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Do people with spinal cord injury meet the WHO recommendations on physical activity?

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Abstract

Objectives To describe physical activity (PA) levels in persons with spinal cord injury (SCI) and to investigate associated factors.

Methods PA behavior of people with SCI in Switzerland was assessed in a community survey with four items from the Physical Activity Scale for individuals with physical disabilities (PA of light, moderate, and strenuous intensity and muscle-strengthening exercises). In addition to descriptive analyses, the odds of performing PA according to the WHO recommendations (at least 2.5 h/week of at least moderate intensity) were analyzed by multivariable logistic regression.

Results Participants ($n = 485$; aged 52.9 $\pm$ 14.8; 73.6 % male) carried out PA a total of 6.0 h/week (median). 18.6 % were physically inactive, 50.3 % carried out muscle-strengthening exercises, and 48.9 % fulfilled the WHO recommendations. Regression analyses showed that women, people aged 71+, and people with complete tetraplegia had significantly lower odds of fulfilling the WHO recommendations than participants in the respective reference category (men, ages 17–30, incomplete paraplegia).

Conclusions PA levels of people with SCI in Switzerland are rather high. However, some subgroups need special consideration when planning interventions to increase PA levels.

Keywords Spinal cord injury · Physical activity · Sport · Disability · Health behavior · WHO recommendations

The members of the SwiSCI study group are listed in the "Acknowledgments" section.

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Introduction

In general, regular physical activity (PA), usually understood as any bodily movement that increases energy expenditure above that of a resting level (ODPHP 2008), is an effective means to prevent the development of cardiovascular and other diseases (ODPHP 2008). The increased energy expenditure influences body composition and lipid metabolism positively and leads to reduced blood pressure and reduced systemic inflammation (Warburton et al. 2006). Persons affected by a spinal cord injury (SCI), however, have limited physical capacity due to the loss of muscle functions, which again reduces energy expenditure in the activities of daily living (Buchholz et al. 2003). This may explain the increased prevalence of cardiovascular conditions in the SCI population (Cragg et al. 2013). Regular and sufficiently intense PA is necessary to compensate for functional limitations. Evidence suggests that, despite functional limitations, regular PA can effectively improve fitness (aerobic capacity and muscular strength)

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(Hicks et al. 2011) and positively influence risk factors of chronic disease (Buchholz et al. 2009; de Groot et al. 2013).

Certain levels of PA are required to reduce the risks of cardiovascular disease. General exercise recommendations coincide with those of the World Health Organization (WHO) (WHO 2010) and suggest consistently performing at least 2.5 h of moderate aerobic activities and muscle-strengthening exercises on at least 2 days per week (Australian Government Department of Health 2014; FOSPO 2013; ODPHP 2008). These recommendations can also be applied to people with disabilities, but they need to be adapted to an individual's capacity, risk, or limitation (WHO 2010). SCI-specific exercise recommendations are available, but lack consensus. Recent exercise recommendations suggest performing 20 min of aerobic exercise of at least moderate intensity and muscle-strengthening exercises on at least 2 days per week to maintain or improve fitness (Martin Ginis et al. 2011). Previous recommendations refer to risk reduction and suggest levels comparable to those for the general population, namely to perform 20–60 min of aerobic exercises of at least moderate intensity on 3–5 days a week and muscle-strengthening exercises twice weekly (Jacobs and Nash 2004). Based on current knowledge and to allow a comparison with the general population, it is useful to apply the WHO exercise recommendations to people with SCI until more evidence is available.

There presently exists little knowledge on PA levels in people with SCI. In general, it has been reported that PA levels in the SCI population are rather low (Anneken et al. 2010; Buchholz et al. 2003; Kim et al. 2011; Martin Ginis et al. 2010a; Rauch et al. 2014; Sale et al. 2012; Tasiemski et al. 2000). The reported PA levels vary according to the types of activities and available information on their frequency, duration, and intensity. Figures on those who are physically inactive vary from 27 % (Rauch et al. 2014) to 50 % (Martin Ginis et al. 2010b). No study has investigated whether people with SCI achieve the recommended PA levels, and we have no information about the characteristics of those who fulfill the recommendations and those who do not. Such information is indispensable to facilitate the identification of target groups that require special consideration when promoting PA.

This study aims (1) to quantify the time spent on different types of PA (sports of different intensities and muscle-strengthening exercises) in people with SCI, (2) to report the proportions of those who are completely physically inactive, who carry out muscle-strengthening exercises regularly, and who perform sports according to the WHO exercise recommendations, and (3) to investigate the socio-demographic and SCI-related characteristics associated with the latter three PA categories.

Methods

Study design

Data from the nationwide Swiss Spinal Cord Injury Cohort Study (SwiSCI) community survey were analyzed for this study. Participants were recruited via four specialized SCI rehabilitation centers, the national association for people living with SCI (Swiss Paraplegic Association), a SCI-specific home care institution (Parahelp) and a large national insurance company (SUVA). The SwiSCI survey contained three subsequent modules: (1) Starter Module (brief questionnaire on basic socio-demographics, lesion characteristics, care situation), (2) Basic Module (detailed information on functioning, health, environmental and personal factors), and (3) three thematically different specific modules (Post et al. 2011). A representative sample of 1549 individuals with traumatic or non-traumatic SCI with a minimum age of 16 years participated in the first two modules of the survey (response rate: 49.3 %, median age: 52 years, 71.5 % male, median time since injury: 13.5 years, paraplegia: 69.2 %). 570 were randomly selected (stratified for gender, age, and level of injury) to participate in a specific module on psychological personal factors and health behavior, which included questions on PA behavior. The 511 subjects who answered this module were considered for this study.

