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KEYWORDS: SCI; physical activity; exercising; physical capacity.

THE EFFECT OF INTENSIVE TRAINING AND PHYSICAL ACTIVITY PROGRAM ON PHYSICAL CAPACITY IN PEOPLE WITH SPINAL CORD INJURY

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ABSTRACT:

Background

Physical activity levels are generally low after SCI. The promotion of regular physical activity into daily life is one of the main aspirations of society.

Objective To determine the effectiveness of two-week intensive training and physical activity program on improvement of physical capacity components (PCC) and physical activity (PA) in daily life after SCI.

Material and Methods The research was performed in the Landscape Therapy and Recreation Centre (Palanga). PA was assessed using a brief Life Situation Questionnaire-revised form (LSQ-r). PCC were evaluated using the 8 block tests (Tapping, Box&Block, Ball push, "Figure eight" tests, a straight 20 m sprint, 30 s moving, Cupper test (12 min). The study was based on ethical, privacy and confidentiality principles.

Results Totally participated 64 people with SCI: 31.8 year old, male (89.1%), unmarried (46.8%), employed (39.6%); traumatic SCI (78.1%), AIS A SCI type (54.6%) and paraplegia (57.8%). Social life, sports and active leisure prevailed in paraplegia; exercising were more expressed in tetraplegia ($P<0.05$). During intensive program in paraplegia more increased general capacity and moving in wheelchair skills, than in tetraplegia – hand motor functions ($P<0.05$).

Conclusion Even a short intensive training program was successful to improve physical capacity and promote the physical activity among SCI.

Background

Regular physical activity leads to health benefits and reduces risk of morbidity and mortality from various chronic diseases and especially after spinal cord injury (SCI). Physical activity develops and strengthens all body systems and functions, is useful for prevention of various health disorders and chronic diseases, increases physical capacity . Although a recent research shows, that less and less people allow their leisure time to be physically active especially people with SCI . Physical activity is of importance not only for maintaining health but also for increasing the possibilities of living an independent life after SCI. Physical inactivity leads to poorer muscular strength and endurance, cardiovascular and respiratory conditioning and decreasing levels of functioning in everyday life: restrictions and limitations in self-care, mobility, housework, leisure and social activities , also decreased and physical capacity components .

Physical capacity of people with SCI is reduced and can be described as the capacity of the cardiovascular system, muscle groups and the respiratory system to provide a level of physical activity. Subsequently, an inactive lifestyle may further reduce physical capacity also . Physical capacities components can be improved during appropriate exercising, physical and active leisure / recreation activities. Even 15 min daily physical activity reduces 14% of mortality by all causes – . Physical capacity can be described as a set of features of the functional capacity of the human body, allow to being active in various life activities .

Physical capacity improves during inpatient rehabilitation after SCI onset, and some components continue to improve after discharge during first years. Physical capacity components are related between and intervention studies are needed to confirm whether training 1 component could improve another component (). People with tetraplegia and paraplegia have a different level of (change in) physical capacity during inpatient rehabilitation and in long-term contexts people with SCI may become motivated to participate in exercise programmes and stay in physically active life style if as early as possible would begin monitoring of physical inactivity as well as assessing efficacy of interventions aimed at physical activity promotion .

To ensure successful monitoring of physical activity, it is necessary to have a good understanding of the phenomenon of physical activity, to determine the appropriate indicators for measuring this phenomenon and to select reliable methods of assessment. The need to ensure adequate monitoring of the risk factor – physical passivity – and the assessment of the effectiveness of interventions to increase physical activity is inseparable from the need to measure accurately and reliably the physical activity . The analysis of physical activity and the changes of physical capacity during inpatient rehabilitation long time were interested of many researchers, but monitoring physical activity in long-term period and formation of physically active lifestyle of SCI population is a big challenge for all society .

2. Material and methods

2.1. Study Design

The research was performed in the Landscape Therapy and Recreation Centre (Palanga) during physical activity and recreation camps 2012-2015. Intensive training and physical activities program duration was 2 weeks (14 days). In cooperation with the Lithuanian Paraplegics Association people with SCI in a long-term context (1-10 years after SCI) were included in the research. The physical capacity components were evaluated twice – at the beginning and at the end of two-week intensive training and physical activity program. The research data were collected by rehabilitation team members (occupational therapists, physiotherapists and physical activity specialists).

