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Differences in presence and distribution of various food groups in persons with spinal cord injury

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ABSTRACT

The aim of this study was to analyse the dietary habits of subjects with spinal cord injury (SCI), especially to evaluate differences in the presence and distribution of various food groups among a group of males and females. Subjects ($n = 50$, $n_1 = 36$ males, $n_2 = 14$ females) completed a frequency questionnaire, which included questions focused on the detection of size of consumed foods and frequency of consumption of various food groups (cereals, potatoes, vegetables, fruits, dairy products, meat, meat products, fats, sweets). We noted significant differences in the composition of breakfast (meat intake), lunch (vegetable intake, dairy intake), dinner (dairy intake, sweet intake), snacks (fats intake) in males and females. Differences in dietary habits of males and females with SCI especially concerned sizes of consumed servings of food, but also the representation of individual food groups in the diet throughout the day. In this context, the adapted food pyramid can be used as a visual tool to facilitate understanding and the maintenance of a healthy diet.

KEYWORDS

nutrition; dietary habits; people with special needs; spinal cord injury

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INTRODUCTION

During the last few decades, the incidence of traumatic spinal cord injuries (SCI) has increased in industrial countries, particularly among young people (Maggioni et al., 2003).

A lesion between T1 and T4 can significantly affect the autonomic control of the cardiovascular system and the symphatetic activity of the overall system (Cowell, Squires, & Raven, 1986). The injury usually results in permanent paralysis of voluntary muscles and loss of sensation below the lesion, which is associated with reduced mobility and functional independence, impairment of social and vocational activities, as well as negative influences on the person's health and well-being (Elliott, 2015). SCI causes a number of metabolic changes, i.e. changes in body composition – muscle atrophy, with a parallel increase in relative body fat mass, disturbances in carbohydrate and fat metabolism, and decrease in resting energy expenditure (REE) (Buchholz, McGillivray, & Pencharz, 2003a; Laven et al., 1989). Without an appropriate adjustment of dietary intake after injury, the energy intake easily exceeds daily energy requirements, which predisposes the affected individuals to weight gain (Buchholz, McGillivray, & Pencharz, 2003b).

Research results have led to the identification of cardiovascular risk factors (low physical activity, hypercholesterolaemia, obesity, smoking, hypertension, insulin resistance), which increase the risk of developing coronary heart disease, and non-insulin-dependent diabetes mellitus, or osteoporosis (Bauman et al., 1999; Kocina, 1997). Obesity occurs frequently in persons with SCI, and may be an important contributing factor in the development of cardiovascular disease (CVD) in this population. Estimates of overweight or obesity range from 40% to 65% of the SCI population vs. 30% of the non-SCI population (Kocina, 1997; Philippi et al., 1999). In addition to medical conditions, obesity has been shown to have profound negative effects on quality of life, self-esteem, body image, and satisfaction with life. Clinical studies have shown that anthropometric measurements such as body mass index (BMI) and waist-to-hip ratio are useful for identifying persons at risk of CVD. However, changes in body composition secondary to long term paralysis make interpretation of these parameters problematic in persons with SCI (Després et al., 1990; Houmard et al., 1991; Jakicic et al., 1993).

Increased levels of stored body fat are the result of a positive energy balance, which occurs when energy intake exceeds energy expenditure (EE). Whereas energy intake is dependent on food ingestion, the major components of EE include resting metabolic rate (RMR), dietary induced thermogenesis, and physical activity. The final major component of EE is physical activity. It is well known that individuals with SCI fall within the lowest spectrum of physical activity (Vissers et al., 2008). A necessary component of any CVD prevention is a healthy diet. This can be especially challenging for persons experiencing body composition changes, low resting metabolic rates, functional impairments, and barriers to healthy living. Predicting energy needs is a key element of the diet prescription for people with SCI, although for several reasons this is a challenging process for the clinical dietitian. The most successful weight management programs are those that incorporate periodic measurement of the body habitus (i.e., weight, body mass index, body fat, waist circumference) along with behavioral support (Feasel & Groah, 2009).

The aim of this study was to analyse the dietary habits of participants with SCI from the Czech population (n = 50, n_1 = 36, n_2 = 14), especially to evaluate differences in the presence and distribution of various food groups among a group of males and females.

METHODS

Subjects

This study contained a total amount of 50 sedentary SCI subjects from the Czech population (n_1 = 36 males – 13 tetraplegics with a lesion of segments C5–C8, 13 'higher' paraplegics with a lesion of segments T1–T10 and 10 'lower' paraplegics with a lesion T11–S5; n_2 = 14 females – 11 'higher' paraplegics with a lesion of segments T1–T10 and 3 'lower' paraplegics with a lesion T11–S5) dependent on a manual wheelchair (5 years and more). The average time since injury of subjects was 9.2 ± 6.8 years. This study was approved by the Ethics Committee of the Faculty of Physical Education and Sport, Charles University (reference number 103/2015) and measurements were performed according to the ethical standards of the Helsinki Declaration. The subjects were fully informed in advance regarding the objectives of the study, the study methods involved no risks, and written informed consent was obtained from each subject for participation in this study.

