sampling weights ranged from 0.5 to 3.2, indicating minor non-response bias. To account for potential bias due to item non-response (i.e. incomplete response of participants) we imputed missing values with the function ''missForest'' of the R-package that uses a robust permutation algorithm [21]. We present results of regression analyses that account for unit non-response and item non-response as main results. The results of the classification tree do account for item non-response. Complete case analysis (that does not account for either form of non-response bias) was also performed as sensitivity analysis, and there were no conflicting results. The analysis and reporting was done according to the guidelines of ISCOS [22] and STROBE [23].

Table 1. Patient characteristics and demographics (unimputed dataset): overall, stratified by handbike use and percentage of handbike use within each category.

	Overall ($N = 1549$) N (%)	Handbike user ($N = 350$) n (%)	Non-user ($N = 1165$) n (%)	Handbike use within category[a]	
				Unadjusted (%)	Weighted (%)
Gender					
Male	1107 (71.5)	273 (78.0)	808 (69.4)	25.3	23.7
Female	442 (28.5)	77 (22.0)	357 (30.6)	17.7	16.4
Age (years)					
Median (IQR)	52 (42–63)	46 (39–56)	54 (43–65)		
16–30	129 (8.3)	35 (10.0)	92 (7.9)	27.6	27.5
31–45	377 (24.3)	126 (36.0)	244 (20.9)	34.1	32.6
46–60	571 (36.9)	140 (40.0)	422 (36.2)	24.9	23.9
61–75	378 (24.4)	47 (13.4)	320 (27.5)	12.8	11.5
≥76	94 (6.1)	2 (0.6)	87 (7.5)	2.3	2.4
Level of education					
Median (IQR) of years	13 (12–15)	13 (12–16)	13 (12–15)		
Compulsory	143 (9.2)	18 (5.2)	119 (10.2)	13.1	11.9
Vocational	377 (24.3)	71 (20.3)	300 (25.8)	19.1	17.8
Secondary	721 (46.6)	181 (51.7)	527 (45.2)	25.6	23.9
University	276 (17.8)	76 (21.7)	194 (16.7)	28.2	26.7
Missing	32 (2.1)	4 (1.1)	25 (2.1)	13.8	13.2
Net equivalent household income (tertiles)					
Low	584 (37.7)	99 (28.3)	480 (41.2)	17.1	16.1
Middle	338 (21.8)	105 (30.0)	231 (19.8)	31.3	29.0
High	459 (29.6)	117 (33.4)	339 (29.1)	25.7	24.2
Missing	168 (10.9)	29 (8.3)	115 (9.9)	20.1	18.1
Language					
German	1088 (70.3)	287 (82.0)	778 (66.8)	27.0	25.2
French	391 (25.2)	51 (14.6)	332 (28.5)	13.3	12.3
Italian	70 (4.5)	12 (3.4)	55 (4.7)	17.9	17.5
Lesion characteristics					
Paraplegia, incomplete	577 (37.2)	72 (20.6)	489 (42.0)	12.8	11.9
Paraplegia, complete	486 (31.4)	203 (58.0)	276 (23.7)	42.4	41.5
Tetraplegia, incomplete	314 (20.3)	36 (10.3)	271 (23.3)	11.7	11.1
Tetraplegia, complete	160 (10.3)	39 (11.1)	117 (10.0)	25.0	25.6
Missing	12 (0.8)	0 (0.0)	12 (1.0)	0.0	0.0
Time since injury (years)					
Median (IQR)	13 (6–25)	19 (9–27)	12 (5–24)		
<1	23 (1.5)	4 (1.2)	19 (1.6)	17.4	16.9
1–5	340 (21.9)	40 (11.4)	292 (25.1)	12.1	10.9
6–10	258 (16.7)	59 (16.9)	193 (16.6)	23.4	20.4
11–15	215 (13.9)	48 (13.7)	163 (14.0)	22.8	20.3
16–20	165 (10.7)	46 (13.1)	112 (9.6)	29.1	27.8
21–25	160 (10.3)	50 (14.3)	107 (9.2)	31.9	30.1
26–30	124 (8.0)	35 (10.0)	87 (7.5)	28.7	27.1
31–35	90 (5.8)	28 (8.0)	61 (5.2)	31.5	29.4
≥36	147 (9.5)	34 (9.7)	110 (9.4)	23.6	23.1
Missing	27 (1.7)	6 (1.7)	21 (1.8)	1.7	21.8
Cause of injury					
Traumatic	1202 (77.6)	311 (88.9)	865 (74.2)	26.5	24.8
Non-traumatic	332 (21.4)	39 (11.1)	285 (24.5)	12.0	11.6
Missing	15 (1.0)	0 (0.0)	15 (1.3)	0.0	0.0