2.2 Study population

In total, 64 people with SCI participated in the research.

The inclusion criteria were: (I) age of 18-59 year (II) traumatic or non-traumatic SCI, (III) AIS A, B and C SCI level, (IV) usage of mechanical wheelchair, (V) voluntary participation, confirmed by a signature in the informed consent.

The exclusion criteria were as follows: (I) age of more than 60 years, (II) the high SCI level – cervical C1-C4 level and / or above it, (III) AIS D and E SCI level, (IV) oncological diseases, and (V) usage of electrical wheelchair, (VI) disagreement with participation in research.

2.3 Ethical issues

Ethical approval was obtained from the Lithuanian Bioethics Committee (protocol No. 1.17/3/2011). All the participants provided written informed consent at initial assessment. Participants were required to consent to complete the questionnaire and undergo a brief examination of physical capacity components as well as evaluation of physical activity in and daily living.

2.4 Instruments

In order to analyze the physical activity in daily life of people with SCI in long-term context (1-10 years after SCI) and evaluation of effectiveness of two-week intensive training and physical activity program, a research protocol was prepared. This protocol included the assessment of the data collected on the participant's clinical state, socio-demographic characteristics, physical activity in daily life and physical capacity components. The research was carried out individually with each participant during direct interviews.

2.4.1 Clinical state was assessed in accordance to the SCI neurological level, localization and type. In order to determine the participant's spinal cord motions and sensory function participants were assessed once at the beginning of program according to the American Spinal Injury Association Classification (AIS). For identification of main differences between SCI lesions, the participants were divided into groups:

I group – 27 (42.2%) participants with tetraplegia (SCI in the cervical level, C4-C8 spinal segment);

II group – 37 (57.8%) participants with paraplegia: SCI in thoracic level, Th1-Th12 spinal segment – 20 (54.1%) participants; SCI in the lumbar level, L1-L5 spinal segment – 17 (47.8%) participants.

2.4.2 To obtain more detailed data about socio-demographic characteristics and physical activity in daily life a brief form of Life Situation Questionnaire-revised (LSQ-r, JS Krause) was used . LSQ-r includes information about participants' socio-demographic characteristics – age, sex, education, employment state, living place; information related with SCI (time since SCI onset, SCI level, severity and etiology) and physical activity in daily life:

How often do people come to see you?

How often do you get away from home for social or entertainment purposes (for example: to go shopping, visiting friends, or on an "outing")?

In a typical week, how many days do you get out of your house and go somewhere?

Approximately how many hours per week do you spend in going volunteer work for an organization?

What is your sitting tolerance per day?

How often do you exercise?

How much exercise do you get compared to other people with spinal cord injuries who have about the same severity of injury? Approximately how many hours per week do you spend in active homemaking, including parenting, housekeeping, and food preparation?

2.4.3 Physical activity in daily life of participants was assessed at the beginning of two-week intensive training and physical activity program; physical capacity components were evaluated twice: at the beginning and at the end of program. For evaluation of effectiveness of two-week training program on physical capacity components the 8 block of test were used (I table).

Table I. Description of different physical capacity components evaluated 8 block of test.

	Test	The test performance explanation
1	Tapping test	For evaluation of the hand movement rate (the time spent doing 25 hand movements)
2	Box&Block test	For evaluation of better gross manual dexterity (the count of cubes moved during 60 s)
3	Ball push test	To estimate the explosive force (in tetraplegia – 1 kg, in paraplegia – 4 kg). Meters (m)
4	Hydraulic dynamometer (0-90 kg)	For evaluation of isometric hand grip force (in the case of paraplegia)
5	"Figure eight" moving in wheelchair test	For evaluation of moving in wheelchair skills and speed – 2 meters distance ride a eight figure during 60 s (the count of eight figures)
6	A straight 20 meters sprint	For evaluation of moving speed in wheelchair (seconds)
7	30 s moving in wheelchair test	For anaerobic glycolytic capacity evaluation (meters)
8	Cupper test (12 min)	For evaluation of aerobic capacity and endurance (meters / 12 min)