Data collection

Four items from the Physical Activity Scale for Individuals with Physical Disabilities (PASIPD; items 3–6) (Washburn et al. 2002) were selected to assess PA. These items cover sports and recreational activities of (1) light, (2) moderate, and (3) strenuous intensity and (4) muscle-strengthening exercises (power and endurance). For each item, the frequency (never, 1–2 days, 3–4 days, 5–7 days per week) and duration (less than 1 h, 1 but less than 2 h, 2–4 h, more than 4 h per day) of the corresponding activity were asked. Based on the combination of answers, the PASIPD provides an algorithm to obtain the average daily activity time (hours/day) spent on each PA category.

Socio-demographic (gender, age, partnership, education, and income) as well as SCI-related (etiology, time since injury, severity and type of locomotion) aspects likely to associate with PA levels, were selected as independent variables. The type of locomotion was assessed with item 13 (mobility for moderate distances, 10–100 m) of the self-report version of the Spinal Cord Independence Measure (Fekete et al. 2013); the response options for walking with different devices were summarized to "pedestrian with device or support".

Data analysis

Only participants who completely answered the four items of the PASIPD were included in the analyses. Descriptive statistics were conducted to describe the study population. To calculate the hours per week spent on the four types of PA, the average hours/day was multiplied by seven. Sum scores were calculated for the weekly time spent on sports and recreational activities of at least moderate intensity (sum of moderate and strenuous PA items) and for the total time spent on PA per week (sum of all items). All figures were calculated for the total study sample and stratified by socio-demographic and SCI-related characteristics. Whenever feasible, variables collected as metric data were grouped based on current reporting guidelines (DeVivo et al. 2011). Education was categorized based on time required to achieve certain academic degrees, and income was categorized into quartiles of the income distribution. Bivariate non-parametric tests were conducted to identify group differences within the socio-demographic and SCI-related characteristics (binary data: Mann–Whitney; ordinal data: Kruskal–Wallis). The significance level was set at a p value <0.05. Mann–Whitney U tests were applied to identify the subgroups that differ within the distinct characteristics. The significance level was now set at a p value of <0.008 based on Bonferroni correction for six tests.

For additional analyzes, three following additional categories were created: (1) being completely physically inactive, (2) performing muscle-strengthening exercises on at least 1–2 days per week, and (3) performing sports or recreational activities of at least moderate intensity for at least 2.5 h per week (according to the WHO exercise recommendations). Frequencies and proportions were calculated for each of these categories. Multivariate logistic regressions were performed, and odds ratios with 95 % confidence intervals were calculated. Missing values in the independent variables were addressed by conducting multiple imputations (MI). For the MI, all variables included in the regression models were entered, and 5 iterations were performed.

Results

Data from 485 subjects were included in this study; their characteristics are presented in Table 1. For these characteristics no differences between the responders and the excluded subjects and non-responders of the survey have been found.

The time spent on the different PA categories is shown for the total study sample and stratified for socio-demographic (Table 2) and SCI-related characteristics (Table 3). All results on the PA levels showed a non-normal distribution. Overall, participants spent the most time (median 2.2 h) performing sports of light intensity. People with complete paraplegia, manual wheelchair users, and people with a time since injury of 16–25 years spent the most median time on sports of moderate intensity. The sample spent the least median time on strenuous sporting activities (0.0) and 0.8 h performing muscle-strengthening exercises. On average, participants carried out a total of 2.2 h (median) on sports of moderate or strenuous intensity, whereas the number of hours spent on these intensities was the lowest in women (1.8), the eldest participants (1.5), pedestrians requiring devices (0.8), and in those who needed an electric wheelchair (0.8). The median total time for all PAs per week was 6.0 h.

People aged between 17 and 30 showed the highest total PA time (median 8.8 h). People 71 and older (4.5), women (4.6), people with complete tetraplegia (4.5), and users of electric wheelchairs (3.8) showed the lowest total PA times.

Significant differences within the subgroups were found for all characteristics in at least one PA category, but most frequently for the “strenuous intensity” and the “muscle-strengthening exercises” category. For the type of locomotion, group differences were found in all PA categories except the “light-intensity” category.

Table 4 shows the proportions and the corresponding odds ratios of those who were completely physically inactive, of those meeting the WHO recommendations by carrying out sports of at least moderate intensity for at least 2.5 h/week, and of those carrying out muscle-strengthening exercises at least 1–2 days/week.

18.6 % of the study population was completely physically inactive. The youngest showed the lowest, and those requiring an electric wheelchair showed the highest proportion of physically inactive people. The proportion of those who were inactive increased with age, and those aged 71 and older had 6.8 times higher odds of being physically inactive compared to the youngest age group. Those with complete tetraplegia had 3.3 times higher odds of being physically inactive compared to those with incomplete paraplegia. Those with a time of 6–15 years since injury showed significantly lower odds of physical inactivity compared to those with a time since injury of 5 years or less. Manual wheelchair users had significantly reduced odds (OR = 0.24) of being physically inactive compared to pedestrians without devices.