[a]Unadjusted: raw data; adjusted: propensity scores were used as weights to adjust for 367 potential bias due to unit non-response.

Results

Out of 1549 survey participants, 22.6% (350 subjects) were classified as handbike users. A further 2.2% (34 subjects) failed to indicate handbike use. Participants' characteristics are shown in Table 1 for all participants and stratified by handbike use.

Adjusted for unit response, we found that 23.7% of men and 16.4% of women were using the handbike. The highest, crude percentage of handbike use was found in persons from the age category of 34–45 years, with the highest education level (university), with a middle income and German as the primary language. Regarding injury characteristics, the percentage handbike use was highest in persons with complete paraplegia, a traumatic cause of the injury and a time since injury ranging 21–25 years. These uni-variable findings were confirmed in the multivariable logistic regression analysis (Table 2). The adjusted odds for handbike use were 45% higher in males than females, higher in the middle-income and high-income groups than in the low-income group, 2.6 times higher in German-speaking than in French- or Italian-speaking participants, and particularly high in complete SCI as compared with incomplete SCI. Handbike use further showed an accelerating decline with increasing age and a levelling-off increase with increasing time since injury (Figure 1).

The generated classification tree is displayed in Figure 2. The variable with the highest discriminative power was age (≥62 years) followed by the SCI characteristics incomplete paraplegia and incomplete/complete tetraplegia subsequently.

The reasons for not using a handbike (Table 3) are stratified for these categories. Over all, the most frequent reasons for refraining from handcycling were no interest, bodily constraints, unfamiliarity with the handbike and financial constraints.

Sub-group analysis of handbike use among participants with detailed information on lesion characteristics taken from their medical records ($n = 297$) showed most frequent usage in persons with AIS A, implying a complete lesion. With reference to the UCI sports classes, persons in the H1 or H3 class, with a combined lesion level range from the seventh cervical vertebra (C7) to the 10th thoracic vertebra (TH10), showed the highest percentage of handbike use (Table 4).

In the subgroup of 425 participants who answered the HSR module, 23.4% of the 107 handbike users indicated to handcycle less than once a month, 30.8% were cycling 1–3 times per month, 40.2% were cycling 1–6 times per week and 5.6% were using their handbike daily.

Table 2. Logistic regression modelling of handbike use ($N = 1549$).

Variable	Multivariable Odds ratio (95% CI)	*p* Value*
Gender		0.024
Male	1	
Female	0.69 (0.50–0.95)	
Age (linear)		<0.001
Per year	0.96 (0.95–0.97)	
Level of education		0.528
Compulsory	1	
Vocational	0.90 (0.49–1.67)	
Secondary	1.04 (0.58–1.86)	
University	1.24 (0.65–2.37)	
Net equivalent household income (tertiles)		0.005
Low	1	
Middle	1.79 (1.26–2.53)	
High	1.38 (1.00–1.92)	
Language		<0.001
German	1	
French/Italian	0.39 (0.28–0.54)	
Lesion characteristics		<0.001
Paraplegia, incomplete	1	
Paraplegia, complete	4.44 (3.16–6.25)	
Tetraplegia, incomplete	0.81 (0.51–1.28)	
Tetraplegia, complete	1.76 (1.11–2.78)	
Time since injury (TSI)		<0.001
Unit of change: ln(TSI/10)-0.52[a]	1.52 (1.28–1.80)	
SCI cause		0.557
Traumatic	1	
Non-traumatic	0.88 (0.58–1.34)	

[a]Transformation yielding the best fitting fractional polynomial function, centered to the mean.
*p Value from likelihood ratio test.