Two-week intensive training and physical activity program has activities / trainings 3 times per day the duration of which was an average of 5.3±1.25 hours per day:

1) First training / exercising in the morning: physical training and general exercising for increasing the range of motion, strengthening of muscle functions (back, waist/torso, shoulder, arm and hand) and increasing of endurance;

2) Second training during midday: training of mobility and functional skills in wheelchair – transferring from/ to wheelchair/ bath/ car, fallout from wheelchair and techniques to get up from the ground, driving a long / short distances in wheelchairs, overcoming obstacles / slopes, driving a car and etc.;

3) The third activities in the evening: active recreation activities and aerobics (active and indicative games, racetrack, dancing, task on body balance, swimming in the sea, etc.).

2.5 Statistical analysis

Statistical analysis was performed using SPSS 19.0 computer software statistical package. Descriptive statistics was used for the calculation of the numerical characteristics of a variety of socio-demographic and medical indicators. The chi-square ($\chi 2$) criterion was used for the comparison of qualitative variable frequency, expressed as a percentage. For the physical activities in daily life absolute frequencies and relative frequencies (prevalence) in the research sample were reported along with their 95% CI. We inspected the distribution of all study variables to ensure that they met the assumptions of the statistical tests performed. All scales met conditions for normality and hence parametric tests were used. Mean of variables, standard deviation (SD) were calculated. Student-t test for independent samples was applied to compare the means of independent variables. For the comparison of independent samples when variables were measured on an ordinal scale, the Kruskal&Wallis H-test criterion was used. All tests were two-tailed and statistical significance was set at P<0.05, significant difference between subgroups (P<0.05, Kruskal&Wallis H-test or CI).

3. Results

3.1. Socio-demographic and SCI-related characteristics

In our research participated 64 people with SCI: 57 (89.1%) male, 7 (10.9%) female. Mean age of participants when they experienced SCI was 31.8 year (SD±5.9 years, min-max = 19-41 years, CI 95% from 24.7 to 44.5 year). Men and women were the same age (P=0.489). The majority of the participants (78.1%) belonged to the 18-34 years age group. According to the SCI localization 37 (57.8%) participants had paraplegia, 27 (42.2%) participants had tetraplegia. Traumatic SCI (78.1%) and the heaviest AIS A (54.6%) SCI types were prevailed.

According to social state 46.8% of participants were unmarried (single), 28.1% of participants were currently married and 18.8% living with boyfriend/girlfriend. 34.4% of participants had a college education, 25.0% – higher education and 25.0% – special education. During research the most of participants were unemployed (59.4%), prevailed jobs at home (15.6%) and short-term jobs <4 months/year, especially during summer time (9.3% of participants) (Table II).

Table II. General Characteristics of participants (n=64)

Characteristics	Category	Proportion, n=64 (%)
Sex	Female Male	7 (10.9%) 57 (89.1%)
SCI level	Tetraplegia Paraplegia	27 (42.2%) 37 (57.8%)
SCI type	AIS A AIS B AIS C	35 (54.6) 18 (28.1) 11 (17.2)
SCI ethology	Traumatic Non-traumatic	50 (78.1) 14 (21.9)
Marital status	Single Currently married Divorced Separated Living with girlfriend / boyfriend	30 (46.8%) 18 (28.1%) 3 (4.68%) 1 (5.56%) 12 (18.8%)
Educational state	Higher (University) education College or Special education Secondary education Primary education	16 (25.0%) 38 (59.4%) 8 (12.5 %) 2 (3.1%)
Employment state	Permanent job Private business Short-term jobs (<4 months/year) Work to order Job at home / home-works Not working	4 (6.3%) 2 (3.1%) 6 (9.3%) 3 (4.7%) 10 (15.6%) 38 (59.4%)
Living residence	Town / city Country / village Flats Private house	41 (64.1%) 23 (35.9%) 39 (60.9%) 25 (39.1%)

n – number of participants; SCI –Spinal Cord Injury.