50.3 % carried out muscle-strengthening exercises at least one to 2 days a week, the highest proportion again being among the youngest and the lowest among those requiring an electric wheelchair. Those with complete paraplegia showed significantly reduced odds (OR 0.56) of carrying out muscle-strengthening exercises compared to those with incomplete paraplegia.

Table 1 Characteristics of the study population ($n = 485$); Switzerland, 2015

	n (% of valid values)	Mean (SD); median (range)
Gender		
Male	357 (73.6)	
Missing	0 (0.0)	
Age		
In years		52.9 (14.8); 53 (17; 90)
Missing	0 (0.0)	
Partnership		
Yes	316 (67.4)	
Missing	16 (3.3)	
Years of education		
Compulsory school (≤9 years)	33 (7.0)	
Vocational training (10–12 years)	134 (28.3)	
Secondary education (13–16 years)	215 (45.3)	
University education (≥17 years)	92 (19.4)	
Missing	11 (2.3)	
Net income per month		
In Swiss Francs (CHF)		4197 (1918); 3750 (3570; 9750)
Missing	47 (9.3)	
Etiology of SCI		
Traumatic	380 (78.7)	
Non-traumatic	103 (21.3)	
Missing	2 (0.4)	
Age at onset of SCI		
In years		35.4 (17.5); 32 (0; 86)
Missing	5 (1.0)	
Time since injury		
In years		17.3 (12.9); 14 (0; 76)
Missing	0 (0.0)	
Severity of SCI		
Complete paraplegia	159 (32.9)	
Incomplete paraplegia	169 (35.0)	
Complete tetraplegia	55 (11.4)	
Incomplete tetraplegia	100 (20.7)	
Missing	2 (0.4)	
Type of locomotion (when moving around for 10–100 m)		
Pedestrian without device or assistance	70 (15.0)	
Pedestrian using device or assistance	91 (19.4)	
Wheelchair user (manual without assistance)	218 (46.6)	
Wheelchair user (electric or manual with assistance)	89 (19.0)	
Missing	17 (3.5)	

SCI spinal cord injury, *SD* standard deviation

48.9 % of the study sample fulfilled the WHO recommendations on PA (at least 2.5 h of sports of at least moderate intensity). 61.5 % of those using a manual wheelchair fulfilled these exercise recommendations. Among those aged 71 and older, only 32.7 % did. Women, people aged 71 and older, and people with complete

Table 2 Comparison of sport and exercise levels analyzed for the total sample and for subgroups with socio-demographic characteristics (n = 485); Switzerland, 2015

	Subgroups (n)	Mean; median (interquartile range)					
		Hours per week				Sum of hours per week	
		Intensity of sport			Muscle exercises	Moderate and strenuous intensity	Total hours
		Light	Moderate	Strenuous			