Methods

Body height (cm) was self-reported. Body weight was measured on a digital scale with a special seat to the nearest 0.1 kg. Body mass index (BMI) (kg m^{-2}) was calculated. The questionnaires and software SURVEY (version 2.95) were used to analyse dietary habits. Each participant completed a frequency questionnaire, which included questions focused on the detection of size of consumed foods and frequency of consumption of various food groups – cereals (bread, rice, pasta, dumplings), potatoes, vegetables, fruits, dairy products (milk, milk drinks, cheese, yogurts, curd), meat (red meat, poultry, fish, eggs, pulses), meat products (smoked meat, pies), fats (butter, skim, high-fat meats), sweets (desserts, wafers, chocolate, jam, honey, sugar). Participants reported how frequently they consumed a defined amount of food groups for individual meals (frequency of ingestion on the scale – several times a day – exceptionally – never).

Data Analysis

Basic descriptive statistics (mean, median, standard deviation, min – max values) were computed for all variables, which were subsequently tested for normality using Shapiro-Wilk tests. Differences in normally distributed demographic (age) and anthropometric (height, weight, BMI) variables between males and females were evaluated by independent-group t-test. When comparing nutrition habits (serving size) between males and females, the Mann-Whitney test was used, given the ordinal nature of the indicators of nutrition habits. Changes in nutrition habits during the day were assessed separately for males and females by the Friedmann test, followed by a series of Wilcoxon signed ranks tests (breakfast vs. lunch; breakfast vs. dinner; lunch vs. dinner) as a post-hoc comparison, while using a Bonferroni correction. P-values below 0.05 were considered to be statistically significant. The effect size between the means of the groups was assessed using an index of effect size – ES (Cohen's d) using formulae from Cohen (1988) and Rosenthal (1994). This was calculated as the difference of the means of the compared parameters and divided by a 'pooled' standard deviation. The effect size (ES) was assessed as follows: ES < 0.20 (small effect), ES = 0.50 (medium effect), ES > 0.80 (large effect). Statistical analyses were performed using SPSS version 22 (SPSS Inc., Chicago, IL, USA).

RESULTS

Anthropometric parameters

A total number of 50 volunteer participants with SCI were evaluated. Average values of basic anthropometric characteristics (body weight, body height, BMI) are shown in Table 1.

Table 1 Basic anthropometric characteristics of participants with SCI ($n = 50$, $n_1 = 36$ males, $n_2 = 14$ females)

	MALES		FEMALES			
	mean (SD)	(min – max)	mean (SD)	(min – max)	p-value[a]	ES*
Age (years)	32.3 (10.1)	(16.0 – 61.0)	41.4 (16.5)	(17.0 – 64.0)	0.071	**0.74**
Body weight (kg)	78.2 (12.4)	(55.0 – 115.0)	71.9 (12.0)	(57.0 – 92.0)	0.106	**0.51**
Body height (cm)	182.3 (6.9)	(165.0 – 197.0)	169.3 (5.9)	(160.0 – 179.0)	**<0.001**	**1.96**
BMI (kg m^{-2})	23.6 (4.1)	(17.0 – 35.5)	25.3 (5.0)	(17.8 – 33.2)	0.284	0.39

Note: SD – standard deviation; p-value[a] – between-group differences tested by independent-group t-test; ES* – effect size of the between-group differences measured by Cohen's d, medium and large effects are in bold

Anthropometric parameters of males and females were evaluated and compared. Significant difference was evaluated only at values of body height (cm) between groups of males and females ($p < 0.001$, ES = 1.96). Differences in age values (ES = 0.74), body weight (ES = 0.51) and BMI (ES = 0.39) were statistically insignificant. The average value of BMI (23.6 ± 4.1 kg m^{-2}) of males was at the recommended range for optimal body weight in the normal adult population (BMI = 18.5 – 24.9 kg m^{-2}, WHO, 2015), and the average value of BMI at females was (25.3 ± 5.0 kg m^{-2}), above the upper limit for assessing optimal body weight.

Dietary habits

A questionnaire survey is primarily able to help us to determine the quantity of consumed servings and ingestion frequency of individual food groups (Table 2). The following analysis of questionnaires by software SURVEY (version 2.95) allows the evaluation of dietary habits in the form of a dietary pyramid (Fig. 1, Fig. 2).