3.2 Physical activity in Daily Life

The analysis of participant's activity related with social / community life (visits by relatives, friends/ neighbours; going to shopping, visiting friends, or on an "outing" or going volunteer work for an organization) showed that people with SCI actively participated in social life. The results showed, that participants with tetraplegia indicated that they were visited by relatives, friends or neighbours 3-4 times a week (37.1%) and more than 5 times per week (44.4%); they went outside on average 1-2 times a week (51.8%) and very rarely or few times per month went out to manage social matters (74.0%) due to lake of environment adaptation, need of permanent assistance another person in moving around in wheelchair (outside) and inability to drive independently car (moving difficulties in to/from a car, wheelchair transportation). Participants with paraplegia in social life were more active (P<0.05): they were visited by relatives, friends or neighbours 1-2 times a week (29.7%) or 3-4 times a week (21.6%), but they went outside on average 3-4 and ≥5 times a week (59.4%) and they went out to manage social matters 1-2 times per week (43.2%) or 3-4 times per week (18.9%) (Table III). Just one participant with tetraplegia was going to volunteer work in a social organization, than 5 (13.5%) participants with paraplegia participated in social organization volunteer works.

Table III. Distribution of participants according to activity in social life (n=64, 95% CI).

Frequencies	visits by relatives, friends / neighbour	get away from home for social purposes	get out of house and go somewhere
	Tetraplegia / Paraplegia		
Rarely	- / 2 (5.4%)	1 (3.7%) / -	9 (33.3%) / 3 (8.1%)
1 times per month	1 (3.7%) / 1 (2.7%)	2 (7.4%) / 2 (5.4%)	6 (22.2%) / 2 (5.4%)
2-3 times per mount	2 (7.4%) / 4 (10.8%)	3 (11.1%) / 4 (10.8%)	5 (18.5%) / 4 (10.8%)
1-2 times per week	2 (7.4%) / 11 (29.7%)	14 (51.8%) / 4 (10.8%)	4 (14.8%) / 16 (43.2%)
3-4 times per week	10 (37.1%) / 8 (21.6%)	4 (14.8%) / 13 (35.1%)	1 (3.7%) / 7 (18.9%)
≥5 times per week	6 (22.2%) / 7 (18.9%)	2 (7.4%) / 9 (24.3%)	1 (3.7%) / 4 (10.8%)
Everyday	6 (22.2%) / 4 (10.8%)	1 (3.7%) / 5 (13.5%)	1 (3.7%) / 1 (2.7%)
P value	0.042	0.007	0.012

n – number of participants; SCI – Spinal Cord Injury; P – level of significance of Kruskal&Wallis H-test criteria.

The analysis of participant's physical activity in daily life (intensive training / exercising, participation in sports / active leisure and how many hours per week do they spend in active homemaking, including parenting, housekeeping, and food preparation) showed a significant differences between participants with different SCI level. It was found different sitting tolerance in wheelchair (hours per day) of participants – time, spent in a wheelchair of participants with tetraplegia was 5.89±1.92 hours per day, and significantly different from participants with paraplegia 7.88±2.17 hours per day (P<0.001) (Figure 1).

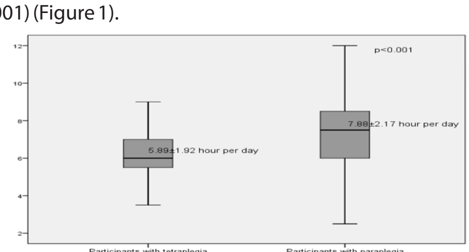

Figure 1. Distribution of participants according to the sitting tolerance in a wheelchair (hour per day).

The lowest average of hours per week participants with tetraplegia spend in active homemaking, including parenting, housekeeping, and food preparation (2.28±1.59 hour per day), than participants with paraplegia had significantly prolonged time on housework activities (3.89±3.43 hour per day, P=0.016) (Figure 2).

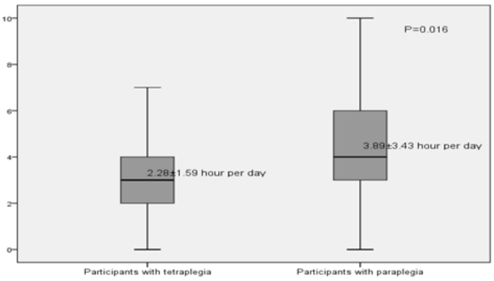

Figure 2. Distribution of participants according to participation in homework's (hour per day).