Discussion

This cross-sectional survey found that the overall prevalence of handbike use in the Swiss SCI community was close to 25%, which is comparable with that in other European countries [12,13]. Main determinants of handbike use, ordered by their discriminate potential, included current age, lesion characteristics and other socio-demographic characteristics, including language and socio-economic group. We estimated the highest probability of handbike use at 65% among persons <62 years of age, with complete paraplegia, who are German-speaking (versus French/Italian) and having a middle or high net income. Indicated reasons for not using a handbike varied by SCI characteristics and included disinterest, inability related to the level of impairment, unfamiliarity and financial costs. Summarizing, our study suggests two principal determinants for handbike use in the Swiss SCI population: (1) disparity in bodily capacity, related to age and SCI-characteristics and (2) variation in apparent contextual factors as facilitator or restraint for utilization. These factors need careful consideration in the design of health promotion strategies that aim at increasing handbike use among persons living with SCI.

To appraise the potential of handbike promotion, it is important to evaluate to what extent variation in current usage relates to actual variation in bodily capacity rather than subjectively perceived restraints that may be overcome. Such campaigns, for instance, need to emphasize that the handbike can be equipped with an electric assistance, which reduces the physical demand and increases accessibility of handcycling to persons with lower bodily capacity. The classification tree indicated age and SCI characteristics as the major discriminative person traits. Physical strength obviously declines with age and may thus explain the age-related decline in handbike use in this as well as previous studies [12,13]. Higher ability to walk and lesser dependency on the wheelchair most likely explained why persons with an incomplete lesion showed lowest rates of handbike use [13], whereas more than half of the persons with a complete tetraplegia indicated not being able to use the handbike due to their disability.

Accepting that variation in bodily capacity is the predominant factor for differences in handbike use, our study also provided evidence that usage is restraint by contextual factors. Identifying such restraining factors is important as they may principally be overcome by targeted promotion campaigns. Barriers to handbike use as indicated by participants in this study include financial

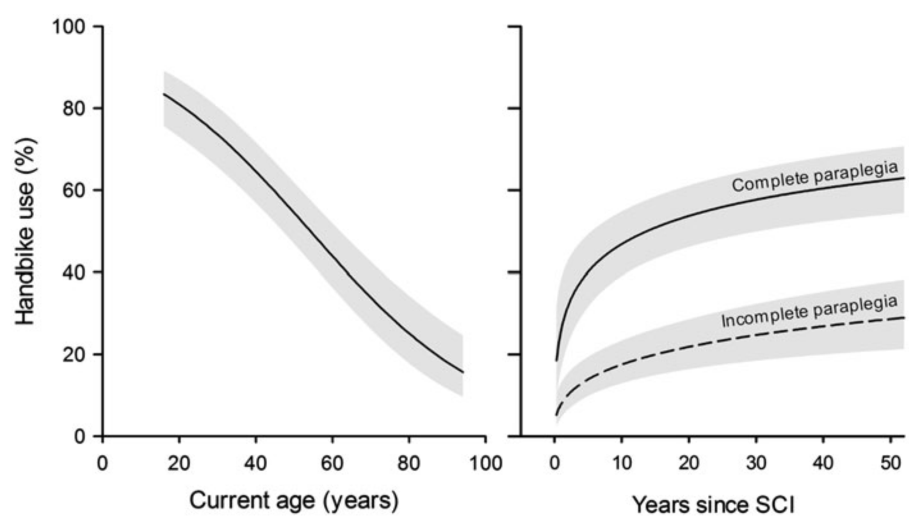

Figure 1. Handbike use in relation to age (left) and time since injury (right) for selected groups. Lines with grey areas reflect estimates with 95% confidence interval as derived using estimates from the model in Table 2 for the most frequent person characteristics within the handbike user population (Table 1), at the overall mean time since injury (16.7 years) in left panel, and the overall mean age (52.3 years) in right panel.