Size of consumed servings of individual food groups was different between males and females. Male subjects consumed larger servings of individual food groups on average than female subjects. Significant differences were found in size of consumed servings of cereals ($p < 0.05$, ES = 0.67) and fats ($p < 0.05$, ES = 0.62) (Table 2).

Table 2 Size of individual food groups

	MALES		FEMALES			
	mean (SD)	median (min – max)	mean (SD)	median (min – max)	p-value[b]	ES*
Cereals	1.6 (0.8)	1.3 (0.5 – 4)	1.1 (0.4)	1 (0.5 – 2)	**0.024**	**0.67**
Potatoes	1.3 (0.7)	1 (0.5 – 3)	1.0 (0.5)	1 (0.5 – 2)	0.148	0.42
Vegetables	1.3 (0.7)	1 (0.5 – 4)	1.1 (0.3)	1 (0.5 – 2)	0.655	0.13
Fruits	1.3 (0.5)	1 (0.5 – 3)	1.2 (0.4)	1 (1 – 2)	0.694	0.11
Dairy products	1.2 (0.5)	1 (0.5 – 3)	1.1 (0.4)	1 (0.5 – 2)	0.646	0.13
Meat	1.5 (0.7)	1.5 (0.5 – 3)	1.2 (0.5)	1 (0.5 – 2)	0.078	0.51
Meat products	1.0 (0.4)	1 (0.5 – 2)	0.9 (0.4)	1 (0.5 – 2)	0.445	0.22
Fats	0.9 (0.4)	1 (0.5 – 2)	0.7 (0.3)	0.5 (0.5 – 1)	**0.035**	**0.62**
Sweets	1.2 (0.7)	1 (0.5 – 3)	1.0 (0.6)	1 (0.5 – 2)	0.543	0.17

Note: SD – standard deviation; serving size – 0.5 = half, 1 = standard serving, 1.5 = 1.5 times langer, 2 = 2 times langer, 3 = 3 times langer, 4 = 4 times langer; p-value[b] – between-group differences tested by Mann-Whitney test; ES* – effect size of the between-group differences measured by Cohen's d, medium and large effects are in bold

Table 3 Ingestion frequency of individual food groups during the day

		MALES			FEMALES				
		mean (SD)	median (min – max)	p-value[w]	mean (SD)	median (min – max)	p-value[w]	p-value[b]	ES*
Cereals	breakfast	5.9 (1.6)	6 (1 – 7)	p^{bl} = **0.001**	5.1 (2.4)	6 (1 – 7)	p^{bl} = 0.413	0.473	0.20
	lunch	4.9 (1.1)	5 (2 – 7)	p^{ld} = 0.382	4.5 (1.3)	5 (1 – 6)	p^{ld} = 0.355	0.322	0.28
	dinner	5.1 (1.4)	5 (2 – 7)	p^{bd} = **0.006**	5.0 (2.1)	5 (1 – 7)	p^{bd} = 0.496	0.813	0.07
	snacks	3.2 (2.3)	3 (1 – 8)		3.4 (2.6)	3 (1 – 8)		0.946	0.02
Potatoes	breakfast	1.3 (0.9)	1 (1 – 5)	p^{bl} < **0.001**	1.0 (0.1)	1 (1 – 1)	p^{bl} = **0.003**	0.270	0.32
	lunch	4.1 (0.8)	4 (2 – 5)	p^{ld} < **0.001**	3.4 (1.7)	4 (1 – 5)	p^{ld} = **0.008**	0.329	0.28
	dinner	3.2 (1.3)	3.5 (1 – 5)	p^{bd} < **0.001**	2.6 (1.6)	3 (1 – 5)	p^{bd} = **0.008**	0.312	0.29
	snacks	1.3 (0.9)	1 (1 – 5)		1.0 (0.1)	1 (1 – 1)		0.198	0.37
Vegetables	breakfast	2.0 (1.4)	1 (1 – 5)	p^{bl} < **0.001**	1.6 (1.2)	1 (1 – 4)	p^{bl} = **0.001**	0.385	0.25
	lunch	4.0 (1.5)	4 (1 – 7)	p^{ld} = 0.718	4.9 (1.5)	5 (2 – 7)	p^{ld} = 0.951	0.056	**0.56**
	dinner	4.1 (1.8)	4 (1 – 7)	p^{bd} < **0.001**	4.9 (1.5)	5 (1 – 7)	p^{bd} = **0.002**	0.111	0.46
	snacks	3.3 (2.2)	4 (1 – 8)		3.9 (2.4)	4 (1 – 7)		0.351	0.27
Fruits	breakfast	3.1 (1.9)	3 (1 – 7)	p^{bl} = 0.520	3.9 (2.3)	4 (1 – 7)	p^{bl} = 0.024	0.264	0.32
	lunch	2.8 (1.6)	3 (1 – 7)	p^{ld} = **0.006**	2.4 (2.1)	1 (1 – 7)	p^{ld} = 0.043	0.183	0.38
	dinner	3.4 (1.7)	4 (1 – 7)	p^{bd} = 0.214	3.6 (2.1)	4 (1 – 7)	p^{bd} = 0.682	0.689	0.11
	snacks	4.8 (2.4)	5 (1 – 8)		6.1 (1.8)	7 (2 – 8)		0.111	0.46