Total sample	485	3.2; 2.2 (0.8; 4.5)	2.8; 1.8 (0.0; 3.0)	1.8; 0.0 (0.0; 2.2)	1.2; 0.8 (0.0; 1.8)	4.7; 2.2 (0.0; 6.0)	9.1; 6.0 (2.3; 12.0)
Gender	Men (357)	3.3; 1.8 (0.8; 5.3)	2.8; **1.8** (0.0; 3.0)	2.0; 0.0 (0.0; 2.2)	1.2; 0.8 (0.0; 2.2)	4.8; 3.0 (0.0; 6.4)	9.3; 6.7 (2.3; 12.0)
	Women (128)	3.0; 2.2 (0.8; 4.1)	2.9; **0.8** (0.0; 2.2)	1.7; 0.0 (0.0; 2.2)	1.1; 0.0(0.0; 0.8)	4.6; 1.8 (0.0; 5.8)	8.7; 4.6 (2.2; 10.5)
	p value[1]	0.901	0.032*	0.152	0.195	0.062	0.143
Age	17–30 (41)	3.2; 2.2 (0.8; 5.3)	3.2; 2.2 (0.0; 4.9)	2.6; **0.8**° (0.0; 4.5)	1.3; 0.8 (0.0; 2.2)	5.8; **4.5**° (1.2; 9,8)	10.3; **8.8**° (4.1; 13.5)
	31–50 (170)	3.8; 2.2 (0.8; 5.3)	2.9; 1.3 (0.0; 3.0)	2.5; **0.8**$^{+}$ (0.0; 2.2)	1.2; 0.0 (0.0; 2.2)	5.5; 2.8 (0.6; 7.1)	10.4; 6.7 (2.3; 12.8)
	51–70 (219)	3.0; 2.2 (0.8; 4.5)	2.9; 1.8 (0.0; 3.0)	1.4; 0.0 (0.0; 2.2)	1.1; 0.0 (0.0; 1.8)	4.3; 2.2 (0.0; 6.0)	8.4; 6.0 (2.3; 11.3)
	71 and older (58)	2.5; 1.8 (0.8; 3.0)	2.1; 0.8 (0.0; 2.2)	1.0; **0.0**$^{\circ,+}$ (0.0; 0.8)	1.4; 0.0 (0.0; 2.2)	3.1; **1.5**° (0.0; 5.3)	6.9; **4.5**° (1.5; 10.5)
	p value[2]	0.337	0.302	0.005*	0.253	0.058	0.039*
Partnership	No partner (153)	3.2; 2.2 (0.8; 5.3)	3.0; 1.8 (0.0; 2.6)	1.5; **0.0** (0.0; 2.2)	1.0; **0.8** (0.0; 0.8)	4.5; 2.2 (0.0; 6.4)	8.6; 6.0 (2.2; 12.0)
	With partner (316)	3.3; 2.2 (0.8; 4.5)	2.8; 1.3 (0.0; 3.0)	2.1; **0.8** (0.0; 2.2)	1.4; **0.8** (0.0; 2.2)	4.9; 2.5 (0.8; 6.0)	9.5; 6.5 (2.3; 12.0)
	p value[1]	0.409	0.832	0.043*	0.046*	0.487	0.621
Education	<13 years (167)	2.9; 1.8 (0.8; 4.5)	2.8; 0.8 (0.8; 2.2)	1.8; **0.0** (0.0; 2.2)	1.5; 0.0 (0.0; 2.2)	4.5; 2.2 (0.0; 5.3)	8.9; 6.0 (1.8; 12.0)
	≥13 years (307)	3.4; 2.2 (0.8; 5.3)	2.9; 1.8 (0.0; 3.0)	2.0; **0.8** (0.0; 2.2)	1.0; 0.8 (0.0; 1.8)	4.9; 3.0 (0.8; 6.7)	9.3; 6.7 (3.0; 12.0)
	p value[1]	0.123	0.555	0.002*	0.751	0.076	0.701
Net income per month (in CHF)	≤2.500 (111)	2.8; **1.8**° (0.8; 4.5)	3.2; 0.8 (0.0; 5.3)	2.2; 0.0 (0.0; 2.2)	1.3; 0.8 (0.0; 2.2)	5.3; 2.2 (0.0; 7.5)	9.5; 6.7 (1.5; 14.3)
	2.501–3.750 (132)	3.1; 1.8 (0.8; 4.5)	2.6; 1.8 (0.0; 3.0)	1.2; 0.0 (0.0; 2.2)	0.9; **0.0**° (0.0; 1.8)	3.7; 2.2 (0.8; 5.3)	7.7; 6.0 (2.2; 11.0)
	3.751–5.250 (90)	4.4; **2.2**$^{\circ,+}$ (0.8; 5.3)	2.7; 0.8 (0.0; 2.2)	2.6; 0.8 (0.0; 2.2)	1.8; **0.8**$^{\circ,+}$ (0.0; 2.2)	5.3; 2.4 (0.8; 6.0)	11.4; 7.1 (3.0; 14.5)
	>5.250 (109)	2.8; **1.8**$^{+}$ (0.8; 3.0)	2.9; 2.2 (0.0; 2.2)	1.9; 0.0 (0.0; 2.2)	1.0; **0.0**$^{+}$ (0.0; 0.8)	4.8; 3.0 (0.8; 6.7)	8.7; 6.2 (2.3; 11.0)
	p value[b]	0.018*	0.981	0.321	0.019*	0.817	0.206

