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THE ROLE OF PHYSICAL ACTIVITY IN THE LIFESTYLE OF THE INHABITANTS OF THE LIBEREC REGION

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ABSTRACT

Purpose. The aim of the study is to characterize physical activity and physical inactivity of the inhabitants of the Liberec region in their common life. **Basic procedures.** The research sample consisted of 818 males and 831 females aged 15–69, which were either systematically or randomly drawn from throughout the region. Physical activity and its correlates were assessed using the IPAQ questionnaire. **Main findings.** According to self-reported data, 10% of the inhabitants are insufficiently physically active, 30% are sufficiently physically active, and 60% are highly physically active. The median of performed physical activity in the inhabitants in Liberec region expressed in MET · min^{-1} · week^{-1} was 3822 MET · min^{-1} · week^{-1} (IQR = 4371). On average, men spent sitting 393 min and women 415 min in total during a working day. Out of the total sample of respondents, 58% of the inhabitants in the Liberec region were of normal weight, 9% were underweight, 23% were overweight and 10% obese. **Conclusions.** These facts point to the necessity of increasing knowledge about the negative impacts of inactive behavior and emphasizing the advantages of performing regular physical activity along with the need to establish such conditions that would contribute to physical activity performance.

Key words: IPAQ, BMI, inactivity, intensity, correlates

Introduction

The decline in physical activity is one the characteristics that are monitored worldwide, and not only in relation to obesity and overweight [1–4]. It is essential to distinguish between physical activity and energy expenditure as these are not identical terms. Physical activity is defined as behavior that results in energy expenditure and is often described using FITT characteristics (frequency, intensity, time, type). The energy expenditure or its energy equivalent in MET is through the level of metabolism or PA intensity associated with the particular physical activity and thus is the indicator of the level of the physical activity [5].

The positive effect of regularly performed physical activity is well reflected in literature. Regular physical activity of optimal intensity and duration positively influences the efficiency of cardiovascular system, diabetes mellitus, hypertension, osteoporosis, overweight, mental health, etc. [6–8]. Recommendations for and effective intervention in physical activity regimes should be based on a standardized tool for assessing physical activity, which would allow such assessment to be made according to different intensities and different contexts [9]. The standardized International Physical Activity Questionnaire (IPAQ) can be applied as such a tool, since it also allows international comparisons and identification of the correlates of physical activity.

The aim of the study is to characterize physical activity and physical inactivity of the inhabitants of the Liberec region in their common lives. Further, through providing the findings to regional policy-makers to facilitate the improvement of the conditions necessary for active lifestyle of the inhabitants.

Material and methods

The survey was carried out as a part of the nationwide research of physical activity which itself was a part of an international research called International Physical Activity Questionnaire Prevalence Study. Physical activity was assessed using the IPAQ, namely its internationally standardized short administrative version

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[10, 11]. The questionnaire assesses physical activity performed during the past seven days. It makes it possible to compare physical activity of vigorous and moderate intensity, walking and sitting in relation to other personal, demographic and environmental data. The data were collected in 2002–2004. In total, four surveys were carried out during this period; in two fall terms and two spring terms. The questionnaires were distributed systematically and randomly. Overall, 1649 questionnaires were collected from the respondents aged 15–69 in the Liberec region (818 men and 831 women). The Liberec province is a mountainous area offering lots of opportunities for physical activity. Any changes to the collected data were done in compliance with the internationally implemented guidelines for data processing issued by the "IPAQ Research Committee" (for more information, visit www.ipaq.ki.se). When assessing the intensity of physical activity in METs, vigorous activity was set to equal the energy expenditure of 6 METs, moderate activity of 4 METs, and walking of 3.3 METs.

The overall average physical activity expressed in terms of $MET \cdot min^{-1} \cdot week^{-1}$ was calculated from average minute data for a given physical activity (vigorous PA, moderate PA, walking) multiplied by the appropriate energy equivalent in METs for the given physical activity intensity. The sum of the values of vigorous PA, moderate PA, and walking in terms of $MET \cdot min^{-1} \cdot week^{-1}$ expresses the total physical activity.