Dairy	breakfast	4.3 (1.9)	5 (1 – 7)	$p^{bl} <$ **0.001**	3.8 (2.2)	4 (1 – 7)	$p^{bl} =$ **0.003**	0.474	0.20
products	lunch	2.2 (1.3)	2 (1 – 5)	$p^{ld} <$ **0.001**	1.5 (1.1)	1 (1 – 4)	$p^{ld} = 0.125$	0.052	**0.57**
	dinner	3.7 (1.5)	4 (1 – 7)	$p^{bd} = 0.078$	2.4 (1.5)	1.5 (1 – 5)	$p^{bd} = 0.071$	**0.012**	**0.76**
	snacks	3.3 (2.3)	4 (1 – 7)		4.1 (2.6)	4.5 (1 – 8)		0.221	0.35
Meat	breakfast	2.7 (1.8)	2.5 (1 – 6)	$p^{bl} <$ **0.001**	1.6 (1.3)	1 (1 – 5)	$p^{bl} =$ **0.001**	**0.026**	**0.67**
	lunch	5.4 (1.2)	5 (2 – 7)	$p^{ld} <$ **0.001**	5.3 (1.2)	5 (4 – 7)	$p^{ld} =$ **0.007**	0.822	0.08
	dinner	4.1 (1.4)	4 (1 – 7)	$p^{bd} =$ **0.001**	3.8 (1.5)	4 (1 – 6)	$p^{bd} =$ **0.004**	0.591	0.15
	snacks	1.8 (1.1)	1 (1 – 4)		1.3 (0.8)	1 (1 – 4)		0.102	0.48
Meat	breakfast	2.9 (1.8)	3 (1 – 7)	$p^{bl} = 0.059$	2.3 (2.3)	1 (1 – 7)	$p^{bl} = 0.681$	0.102	0.47
products	lunch	2.2 (1.4)	2 (1 – 5)	$p^{ld} =$ **0.001**	1.9 (1.4)	1.5 (1 – 6)	$p^{ld} = 0.073$	0.337	0.27
	dinner	3.3 (1.4)	4 (1 – 6)	$p^{bd} = 0.152$	3.0 (1.9)	2.5 (1 – 6)	$p^{bd} = 0.117$	0.667	0.12
	snacks	1.9 (1.4)	1 (1 – 6)		1.6 (1.4)	1 (1 – 5)		0.324	0.28
Fats	breakfast	5.1 (1.4)	2.5 (1 – 7)	$p^{bl} = 0.320$	2.9 (2.4)	1.5 (1 – 7)	$p^{bl} = 0.776$	0.589	0.15
	lunch	2.9 (2.0)	2 (1 – 7)	$p^{ld} = 0.707$	2.8 (2.4)	2 (1 – 7)	$p^{ld} = 0.414$	0.824	0.06
	dinner	3.0 (2.0)	2.5 (1 – 7)	$p^{bd} = 0.554$	3.1 (2.5)	2 (1 – 7)	$p^{bd} = 0.595$	0.929	0.03
	snacks	2.3 (1.9)	1 (1 – 7)		1.0 (0.1)	1 (1 – 1)		**0.003**	**0.91**
Sweets	breakfast	2.7 (1.7)	2 (1 – 7)	$p^{bl} = 0.021$	2.4 (1.4)	2 (1 – 4)	$p^{bl} = 0.184$	0.472	0.20
	lunch	2.0 (1.3)	2 (1 – 7)	$p^{ld} = 0.414$	1.8 (0.8)	2 (1 – 3)	$p^{ld} = 0.020$	0.899	0.04
	dinner	2.2 (1.5)	1.5 (1 – 6)	$p^{bd} = 0.172$	1.3 (0.5)	1 (1 – 2)	$p^{bd} = 0.026$	0.056	**0.56**
	snacks	2.6 (2.1)	2 (1 – 9)		3.2 (1.5)	4 (1 – 5)		0.121	0.45