The analysis of participant's physical activity (intensive training/ exercising, participation in sports and active leisure) showed, that training / exercising were more observed between participants with tetraplegia – approximately 1.5-2 hour per day 3-4 times per week (51.8% of participants), than in paraplegia observed a decreasing training/exercising intensity from 30 minutes to 1 hours per day to 1-2 times a week (43.2%) or 2-3 times per month (29.7%) (P=0.002). However, participants with paraplegia more frequently participated in sports and active leisure activities compared with participants with tetraplegia (P<0.000) (Table IV).

Table IV. Distribution of participants according to intensity of training/ exercising, participation in sports / active leisure (95% CI).

Frequency	Intensity of exercising / training	Participation in sport / active leisure
	Tetraplegia / Paraplegia	
Rarely	- / 1 (2.7%)	11 (39.6%) / 1 (2.7%)
1 times per month	- / 2 (5.4%)	10 (37.1%) / 3 (8.1%)
2-3 times per month	1 (3.7%) / 11 (29.7%)	4 (14.8%) / 5 (13.5%)
1-2 times per week	4 (14.8%) / 16 (43.2%)	1 (3.7%) / 13 (36.8%)
3-4 times per week	14 (51.8%) / 4 (10.8%)	1 (3.7%) / 11 (29.7%)
≥5 times per week	6 (22.2%) / 3 (8.1%)	- / 3 (8.1%)
Everyday	2 (7.4%) / 1 (2.7%)	- / 1 (2.7%)
P value	0.002	<0.000

n – number of participants; SCI – Spinal Cord Injury; p – level of significance of Kruskal&Wallis H-test criteria.

3.3 The changes of physical capacity components during two-week training program

In order to determine the effectiveness of two-week intensive training and physical activity program to development of physical capacity components of people with SCI, we measured these components and compared according to SCI level – tetraplegia and paraplegia.

The analyses of participant's motor hand function improvement during two-week intensive training and physical activity program, showed significant changes of hand motor function: isometric hand grip force (in paraplegia) with evaluated with hydraulic dynamometer significantly improved from 49.46±9.78 kg to 54.18±4.44 kg (change 4.78±5.63 kg, P<0.000). The hand movement rates (Tapping test) significantly improved during program from 29.10±11.58 seconds to 28.22±10.76 seconds (change 1.28±1.82, P=0.004). However, significant improvement of hand movement rates was found just in tetraplegia (P=0.007). Significant changes was found in participants hand gross manual dexterity (Box&Block test): at the beginning of program the average of cubes count moved during 60 seconds in paraplegia was significantly better than in tetraplegia (P<0.000) however, significant improvement of hand gross manual dexterity was found just in tetraplegia (P=0.034). These results suggest that participants with paraplegia is achieved the highest level of hand movements rates and these results significantly not changed during program, but for the development of hand motor function in tetraplegia was effective two-week intensive training and physical activity program. Statistically significant changes were not found between participant's explosive force (Ball push test): at the beginning of program participants with paraplegia 4 kg ball pushed 3.81±1.21 meters and at the end of program – 3.89±1.73 meters (change 0.82±5.43, P=0.412), than participants with tetraplegia 1 kg ball pushed significantly less: at the beginning of program 2.75±1.71 meters and at the end of program – 3.24±1.89 meters (change 1.54±4.12, P=0.069) (Table V).

Table V. Hand motor function changes during two-week intensive training and physical activity program.