Bold letters: significant differences identified between marked groups; for ordinal data by applying post hoc Mann–Whitney U tests with Bonferroni adjusted significance level: <0.008 (for each 6 test) marked with $^{\circ,+,\Delta}$

[1] p values for Mann–Whitney U test; [2] p values based on Kruskal–Wallis test; significance level for both: * <0.05

Table 3 Comparison of sport and exercise levels analyzed for the total sample and for subgroups with spinal cord injury-specific characteristics ($n = 485$); Switzerland, 2015

	Subgroups (*n*)	Mean; median (interquartile range)					
		Hours per week				Sum of hours per week	
		Intensity of sport			Muscle exercises	Moderate and strenuous intensity	Total hours
		Light	Moderate	Strenuous			
Total sample	485	3.2; 2.2 (0.8; 4.5)	2.8; 1.8 (0.0; 3.0)	1.8; 0.0 (0.0; 2.2)	1.2; 0.8 (0.0; 1.8)	4.7; 2.2 (0.0; 6.0)	9.1; 6.0 (2.3; 12.0)
Etiology of SCI	Traumatic (380)	3.4; 2.2 (0.8; 5.3)	2.8; 1.8 (0.0; 3.0)	2.1; **0.8** (0.0; 2.2)	1.2; 0.0 (0.0; 2.1)	5.0; 2.5 (0.8; 6.7)	9.7; 6.7 (2.5; 12.4)
	Non-traumatic (103)	2.4; 1.8 (0.8; 3.0)	2.9; 0.8 (0.0; 5.3)	0.9; **0.0** (0.0; 1.8)	1.0; 0.8 (0.0; 1.8)	3.8; 2.2 (0.0; 5.3)	7.2; 5.3 (1.8; 9.8)
	p value[1]	0.097	0.840	0.012*	0.530	0.180	0.126
Time since injury	0–5 years (99)	4.0; **2.2**° (0.8; 5.3)	2.8; 0.8 (0.0; 4.5)	1.9; 0.0 (0.0; 2.2)	1.8; **0.8**° (0.0; 2.2)	4.6; 2.2 (0.0; 5.3)	10.4; 6.7 (1.8; 12.7)
	6–15 years (155)	3.4; 2.2 (0.8; 5.3)	2.6; 1.8 (0.0; 2.2)	2.2; 0.8 (0.0; 2.2)	1.2; **0.8**$^{+}$ (0.0; 2.2)	4.8; 2.5 (0.8; 6.0)	9.4; 6.7 (2.5; 12.0)
	16–25 years (108)	3.0; 2.2 (0.8; 5.1)	3.8; 2.2 (0.0; 5.3)	2.0; 0.8 (0.0; 2.2)	1.0; 0.0 (0.0; 1.5)	5.8; 3.0 (0.8; 7.5)	9.8; 6.7 (2.3; 13.5)
	26 years and longer (118)	2.6; **1.8**° (0.8; 2.2)	2.4; 0.8 (0.0; 2.2)	1.4; 0.0 (0.0; 2.2)	0.9; **0.0**$^{\circ,+}$ (0.0; 0.8)	3.8; 2.2 (0.6; 5.3)	7.3; 5.1 (1.8; 9.7)
	p value[2]	0.034*	0.310	0.110	0.010*	0.210	0.131
Severity of SCI	Incomplete parapl. (169)	3.8; 2.2 (0.8; 5.3)	2.9; 0.8 (0.0; 3.0)	1.8; **0.0**° (0.0; 2.2)	1.4; **0.8**° (0.0; 2.2)	4.7; 2.2 (0.0; 6.0)	9.9; 6.7 (2.3; 13.5)
	Complete parapl. (159)	2.7; 1.8 (0.8; 3.0)	2.8; 2.2 (0.8; 3.0)	2.5; **0.8**$^{+}$ (0.0; 2.2)	0.9; **0.0**° (0.0; 1.8)	5.4; **3.0**° (0.8; 7.5)	9.0; 6.3 (2.5; 11.3)
	Incomplete tetrapl. (100)	3.1; 1.8 (0.8; 3.0)	2.9; 0.8 (0.0; 2.4)	1.6; 0.0 (0.0; 2.2)	1.5; 0.0 (0.0; 2.1)	4.5; 2.2 (0.0; 6.0)	9.0; 5.3 (1.7; 12.0)
	Complete tetrapl. (55)	3.1; 1.8 (0.8; 3.0)	2.7; 0.8 (0.0; 2.2)	0.8; **0.0**$^{\circ,+}$ (0.0; 0.8)	0.9; 0.0 (0.0; 0.8)	3.4; **2.2**° (0.0; 4.5)	7.4; 4.5 (2.2; 10.5)
	p value[2]	0.071	0.333	0.002*	0.024*	0.037*	0.313
Type of locomotion	Pedestrian, no device (70)	3.6; 2.2 (0.8; 5.3)	1.6; **0.8**° (0.0; 2.2)	1.6; **0.4**° (0.0; 2.2)	1.1; 0.8 (0.00; 2.24)	3.1; **2.2**° (0.0; 4.5)	7.9; 6.0 (2.2; 10.5)
	Pedestrian, with device (91)	3.2; 1.8 (0.8; 5.3)	2.6; **0.8**$^{+}$ (0.0; 2.2)	1.3; **0.0**$^{+}$ (0.0; 1.8)	1.6; **0.8**° (0.0; 2.2)	3.9; **0.8**$^{+}$ (0.0; 5.3)	8.7; 6.0 (1.5; 12.0)
	Wheelchair, manual (218)	3.2; 2.2 (0.8; 4.5)	3.2; **2.2**$^{\circ,+,\Delta}$ (0.8; 4.5)	2.5; **0.8**$^{+,\Delta}$ (0.0; 2.2)	1.1; 0.8 (0.0; 1.8)	5.7; **3.0**$^{\circ,+,\Delta}$ (1.3; 7.5)	10.0; **6.7**° (3.0; 12.2)
	Wheelchair, electr./assist. (89)	2.5; 1.8 (0.8; 3.0)	3.0; **0.8**$^{\Delta}$ (0.0; 2.2)	0.5; **0.0**$^{\circ,\Delta}$ (0.0; 0.0)	0.7; **0.0**° (0.0; 0.8)	3.5; **0.8**$^{\Delta}$ (0.0; 5.3)	6.7; **3.8**° (1.5; 10.2)
	p value[2]	0.297	<0.001**	<0.001**	0.002*	<0.001**	0.013*

Bold letters: significant differences identified between marked groups; for ordinal data by applying post hoc Mann–Whitney *U* tests with Bonferroni adjusted significance level: <0.008 (for each 6 test) marked with °, +, Δ

[1] *p* values for Mann–Whitney *U* test; [2] *p* values based on Kruskal–Wallis test; significance level for both: * <0.05; ** <0.001

Table 4 Proportions and associations of characteristics with binary physical activity outcomes based on multivariate logistic regression ($n = 485$; imputed dataset; regression analyses adjusted for all variables in the table); Switzerland, 2015