Note: SD – standard deviation; the frequency of intake of individual food groups – 1 = less than once a month, 2 = 1–2 times per month, 3 = 3–4 times per month, 4 = 1–2 times per week, 5 = 3–4 times per week, 6 = 5–6 times per week, 7 = once a day, 8 = 2 times per day, 9 = 3 + times per day; p-value^{w} – within-group differences tested by Wilcoxon test with Bonferoni correction; p^{bl} – p-value of the difference between breakfast and lunch; p^{ld} – p-value of the difference between lunch and dinner; p^{bd} – p-value of the difference between breakfast and dinner; p-value^{b} – between-group differences tested by Mann-Whitney test; ES* – effect size of the between-group differences measured by Cohen's d, medium and large effects are in bold

Table 3 shows conclusive differences between males and females in ingestion frequency and representation of individual food groups. Regarding individual meal composition, we noted significant differences in the composition of breakfast (meat intake – $p < 0.05$, ES = 0.67), lunch (vegetable intake – $p = 0.056$, ES = 0.56; dairy intake – $p = 0.052$, ES = 0.57), dinner (dairy intake – $p < 0.05$, ES = 0.76; sweet intake – $p = 0.056$, ES = 0.56), and snacks (fats intake – $p < 0.05$, ES = 0.91) in males and females.

Significant changes were found between individual meals of males and females during the day. We found significant changes in amount of cereals ($p^{bl} = 0.001$, $p^{bd} = 0.006$), potatoes ($p^{bl} < 0.001$, $p^{ld} < 0.001$, $p^{bd} < 0.001$), vegetables ($p^{bl} < 0.001$, $p^{bd} < 0.001$), fruits ($p^{ld} = 0.006$), dairy products ($p^{bl} < 0.001$, $p^{ld} < 0.001$), meat ($p^{bl} < 0.001$, $p^{ld} < 0.001$, $p^{bd} = 0.001$), and meat products ($p^{ld} = 0.001$) in males. We noted significant changes in amount of potatoes ($p^{bl} = 0.003$, $p^{bd} = 0.008$, $p^{bd} = 0.008$), vegetables ($p^{bl} = 0.001$, $p^{bd} = 0.002$), dairy products ($p^{bl} = 0.003$), and meat ($p^{bl} = 0.001$, $p^{ld} = 0.007$, $p^{bd} = 0.004$) in females.

The food pyramid expresses the principles of an everyday well-balanced diet. The pyramid chart compares graphically the 'ideal' (desirable) and actual consumption of different food groups. The average dietary pyramid of males and females is shown in Fig. 1 and Fig. 2. There are evident differences in the average representation of cereals, fruit, vegetables and other foods (fats, sweets) between males and females.

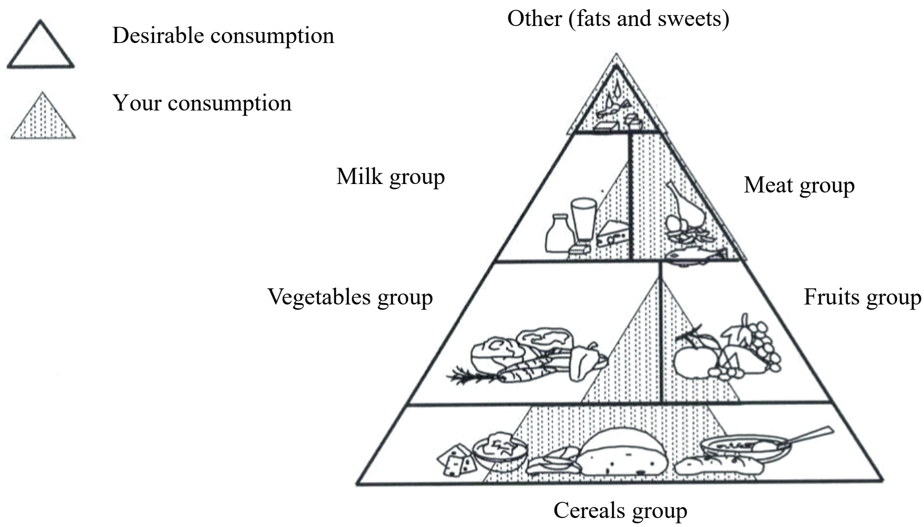

Figure 1 The food pyramid (software SURVEY) – Evaluation of dietary habits of males with SCI ($n_1 = 36$)