Tapping test results (seconds ±SD)				
	Tetraplegia (n=27)	Change, P	Paraplegia (n=37)	Change, P
Beginning of program	39.26±9.53	1.64±2.86 0.007*	20.59±3.25	0.265±1.32 0.291*
End of program	37.62±9.14		20.33±2.41	
P value	<0.000**			
Box&Block test results (count of cubes during 60 seconds ±SD)				
Beginning of program	43.39±12.27	1.23±2.57 0.034*	83.42±15.18	1.47±14.4 0.686*
End of program	44.57±12.19		84.88±4.56	
P value	<0.000**			
Ball push test (meters ±SD)				
Beginning of program	2.75±1.71	1.54±4.12 0.069*	3.81±1.21	0.82±5.43 0.412*
End of program	3.24±1.89		3.89±1.73	
P value	<0.000**			

SD– Standard Deviation; *– Student-t test for dependent samples, α=0.05; **– Student-t test for independent samples, α=0.05

For evaluation general physical capacity were applied different tests: moving skills in wheelchair was evaluated by "Figure eight" test (a count of eight figure ridded with wheelchair during 60 s), moving speed in wheelchair were evaluated by and straight 20 meters sprint test (seconds), anaerobic glycolytic capacity was evaluated by 30 seconds moving in wheelchair test (meters), aerobic capacity and endurance were evaluated applied the Cupper test (meters / 12 min).

The results of "Figure eight" test showed significant improvement of participants moving skills in wheelchair and increasing moving speed in wheelchair (P<0.05), especially of participants with paraplegia: at the beginning of program participants with tetraplegia during 60 seconds ridded on average 8.08±2.59 eight figures, at the end of program the result was improved up to 8.48±2.02 eight figures (change 1.16±0.57, P=0.013), than in paraplegia the results was significantly better – improved from 13.19±3.58 to 14.59±2.56 eight figures (change 2.48±2.25 (P=0.001) (Figure 3).

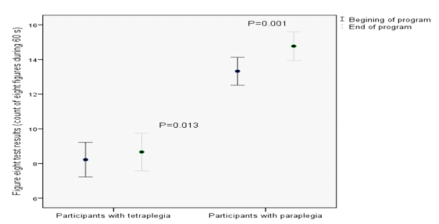

Figure 3. "Figure eight" test results two-week intensive training and physical activity program (count of eight figures / 60 seconds)

During program significantly improved moving speed in wheelchair (20 meters sprint test) just of participants with paraplegia ($P<0.05$): at the beginning program 20 meters distance participants in wheelchair moved during 10.17±13.45 seconds, at the end of program the speed results improved to 8.54±2.45 seconds (change 1.52±3.58 seconds, $P=0.041$). However, the results of participants with tetraplegia significantly not changed from 14.43±10.54 seconds to 14.59±10.01 seconds (change 0.49±0.59 seconds, $P=0.193$).

For evaluation of participant's anaerobic glycolytic capacity was applied 30 seconds moving in wheelchair test (meters). The results showed significant improvement in both groups of participants, but better results was found in paraplegia ($P<0.05$): at the beginning program during 30 seconds participants with tetraplegia moved in wheelchair 31.98±11.88 meters, at the end – 33.12±11.17 meters (change 1.57±1.82 meters, $P=0.012$), than participants with paraplegia distance was significantly longer (respectively 66.86±10.47 meters and 69.79±11.87 meters, change 2.89±2.45 meters, $P<0.001$).

Two-week intensive training and physical activity program was effective to improve aerobic capacity and endurance of participants in both groups (12 min Cupper test results): at the beginning of program participants with tetraplegia during 12 minutes overcome 515.50±271.5 meters, participants with paraplegia overcome more longer distance – 1390.84±458.89 meters ($P<0.000$). At the end of program participants with tetraplegia results significantly improved to 554.42±294.7 meters (change 54.92±64.63 meters, $P=0.045$), than participants with paraplegia changes was significantly bigger – improved to 1485.74±443.28 meters (change 89.9±99.6 meters, $P=0.000$) (Figure 4).

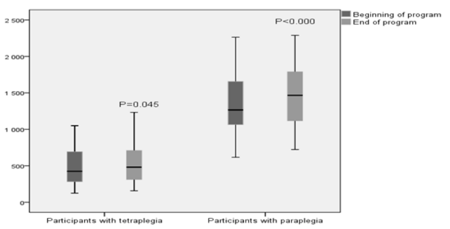

Figure 4. Cupper test results during two-week intensive training and physical activity program (meters / 12 min)

4. Discussion

Physical activity of disabled people due to SCI were decreased, therefore they have higher risk of developing chronic diseases, participation in daily life restriction and lower quality of life (13, 14). The group of researchers (15) decided, that there is strong evidence that exercise, performed 2-3 times per week at moderate-to-vigorous intensity, increases physical capacity components and muscular strength in the chronic SCI population; the evidence is not strong with respect to the effects of exercise on body composition or functional performance.