	Subgroups	Completely physically inactive $n = 90$ (18.6 %)			At least 1–2 days/week muscle exercises $n = 240$ (50.3 %)			≥2.5 h of sport with at least moderate intensity $n = 237$ (48.9 %)		
		n (% of subgroup)	OR (95 %CI)	*p* value	*n* (% of subgroup)	OR (95 %CI)	*p* value	*n* (% of subgroup)	OR (95 %CI)	*p* value
Gender	Men	65 (18.2)	1		183 (51.3)	1		184 (51.5)	1	
	Women	25 (19.5)	1.12 (0.63; 2.02)	0.696	61 (47.7)	0.82 (0.52; 1.27)	0.370	53 (41.4)	0.64 (0.41; 1.00)	**0.049***
Age	17–30	2 (4.9)	1		28 (68.3)	1		25 (61.0)	1	
	31–50	31 (18.2)	4.60 (0.98; 21.54)	0.053	80 (48.8)	0.47 (0.21; 1.02)	0.057	88 (51.8)	0.59 (0.27; 1.28)	0.179
	51–70	41 (18.2)	4.68 (1.00; 21.98)	0.051	107 (48.9)	0.49 (0.22; 1.08)	0.076	106 (48.4)	0.58 (0.26; 1.26)	0.167
	71 and older	16 (29.1)	6.82 (1.36; 34.23)	**0.020***	26 (47.3)	0.42 (0.16; 1.65)	0.064	18 (32.7)	0.31 (0.12; 0.78)	**0.013***
Partnership	No partner	58 (18.4)	1		160 (50.6)	1		159 (50.3)	1	
	With partner	27 (17.6)	0.90 (0.72; 1.13)	0.789	78 (51.0)	1.08 (0.70; 1.66)	0.729	71 (46.4)	1.23 (0.80; 1.87)	0.345
Education	Less than 13 years	40 (24.0)	1		81 (48.5)	1		72 (43.1)	1	
	13 years and more	49 (16.0)	0.69 (0.41; 1.16)	0.161	155 (50.5)	1.01 (0.67; 1.53)	0.953	160 (52.1)	1.26 (0.83; 1.90)	0.278
Net income	Less than 2500 CHF	23 (20.7)	1		58 (47.7)	1		54 (48.6)	1	
	2501–3750 CHF	26 (19.7)	1.00 (0.50; 2.00)	0.990	64 (48.5)	0.82 (0.47; 1.44)	0.987	63 (47.7)	0.99 (0.57; 1.70)	0.962
	3750–5250 CHF	11 (12.2)	0.62 (0.26; 1.49)	0.281	56 (62.2)	1.51 (0.84; 2.70)	0.164	45 (50.0)	1.00 (0.56; 1.81)	0.988
	>5250 CHF	16 (14.7)	0.72 (0.32; 1.62)	0.430	48 (44.0)	0.82 (0.47; 1.44)	0.489	57 (52.3)	1.12 (0.63; 2.01)	0.703
Etiology of SCI	Traumatic	67 (17.6)	1		187 (49.2)	1		193 (50.8)	1	
	Non-traumatic	23 (22.3)	1.11 (0.56; 2.18)	0.770	55 (53.4)	0.95 (0.56; 1.60)	0.841	44 (42.7)	0.87 (0.51; 1.48)	0.611
Time since injury	0–5 years	24 (24.2)	1		56 (56.6)	1		46 (46.5)		
	6–15 years	21 (13.5)	0.48 (0.24; 0.74)	**0.041***	89 (57.4)	1.03 (0.60; 1.76)	0.922	78 (50.3)	1.12 (0.65; 1.91)	0.693
	16–25 years	22 (20.4)	0.87 (0.41; 1.86)	0.727	50 (46.3)	0.77 (0.42; 1.40)	0.385	60 (55.6)	1.24 (0.68; 2.28)	0.483
	26 years and longer	22 (18.6)	0.69 (0.31; 1.52)	0.353	47 (39.8)	0.63 (0.33; 1.17)	0.144	52 (44.1)	0.71 (0.37; 1.34)	0.285
Severity of SCI	Incompl. paraplegic	29 (17.2)	1		101 (59.8)	1		79 (46.7)	1	
	Complete paraplegic	22 (13.8)	2.07 (0.88; 4.86)	0.095	70 (44.0)	0.56 (0.32; 0.99)	**0.046**	92 (57.9)	0.90 (0.51; 1.60)	0.718
	Incompl. tetraplegic	24 (24.0)	1.75 (0.87; 3.53)	0.120	47 (47.0)	0.67 (0.39; 1.16)	0.152	45 (45.0)	0.90 (0.52; 1.56)	0.699
	Complete tetraplegic	15 (27.3)	3.29 (1.24; 8.71)	**0.017***	24 (43.6)	0.67 (0.32; 1.43)	0.303	20 (36.4)	0.43 (0.20; 0.91)	**0.029***
Type of locomotion	Pedestrian without device/support	16 (22.9)	1		38 (54.3)	1		27 (38.6)	1	
	Pedestrian with device or support	24 (26.4)	1.23 (0.54; 2.77)	0.620	55 (60.4)	1.22 (0.62; 2.41)	0.563	37 (40.7)	1.13 (0.57; 2.21)	0.731
	Wheelchair, manual without support	19 (8.7)	0.24 (0.09; 0.61)	**0.003***	110 (50.5)	1.20 (0.63; 2.30)	0.582	134 (61.5)	2.83 (1.46; 5.47)	**0.002***
	Wheelchair, electric or with support	28 (31.5)	0.92 (0.38; 2.18)	0.842	30 (33.7)	0.60 (0.29; 1.24)	0.168	31 (34.8)	1.28 (0.61; 2.66)	0.512

To view the n of the subgroups refer to Tables 2 and 3

OR odds ratio, *CI* confidence interval, *CHF* Swiss francs, *SCI* spinal cord injury

* *p* value level of significance <0.05; marked in bold

tetraplegia had significantly lower odds of fulfilling the recommendations compared to their respective reference population. Manual wheelchair users had significantly lower odds of not achieving the recommendations compared to pedestrians without devices.