The participants were divided into age groups of 15–29, 30–49 and 50–69 for further analyses. The basic characteristics of the sample according to age are given in Tab. 1. Based on the Body Mass Index (BMI), the participants were classified into the following categories in compliance with the classification by Placheta et al. [12]. BMI is defined as the individual's body weight divided by the square of their height. The formulas universally used in medicine produce a unit of measure kg/m^2. Underweight men have the BMI of $< 20\ kg \cdot m^{-2}$ and underweight women have BMI $< 19\ kg \cdot m^{-2}$. BMI in the range of 20–24.9 $kg \cdot m^{-2}$ for men and 19–23.9 $kg \cdot m^{-2}$ for women denotes normal weight. BMI values in the range of 25–29.9 $kg \cdot m^{-2}$ for men and 24–28.9 $kg \cdot m^{-2}$ for women denote overweight.

BMI values over 30 $kg \cdot m^{-2}$ in men and over 29 $kg \cdot m^{-2}$ in women inclusive denote severe or morbid obesity. In order to assess the level of activity, we follow the classification by Abu-Omar et al. [9], who consider the respondents to be sufficiently physically active if they reach the minimal level of 600 $MET \cdot min^{-1} \cdot week^{-1}$ and as highly physically active if they reach the minimal level of 1500 $MET \cdot min^{-1} \cdot week^{-1}$ (for more information, visit www.ipaq.ki.se). The persons who have not reached the level of 600 $MET \cdot min^{-1} \cdot week^{-1}$ are insufficiently physically active.

In order to assess the significant differences, use was made of the non-parametric Kruskal-Wallis test along with the effect size coefficient η^2, the values of which are: $\eta^2 = 0.01$ for low, $\eta^2 = 0.06$ for medium and $\eta^2 = 0.14$ for high effect [13].

Results

The results show that men overall performed vigorous physical activity 2.46 days in a week, moderate physical activity 2.87 days in a week and walking 5.30 in a week. Women performed vigorous physical activity 1.72 days in a week, moderate physical activity 2.4 days in a week and walking 5.65 in a week. Other results concerning the performance of physical activity and sitting differentiated according to age categories are presented in Tab. 2.

In total, regardless of the age, men show higher level of physical activity than women ($H_{1, 1649} = 16.03$, $p = 0.0001$,

Table 1. Characteristics of the sample (weight, height, BMI, age)

Age	Sex	Weight (kg) M (SD)	Height (cm) M (SD)	BMI ($kg \cdot m^{-2}$) M (SD)	Average age in the category M (SD)
Aged 15–29	Males (n = 363)	74.62 (10.75)	179.99 (8.15)	23.00 (2.77)	21.66 (5.88)
	Females (n = 330)	58.81 (7.61)	137.84 (6.59)	20.87 (2.39)	21.61 (4.06)
Aged 30–49	Males (n = 296)	83.33 (11.10)	180.12 (7.37)	25.69 (3.22)	41.42 (5.88)
	Females (n = 337)	65.53 (10.94)	166.94 (5.83)	23.51 (3.74)	41.19 (5.44)
Aged 50–69	Males (n = 159)	84.52 (12.51)	176.99 (6.88)	26.92 (3.55)	55.58 (4.95)
	Females (n = 164)	71.05 (11.32)	164.91 (6.17)	26.15 (4.09)	55.85 (5.27)

M – mean, SD – standard deviation, n – the size of the sample

Table 2. Average data on physical activity performance and sitting depending on age

Physical activity		Aged 15–29				Aged 30–49				Aged 50–69			
		Males (n = 363)		Females (n = 330)		Males (n = 296)		Females (n = 337)		Males (n = 159)		Females (n = 164)	
		M	SD	M	SD	M	SD	M	SD	M	SD	M	SD
Vigorous PA	day·week^{-1}	2.74	2.19	2.07	1.87	2.34	2.07	1.60	1.94	2.04	2.05	1.25	1.83
	min·week^{-1}	311	362	198	257	299	373	168	275	279	387	127	231
Moderate PA	day·week^{-1}	2.89	2.16	2.43	2.05	2.85	2.19	2.44	2.23	2.82	2.50	2.33	2.17
	min·week^{-1}	296	348	218	282	337	381	427	348	345	442	247	328
Walking	day·week^{-1}	5.50	2.04	5.82	1.87	5.10	2.35	5.53	1.88	5.22	2.21	5.56	1.89
	min·week^{-1}	593	505	969	529	605	514	683	563	624	544	702	542
Sitting	min·workday^{-1}	408	181	429	177	377	188	401	179	389	194	418	175

PA – physical activity, M – mean, SD – standard deviation, n – the size of the sample

Table 3. Assessment of the differences in the total weekly physical activity depending on sex and age (MET·min^{-1}·week^{-1})