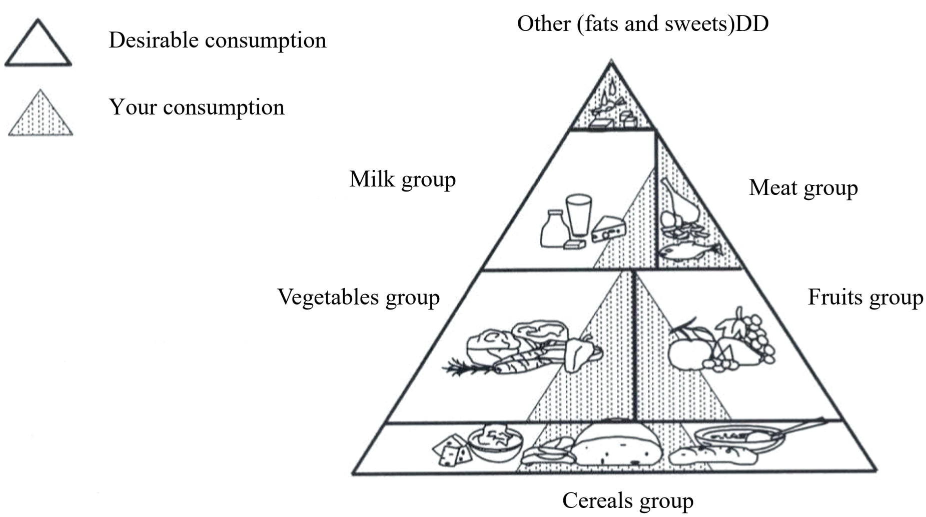

Figure 2 The food pyramid (software SURVEY) – Evaluation of dietary habits of females with SCI ($n_2 = 14$)

DISCUSSION AND CONCLUSION

It has been reported that the annual incidence of SCI varies between 11.5 and 57.8 cases per million people in different countries (Ackery, Tator, & Krassioukov, 2004). This happens usually in the population between 20–40 years of age. Most of these patients return home and, sometimes thanks to progressive possibilities of job opportunities, they may return to work as well. Sensomotor and autonomic function disorder causes changes within body composition, with impaired processing and storage of virtually all nutrients. A significantly reduced level of basal metabolism, together with low physical activity, causes positive energetic balance, with a risk of obesity and metabolic syndrome development (Kriz, Hlinkova, & Slaby, 2014). Therefore it is necessary to approach the problem of obesity, which is one of the risk factors of atherosclerosis, CVD, diabetes mellitus and other civilization diseases, with full knowledge of the possible arising complications (Buchholz, McGillivray, & Pencharz, 2003; Spungen et al., 2003).

Nutritional information about the SCI population is a very important and challenging issue (Perret & Stoffel-Kurt, 2011). The most common reason for poor dietary habits is a lack of knowledge of the proper principles of nutrition (Kriz, Hlinkova, & Slaby, 2014). Monroe et al. (1998) show that the average daily dietary needs of people with SCI are individually modified. Moreover, the nutrition of patients with SCI has a major impact on secondary complications such as pressure sores and prolonged wound healing, negative nitrogen balance, digestion problems, reduced immunofunction, and osteoporosis (Bauman & Spungen, 2000).

In fact, the nutritional behavior of participants with SCI has been investigated in several studies so far, but most studies have evaluated total energy intake, balance of macronutrients, intake of fiber, intake of fat, etc. (Levine et al., 1992; Moussavi et al., 2001; Tomey et al., 2005; Groah et al., 2009). In the study of Tomey et al. (2005) analysis of the macronutrient composition of the diet has shown that individuals with SCI typically consume a diet that provides more than 30% of their total daily energy intake from fat. According to the studies of Levine et al. (1992) and Moussavi et al. (2001), consumption of a diet low in fat can help with weight loss because it can be part of a lower caloric density diet, which encourages the consumption of high fiber foods that foster satiety and are compatible with diets advised for overall health. Generally, intake behaviours of people with SCI favor diets high in fat (31.1%–37.9% of kcal), low to normal in carbohydrate intake (4.4%–52.5% kcal) and low in fiber (12.7–14.5 g/day). Also, like the trends observed in the general population, the diet of people with SCI tends to include an excess intake of total and saturated fat and an inadequate intake of fiber, calcium, fruit, and dairy (Levine et al., 1992; Tomey et al., 2005; Groah et al., 2009).

The use of the food pyramid in SCI studies is so infrequent that we have no adequate comparison with our results. However, in our opinion, evaluation of dietary habits according to the principles of the nutritional pyramid could be one possible approach within dietary intervention. The food pyramid expresses the principles of an everyday well-balanced diet. The pyramid chart compares graphically the 'ideal' (desirable) and actual consumption of different food groups for the general population (Philippi et al., 1999). Our questionnaire survey has shown differences in the representation of individual food groups in meals between males and females (Table 2, Table 3), which reflect differences in dietary habits (Fig. 1, Fig. 2). Male subjects consumed larger servings of individual food groups on average than female subjects, and only the size of consumed serving of meat products was the same in males and females (Table 2). The most significant differences ($p < 0.05$) were mainly in the size of consumed servings of cereal and fats.