Discussion

This study indicates that PA levels in people with SCI in Switzerland are rather high with a median total time of 6.0 h/week (mean 9.1) of sports and muscle-strengthening exercises. Several studies investigated PA levels in people with SCI (Anneken et al. 2010; Buchholz et al. 2003; de Groot et al. 2011; Martin Ginis et al. 2010a; Rauch et al. 2014; Tasiemski et al. 2000; van den Berg-Emons et al. 2008), but a comparison of the results is limited due to the use of different instruments assessing different concepts (all types of PA, leisure-time PA, or sports only). Three studies reported the time spent on PAs (means), which varied from 49 min/day of dynamic activities (measured using an activity monitor) in a Dutch (van den Berg-Emons et al. 2008) to 55 min/day of all types of leisure-time PAs in a Canadian (using the Physical Activity Recall Assessment for People with Spinal Cord Injury, PARA-SCI) (Martin Ginis et al. 2005) to 3.1 h/day on all types of leisure-time PAs in a Korean sample (using a self-developed questionnaire) (Kim et al. 2011). The differences in the PA levels in the different countries may relate to different amount of services and support for PAs, however, the use of the different instruments may as well contribute to the different findings.

The fact that this study population spent the most time on light and the least time on strenuous PAs differs from findings from the Canadian and Korean SCI populations, where people spent the most time on moderate-intensity PAs (Kim et al. 2011; Martin Ginis et al. 2010a). In our study, especially women, pedestrians using devices and people using an electric wheelchair carried out significantly fewer moderate-intensity PAs than men and people using a manual wheelchair. The time spent on strenuous-intensity PAs in general was rather low and differed significantly in some subgroups (age, partnership, education, etiology, severity of SCI, type of locomotion). Those spending only little time on sports of moderate intensities did not compensate for this by spending more time on sports of strenuous intensity. As a result, 50 % of them performed PAs of moderate and strenuous intensities only 0.8–1.8 h/week. The preference for sports of low intensity in these subgroups requires investigating the potential reasons for this and how to facilitate their involvement in more strenuous PAs.

In a previous study, it was found that interest in participating in performance-oriented types of sports is lower in women than in men (Rauch et al. 2013). The results of this study confirmed these findings. Although no gender differences have been found for the time spent performing sports of strenuous intensity, which indicates that a certain proportion of women are interested in performance-oriented sports, the majority of women preferred PAs of only light intensity. The same may apply to those who have less physical capacity (the elderly, those with more severe SCI). There are also hints that the existing sports programs in Switzerland are more performance oriented (Rauch et al. 2013) and therefore might not fulfill the interests of those who prefer sport with less intensity.

The time spent performing muscle-strengthening exercises is rather low compared to the time spent on light- or moderate-intensity sports. Analysis of differences in the time spent on muscle-strengthening exercises found significant differences in income, time since injury, severity of SCI, and type of locomotion. Future research is required to detect the motives for the certain subgroups that spend more time than others with muscle-strengthening exercises.

This study also showed that with 18.6 % the proportion of those who are completely physically inactive is rather low. Previous studies reported much higher proportions: In a German sample 48.5 % that did not participate in any sport (Anneken et al. 2010). In a Canadian sample 50.1 % reported performing no leisure-time PAs at all (Martin Ginis et al. 2010b). In a previous study in Switzerland 33.3 % reported to never participate in sports (Rauch et al. 2014). Even 27.1 % of the Swiss general population reported never participating in sports (Lamprecht et al. 2008). Taking into account that the PA levels were assessed differently in these studies, this comparison should not be overemphasized, but it does provide hints that PA levels vary in different contexts. The low proportion of the physically inactive individuals in the Swiss SCI population suggests that the study sample is rather active, but as well a potential selection bias should be considered.

The given response options in the PASIPD do not allow the identification of people who perform muscle-strengthening exercises at least twice weekly, as recommended in general (WHO 2010) and in SCI-specific recommendations (Martin Ginis et al. 2011). In this study, we compared those who do (at least once per week) with those who do not engage in any muscle-strengthening exercises at all. The proportion (50.3 %) of our study sample reporting performing muscle-strengthening exercises is high compared to other study populations where this proportion varied from 19.3 % (‘gym’) (Sale et al. 2012) to 32.6 % (‘resistance training’) (Martin Ginis et al. 2010a) and 37.6 % (‘fitness/resistance training’) (Anneken et al. 2010).

48.9 % of the study sample fulfilled the WHO exercise recommendations by reporting spending 2.5 h or more per week on sports of at least moderate intensity (WHO 2010). So far, no study has investigated whether people with SCI fulfill general or SCI-specific exercise recommendations, so a comparison with other SCI populations is not presently possible. It has been reported that about two-thirds of the general European population does not reach recommended activity levels (WHO 2006), whereas about 41 % of Swiss adults reported fulfilling exercise recommendations (Martin et al. 2009). Although our results suggest that the proportion of people who fulfill exercise recommendations is higher in the Swiss SCI population than in the able-bodied population, a comparative study including both populations would be required to confirm this.

Analysis of subgroups and associations with the three PA categories identified some subgroups, which might require special consideration for future intervention planning. The socio-demographic characteristics partnership, education, and net income were not associated with any of the PA categories. Education and income are well-known determinants for PA in general populations in many countries (Stalsberg and Pedersen 2010), as well as in Switzerland (Lamprecht et al. 2008). Previous studies have already described that these characteristics are not associated with PA levels in people with SCI (Fekete and Rauch 2012; Rauch et al. 2014). This study confirms the assumption that different approaches than in the able-bodied population are required to explain PA behavior in people with SCI.