costs, lack of knowledge and lack of interest. In addition, we found regional (language-associated) differences in usage. The financial costs associated with the purchase of a handbike in Switzerland is between 5000 and 12 000 Swiss francs, which substantially exceeds the minimal net income of about 3500 Swiss francs or less. Our data suggest that financial costs are less an obstacle for persons with a middle- or high-income, and following that promotion campaigns should particularly aim at removing barriers for the lowest income group. This can be achieved through direct financial support as to facilitate the purchase of a personal handbike or alternatively through establish a bike sharing system. Such personalized financial support is already provided through the Swiss Paraplegic Foundation, but this option might need better advertisement, particularly in the low-income group. Future studies should also aim at establishing the cost-effectiveness of handbike use as to encourage other organizations, such as for instance, health insurance companies, to engage in subsidizing the personal purchase.

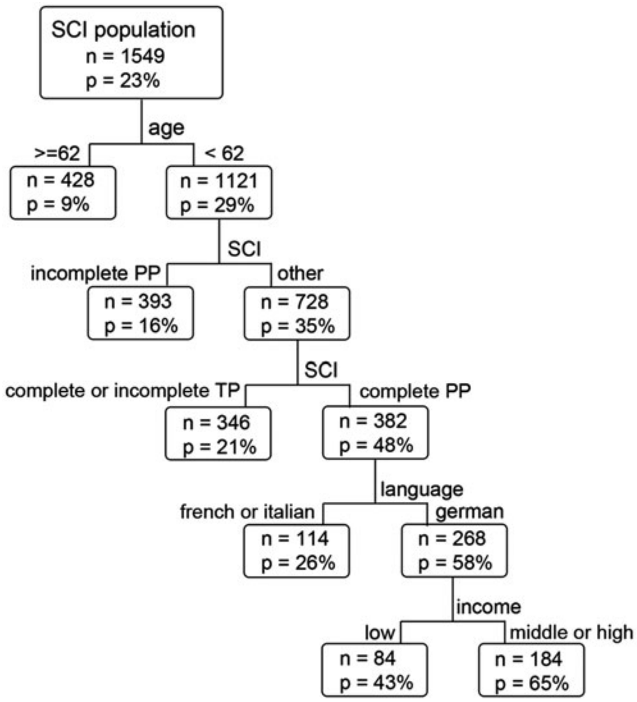

Figure 2. Classification tree model for predicting handbike use in the SCI population. The number of persons (*n*) and the probability of handbike use (*p* value) are given inside each node, with lowest probability characteristics on the left side.

Other self-reported barriers as well as the existence of regional differences in handbike use may be overcome through targeted information policies. The perseverant lack of knowledge or interest regarding handbike use, among the older population and persons with an incomplete injury in particular, may be reduced by the targeted and persistent advertisement of the associated health benefits, also gains in mobility and quality of life. Regional differences in handbike use, as indicated by the variation with the main language (German, French or Italian) of participants, corresponds with recent findings in the general population where physical activity levels were higher in persons from the German-speaking part of Switzerland compared with persons from the French- or Italian-speaking part [24]. Such regional differences might be consolidated in handbiking rates, because persons living with SCI in the French- or Italian-speaking part of Switzerland are less familiar with the Swiss Paraplegic Foundation and its opportunities of financial support.

Promotion and education on the benefits of handcycling should also target established users, of whom approximately, a quarter reports to handcycle less than once per month. To anticipate meaningful health gains, more regular and frequent hand cycling (once a week or more) is required as shown with respect to aerobic physical capacity in persons with paraplegia [6]. To achieve and sustain an adequate routine and frequency of handcycling, the active membership of one of the existing wheelchair clubs may be beneficial and should be promoted.