We found, that food group preference differs between males and females. Males prefer cereals, dairy products and fats for breakfast; vegetables and meat for lunch; cereals, vegetables and meat for dinner; and fruits and dairy products for snacks. Females prefer cereals, fruits and dairy products for breakfast; cereals, vegetables, meat and fats for lunch; vegetables, fruits and meat for dinner; and fruits, dairy products and sweets for snacks. Regarding individual meal composition, we noted significant differences between males and females in the composition of breakfast (meat intake), lunch (vegetable intake, dairy intake), dinner (dairy intake, sweets intake) and snacks (fats intake). We found that females consumed on average more vegetables and fruits than males. Significant differences were found between individual meals of males and females during the day. We found significant differences in amount of cereals, potatoes, vegetables, fruits, dairy products, meat and meat products in males. We noted significant differences in amount of potatoes, vegetables, dairy products and meat in females (Table 3). To link large portion sizes of food to excess energy intake and the increased prevalence of obesity, the effect of portion size on food intake must be established. Unfortunately, these questionnaires and software SURVEY do not calculate individual energy intake.

The fact that dietary habits were different in males and females with SCI in the present study were in accordance with the result of similar nutritional studies in SCI subjects (Moussavi et al., 2001; Walters et al., 2009). From the available studies, we can draw some recommendations. According to the study of Feasel & Groah (2009) an important factor for persons with SCI is reducing reliance on convenience foods, which tend to be high in calories, fat and sodium. This may be more difficult for some people with SCI, as limited mobility favors reliance on convenience and fast foods over cooking meals at home. Another recommendation for people with SCI is to reduce the portion sizes. General principles of the nutritional plan include consuming more of the following foods: dark green vegetables (string beans, broccoli, spinach, cauliflower, cabbage, Chinese cabbage), orange vegetables (carrots, pumpkins), legumes (lens, peas, lima beans), fruits, whole grains, and low-fat milk and milk products. Conversely, the following foods should be limited: refined grains, total fats (especially cholesterol, saturated, and trans fats), added sugars, and calories (Folsom, Parker, & Harnack, 2007).

It is highly recommended that nutrition assessment should be performed during acute, sub-acute and chronic phases of rehabilitation after SCI. Each of these phases should have a set of nutritional goals that address the adaptations in body composition, metabolism and lifestyle after SCI. The need to monitor caloric intake based on the measured basal metabolic rate is an advisable strategy to reduce the burden of obesity (Levine et al., 1992).

In conclusion, the data from the present study show significant differences in dietary habits (sizes of consumed servings of food, and the representation of individual food groups in the diet throughout the day) of males and females with SCI. When we evaluate eating habits, it is very important to adopt an individual approach to each client.

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REFERENCES

Ackery, A., Tator, C., & Krassioukov, A. (2004). A global perspective on spinal cord injury epidemiology. *Journal Neurotrauma*, *21*(10), 1355–1370.

Bauman, W. A., Spungen, A. M., Adkins, R. H., & Kemp, B. J. (1999). Metabolic and endocrine changes in persons aging with spinal cord injury. *Assistive technology*, *11*(2), 88–96.

Bauman, W. A., & Spungen, A. M. (2000). Metabolic changes in persons after spinal cord injury. *Physical medicine and rehabilitation clinics of North America*, *11*(1), 109–140.

Buchholz, A. C., McGillivray, C. F., & Pencharz, P. B. (2003a). Differences in resting metabolic rate between paraplegic and able-bodied subjects are explained by differences in body composition. *The American journal of clinical nutrition*, *77*(2), 371–378.

Buchholz, A. C., McGillivray, C. F., & Pencharz, P. B. (2003b). Physical activity levels are low in free-living adults with chronic paraplegia. *Obesity research*, *11*(4), 563–570.

Cohen, J. (1988). *Statistical Power Analysis for the Behavioral Sciences* (2nd ed.). Hillsdale, NJ: Erlbaum.

Cowell, L. L., Squires, W. G., & Raven, P. B. (1986) Benefits of aerobic exercise for the paraplegic: a brief review. *Medicine and Science in Sports and Exercise*, *18*(5), 501–508.

Després, J. P., Moorjani, S., Lupien, P. J., Tremblay, A., Nadeau, A., & Bouchard, C. (1990). Regional distribution of body fat, plasma lipoproteins, and cardiovascular disease. *Arteriosclerosis*, *10*(4), 497–511.

Elliott, T. R. (2015). Studying depression following spinal cord injury: Evidence, policy and practice. *The Journal of Spinal Cord Medicine*, *38*(5), 584–586.

Feasel, S., & Groah, S. (2009). The impact of diet on cardiovascular disease risk in individuals with spinal cord injury. *Topics in Spinal Cord Injury Rehabilitation*, *14*(3), 58–68.