In this study, gender, age, severity of SCI, time since injury, and the type of locomotion were found to be associated with the PA categories. Women showed a total time of all PAs that was among the lowest. In principle, gender was associated with lower PA levels in women in only few previous studies (Martin Ginis et al. 2010b; Rauch et al. 2014). In this study, the proportion of completely physically inactive women and those who performed muscle-strengthening exercises regularly was comparable to those in men. However, women showed significantly lower odds of fulfilling the exercise recommendations. Taking into account the fact that women spent significantly less time on moderate-intensity sports than men, future interventions should focus on how to encourage women to increase the intensity when performing sports.

People aged 71 and older have the highest odds of being completely physically inactive and of not fulfilling exercise recommendations compared to those aged 17–30 years. It has to be noted that the odds for the age groups 31–50 and 51–70 are also increased although not significantly. This finding differs from a previous study conducted in Switzerland (Rauch et al. 2014) and from studies conducted in other countries (Martin Ginis et al. 2010b; Wu and Williams 2001), where no association between age and sports participation could be found. However, it is in line with the Swiss general population (Lamprecht et al. 2008). Future PA interventions should target the expected increasing number of older individuals with SCI.

People with complete tetraplegia have significantly increased odds of becoming completely physically inactive and not fulfilling exercise recommendations compared to those with less severe SCIs. Previous research also identified that tetraplegia is associated with lower PA levels (Martin Ginis et al. 2010b; Rauch et al. 2014). Comparable to women and the elderly, people with complete tetraplegia reported spending very little time performing sports of strenuous intensity and did not reach the recommended 2.5 h of sports of at least moderate intensity. Taking into account these three subgroups, it should be investigated whether existing sports programs offer types of sports that are suitable and preferable for people with rather little physical capacity, such as women, the elderly, and people with tetraplegia.

People with complete paraplegia showed significantly lower odds for performing muscle-strengthening exercises regularly compared to those with incomplete paraplegia. However, they showed the highest proportion of participants fulfilling the exercise recommendations. Thus, people with complete paraplegia are physically active, but prefer sports to muscle-strengthening exercises.

Electric wheelchair users made up the highest proportion of the completely physically inactive and the second highest among those who did not fulfill exercise recommendations. Although no significant differences for sports-associated odds compared to pedestrians without devices could be found, they present a group which should be given special consideration, as they represent the group spending the least total time on PAs.

Pedestrians requiring devices require special attention regarding their PA levels. Although they are able to walk and suffer from less severe SCI, they spend significantly less time on sports of at least moderate intensity than those using a manual wheelchair. The severity of SCI and the related physical capacity alone does not explain PA behavior. The readiness to use a wheelchair only for sports when limitations in walking, running, or cycling do not allow participation in certain types of sports may also influence participation in sports. Future research should investigate this phenomenon since these results show that the type of locomotion should be taken into account when planning interventions for specific target populations.

Although this study shows that PA levels in people with SCI are generally rather high in Switzerland (with some exceptions for distinct subgroups), the available information cannot answer the question whether the achieved PA levels are sufficient to reduce the increased risk for PA-related chronic conditions in the SCI population. Thus, to answer the question whether general or SCI-specific exercise recommendations are applicable to people with SCI with respect to the reduction of risks for secondary conditions longitudinal cohort studies are required.

In this study, PA was assessed by the PASIPD, a self-report in which participants rate the intensity of PAs based on their own judgment. Research has shown that responders to the PASIPD tend to overestimate PA levels (van den Berg-Emons et al. 2011), making it likely that the participants in our study actually performed less and less-intense PAs than reported. This assumption is confirmed by two studies showing only weak correlation between self-reported PA levels and fitness parameters (de Groot et al. 2010) and overestimated energy expenditure when comparing the PASIPD to objective measures (Tanhoffer et al. 2012). Considering the more reliable measures used in the Dutch and Canadian study, the higher PA levels reported in this Swiss sample should thus be interpreted with caution. Activity monitors designed for wheelchair users, as used in the Dutch study (Bussmann et al. 2001), could overcome the limitations regarding self-reported PA levels. The PARA-SCI (Martin Ginis et al. 2005), an interview-based self-report measure used in the Canadian study, proved to be a good method for predicting energy expenditure in persons with SCI (Tanhoffer et al. 2012). However, for larger studies in which both the use of activity monitors and interviews require large resources, the Leisure Time Physical Activity Questionnaire for People with Spinal Cord Injury (LTPAQ-SCI) (Martin Ginis et al. 2012) could present a reliable alternative since it showed good correlation with the PARA-SCI. Generally, the use of the same assessment tool is desired to overcome the lack of comparability among different studies.

Conclusion

This study attempted for the first time to investigate whether people with SCI fulfill WHO exercise recommendations. It showed that PA levels of people with SCI in Switzerland are rather high, but also identified subgroups that need special consideration when planning interventions. To better understand the physically inactive, those who perform no muscle-strengthening exercises and those who do not fulfill exercise recommendations, future research needs to integrate additional aspects that are likely to be associated with PA levels, such as personal and environmental factors. Future research also needs to investigate whether general exercise recommendations are applicable to people with SCI and whether the achievement of these or SCI-specific recommendations actually lead to a risk reduction for cardiovascular conditions.

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