This is the first epidemiologic study on handcycling. It is an up-to-date study that represents handbike use in Switzerland very well because a substantial portion of persons with SCI is included and there is little bias due to non-response (unpublished data, MB). Self-report might be a limitation of the study as it can be subject to recall or social desirability bias (e.g. concerning the

Table 3. Barriers for handbike use: subgroup analysis of non-users ($N = 1166$), overall and stratified by gender and lesion characteristics (multiple answers possible).

	overall	Percent within age groups		Percent within SCI characteristic			
Reason	*N* (%)	<62 years *N* = 790	≥62 years *N* = 375	PC *N* = 276	PI *N* = 489	TC *N* = 117	TI *N* = 271
No interest	298 (25.6)	27.0	22.7	32.9	23.9	17.1	23.6
Cannot use the handbike due to disability	229 (19.7)	18.6	21.9	14.5	8.2	56.4	30.3
I do not know the handbike	219 (18.8)	13.8	29.3	12.0	25.4	4.3	20.3
Too expensive	166 (14.3)	17.5	7.5	25.0	11.3	10.3	10.3
Living environment not suitable	133 (11.4)	11.8	10.7	18.8	9.2	13.7	7.4
Get no support (for transfer or attachment of the handbike to the wheelchair)	57 (4.9)	5.3	4.0	9.1	1.6	7.7	5.5
Other[a]							
No need, e.g. due to walking ability	129 (11.0)	12.4	8.3	0.7	17.4	0.9	15.1
Pain in back or upper extremity	20 (1.7)	1.7	1.9	3.6	2.0	0.0	0.0
No time	13 (1.1)	1.7	0.0	1.8	0.6	1.7	1.1
I will soon get a handbike	12 (1.0)	1.5	0.0	1.1	0.6	1.7	1.5
Performing other sports	11 (0.9)	1.3	0.3	1.1	1.0	0.9	0.7
Use of a Swiss-track for outdoor mobility	11 (0.9)	0.6	1.6	1.5	1.0	0.0	0.7
Various	30 (2.6)	2.5	2.7	3.6	2.7	2.6	1.5
Missing (no reason given)	69 (5.9)	5.3	7.2	4.4	8.0	6.8	3.3

PC, paraplegia, complete; PI, paraplegia, incomplete; TC, tetraplegia, complete; TI, tetraplegia, incomplete.
[a]Listed as further reasons (free text field).

Table 4. Distribution of lesion characteristics and frequency of handbike use among subgroups of persons for which detailed medical record data were available.

	Overall (N = 297) n (%)	Handbike user (N = 45[a]) n (%)	Non-user (N = 242[a]) n (%)	Handbike use per category[a] Percent
AIS				
A	80 (26.9)	31 (68.9)	47 (19.4)	39.7
B	28 (9.4)	5 (11.1)	21 (8.7)	19.2
C	52 (17.5)	7 (15.6)	45 (18.6)	13.5
D	128 (43.1)	2 (4.4)	121 (50.0)	1.6
E	4 (1.4)	0 (0.0)	4 (1.7)	0.0
Unknown	5 (1.7)	0 (0.0)	4 (1.7)	0.0
UCI sports classes				
H1 (C6 or above)	77 (25.9)	9 (20.0)	65 (26.9)	12.2
H2 (C7-Th3)	27 (9.1)	8 (17.8)	18 (7.4)	30.8
H3 (Th4-Th10)	63 (21.2)	19 (42.2)	43 (17.8)	30.7
H4 and H5 (Th11 or below)	112 (37.7)	9 (20.0)	99 (40.9)	8.3
Unknown	18 (6.1)	0 (0.0)	17 (7.2)	0.0

AIS, AISA Impairment Scale; UCI, Union Cycliste Internationale.
[a]Ten participants (3.4% of all) with unknown status of handbike use are excluded.

frequency of handbike use). A further limitation is that there is no information on the type of handbike, and whether it is primarily used for sports, leisure or commuting. This is relevant information in the light of establishing targeted promotion campaigns.

Even though a substantial proportion of persons with SCI living in Switzerland already use the handbike, results of our study suggest that the proportion could even be increased. Conditional on the major determinants, that include demographic factors and lesion characteristics, main barriers involve contextual factors (financial costs, lack of knowledge and lack of interest) that can principally be overcome by targeted policy. Our findings thus suggest scope for promoting handcycling as a means towards a healthy and more physically active lifestyle in persons living with SCI.

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Declaration of interest

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