Folsom, A. R., Parker, E. D., & Harnack, L. J. (2007). Degree of concordance with DASH diet guidelines and incidence of hypertension and fatal cardiovascular disease. *American Journal of Hypertension*, *20*(3), 225–232.

Groah, S. L., Nash, M. S., Ljungberg, I. H., Libin, A., Hamm, L. F., Ward, E., & Enfield, G. (2009). Nutrient intake and body habitus after spinal cord injury: an analysis by sex and level of injury. *The Journal of Spinal Cord Medicine*, *32*(1), 25–33.

Houmard, J. A., Wheeler, W. S., McCammon, M. R., Wells, J. M., Truitt, N., Hamad, S. F., & Barakat, H. A. (1991). An evaluation of waist to hip ratio measurement methods in relation to lipid and carbohydrate metabolism in men. *International journal of obesity*, *15*(3), 181–188.

Jakicic, J. M., Donnelly, J. E., Jawad, A. F., Jacobsen, D. J., Gunderson, S. C., & Pascale, R. (1993). Association between blood lipids and different measures of body fat distribution: effects of BMI and age. *International journal of obesity and related metabolic disorders: journal of the International Association for the Study of Obesity*, *17*(3), 131–137.

Kocina, P. (1997). Body composition of spinal cord injured adults. *Sports Medicine*, *23*(1), 48–60.
Kriz, J., Hlinkova, Z., & Slaby, K. (2014). Metabolic changes after spinal cord injury. Part I: Differences in body composition and metabolic consequences. *Diabetologie, Metabolismus, Endokrinologie, Vyziva*, *17*(4), 209–213.
Laven, G. T., Huang, C. T., DeVivo, M. J., Stover, S. L., Kuhlemeier, K. V., & Fine, P. R. (1989). Nutritional status during the acute stage of spinal cord injury. *Archives of Physical Medicine and Rehabilitation*, *70*(4), 277–282.
Levine, A. M., Nash, M. S., Green, B. A., Shea, J. D., & Aronica, M. J. (1992). An examination of dietary intakes and nutritional status of chronic healthy spinal cord injured individuals. *Paraplegia*, *30*(12), 880–889.
Maggioni, M., Bertoli, S., Margonato, V., Merati, G., Veicsteinas, A., & Testolin, G. (2003). Body composition assessment in spinal cord injury subjects. *Acta Diabetologica*, *40*(1), 183–186.
Monroe, M. B., Tataranni, P. A., Pratley, R., Manore, M. M., Skinner, J. S., & Ravussin, E. (1998). Lower daily energy expenditure as measured by a respiratory chamber in subjects with spinal cord injury compared with control subjects. *The American Journal of Clinical Nutrition*, *68*(6), 1223–1227.
Moussavi, R. M., Ribas-Cardus, F., Rintala, D. H., & Rodriguez, G. P. (2001). Dietary and serum lipids in individuals with spinal cord injury living in the community. *Journal of Rehabilitation Research and Development*, *38*(2), 225–233.
Perret, C., & Stoffel-Kurt, N. (2011). Comparison of nutritional intake between individuals with acute and chronic spinal cord injury. *The Journal of Spinal Cord Medicine*, *34*(6), 569–575.
Philippi, S. T, Latterza, A. R, Cruz, A. T. R, & Ribeiro L. C. (1999). Adapted food pyramid: a guide for a right food choice. *Revista de Nutrição*, *12*(1), 65–80.
Rosenthal, R. (1994). Parametric measures of effect size. In: H. Cooper & L. V. Hedges (Eds.), *The Handbook of Research Synthesis*. New York, NY: Sage.
Spungen, A. M., Adkins, R. H., Stewart, C. A., Wang, J., Pierson, R. N., Waters, R. L., & Bauman, W. A. (2003). Factors influencing body composition in persons with spinal cord injury: a cross-sectional study. *Journal of Applied Physiology*, *95*(6), 2398–2407.
Tomey, K. M., Chen, D. M., Wang, X., & Braunschweig, C. L. (2005). Dietary intake and nutritional status of urban community-dwelling men with paraplegia. *Archives of Physical Medicine and Rehabilitation*, *86*(4), 664–671.
Vissers, M., van den Berg-Emons, R., Sluis, T., Bergen, M., Stam, H., & Bussmann, H. (2008). Barriers to and facilitators of everyday physical activity in persons with a spinal cord injury after discharge from the rehabilitation centre. *Journal of Rehabilitation Medicine*, *40*(6), 461–467.
Walters, J. L., Buchholz, A. C., & Ginis, K. M. (2009). Evidence of dietary inadequacy in adults with chronic spinal cord injury. *Spinal Cord, 47*(4), 318–322.