Our research results showed, that during two-week intensive training and physical activity program statistically significant improved hand motor function: hand movement rates (Tapping test) and hand gross manual dexterity (Box&Block test). These results suggest that participants with paraplegia is achieved the highest level of hand movements rates and these results significantly not changed during program, but for the development of hand motor function in tetraplegia was effective two-week intensive training and physical activity program also which can be associated with a lower overall physical activity of participants with tetraplegia due to limited self-care activities and mobility or other physical activities in the home and leisure.

Even a short two-week intensive training and physical activity program was effective on a significant improvement in aerobic and anaerobic capacity of participants with different SCI lesion. The results showed, that in paraplegia was reached higher results than in tetraplegia and was found statistically bigger change on moving skills in wheelchair ("Figure eight" test) or moving speed in wheelchair (straight 20 meters sprint test) and this confirms that in paraplegia is greater physical and functional capacity. Though S.M.Tweedya with co-authors (16) state, that there is strong, consistent evidence that exercise can improve cardiorespiratory fitness and muscular strength in people with SCI and in tetraplegia often further reduces exercise capacity due to lower maximum heart-rate and respiratory function, than is emerging evidence for a range of other exercise benefits, including reduced risk of cardio-metabolic disease, depression and shoulder pain, as well as improved respiratory function, quality-of-life and functional independence.

Our results of anaerobic glycolytic capacity (30 seconds moving in wheelchair test) and aerobic capacity and endurance (Cupper test 12 min) showed significant improvement in both group, however better results was found in paraplegia, what reveals the bigger their physical capacity and endurance. J.W. van der Scheer with co-authors (8) state, that 2-3 sessions/week of upper body aerobic exercise at a moderate to vigorous intensity for 20-40 min, plus upper body strength exercise (3 sets of 10 repetitions at 50%–80% 1-repetition max for all large muscle groups), can improve cardiorespiratory fitness, power output, and muscle strength. For chronic SCI, there was low to moderate confidence in the evidence showing that 3-5 sessions per week of upper body aerobic exercise at a moderate to vigorous intensity for 20-44 min can improve cardiorespiratory fitness, muscle strength, body composition, and cardiovascular risk. For inactive manual wheelchair users with spinal cord injury for at least 10 years during 16-week training state, that the low-intensity wheelchair training appeared insufficient for substantial effects in the sample of inactive people with long-term spinal cord injury, presumably in part owing to a too-low exercise frequency. Effective yet feasible and sustainable training, as well as other physical activity programmes remain to be developed for inactive people with long-term spinal cord injury (17). Physical activity and intensive training / exercising can have a positive impact upon health and functional state for people with SCI. Despite these benefits, people with SCI are within the most physically inactive segment of society that comprises disabled people and physical body and functional problems (muscle strength, endurance, decreased anaerobic glycolytic capacity and anaerobic capacity and ect.) were identified as a main barriers limited physical activity in daily life. That is why it is very important to successfully promote a physically active lifestyle and promote a systematic exercising / training (18).

5. Conclusions

Physical activity in daily and social life of people with SCI was decreased, but more restrictions have people with tetraplegia due to limited self-care activities, mobility or other physical activities in home and leisure. Even a short two-week intensive training and physical activity program was effective on improvement of physical capacity components of participants with different SCI lesion: hand muscle strength, movements and dexterity, moving skills and speed in wheelchair, also significantly improved anaerobic glycolytic capacity and aerobic capacity and endurance. It is necessary to pay more attention to the physical activity of people with SCI, motivating them for physical active life style and properly selected optimal physical activity and training programs, which could improve their physical capacity, functional independence, reduce the risk of chronic non-infectious diseases and improve quality of life.

6. Competing interests

The authors have no competing interest concerning this study.

7. Acknowledgments

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