Age category	Sex	n	Mdn	IQR	H	p	η^2
Aged 15–29	men	363	4158	4452	3.22	0.073	0.005
	women	330	3879	3918			
Aged 30–49	men	296	4152	4704	**10.99**	**0.001**	**0.017**
	women	337	3383	4011			
Aged 50–69	men	159	3726	6270	2.77	0.096	0.008
	women	164	3306	4626			
Aged 15–69	men	818	4020	4833	**16.03**	**0.0001**	**0.010**
	women	831	3537	4143			

n – the size of the (sub)sample, Mdn – median, IQR – inter-quartile range, H – testing criterion of Kruskal-Wallis test, p – the level of statistical significance, η^2 – coefficient of effect size

η^2 = 0.01). Based on a more detailed analysis, we can conclude that there is significantly higher level of physical activity in men only in the age category of 30–49; in other age categories this premise has not been confirmed (see Tab. 3).

According to the self-reported data, 10% of the inhabitants are insufficiently physically active, 30% are sufficiently physically active and 60% are highly physically active. In the age category of 15–29, we have identified only 8% of respondents who were insufficiently active, 27% are sufficiently active and 65% are highly physically active. In the age category of 30–49, 11% of respondents were insufficiently active, 32% are sufficiently active and 57% are highly physically active. In the oldest age group of 50–69, we identified 15% of respondents who were insufficiently active, 32% are sufficiently active and 53% are highly physically active.

The development of physical activity depending on sex and the intensity of load is described in Fig. 1. Women perform less vigorous physical activity than men ($H_{1,1649}$ = 68.5, p < 0.0001, η^2 = 0.04), but the differences are of low logical significance. Statistically significant

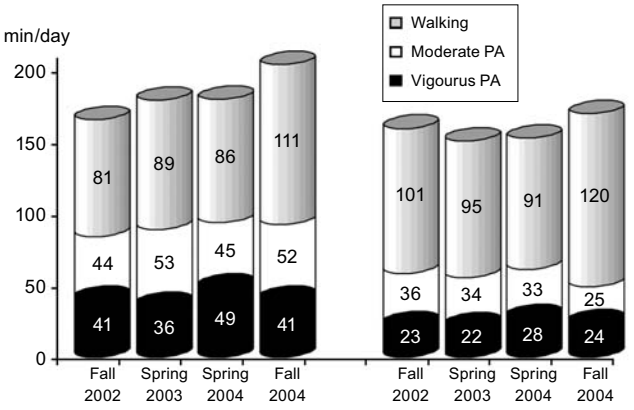

Figure 1. Physical activity (PA) in men and women aged 15–69 (min·day^{-1})

differences, but not logical differences, are also found in moderate physical activity $H_{1,1649}$ = 2.87, p < 0.0001, η^2 = 0.001). In walking, there are found higher values in women than in men ($H_{1,1649}$ = 11.09, p < 0.001, η^2 = 0.006) but the difference is not considered logically significant again. The median of physical activity of the inhabitants

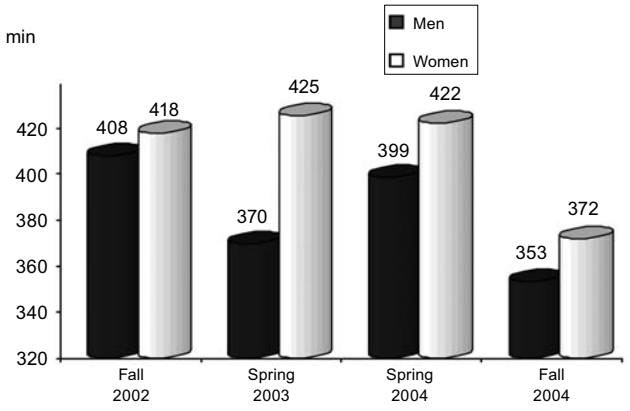

Figure 2. The time spent sitting in men and women (aged 15–69) – an average value for one working day

in the Liberec region expressed in MET-min · week^{-1} was 3822 MET · min^{-1} · week^{-1} (IQR = 4371).

The assessment of the differences between men and women based on the total time spent performing physical activity proves that men are more active than women ($H_{1,1649}$ = 6.75, p = 0.009, η^2 = 0.004) but according to the coefficient η^2 these differences are not significant.

The evaluation of the time spent sitting during five working days shows that women spend significantly more time sitting than men ($H_{1,1649}$ = 7.50, p = 0.006, η^2 = 0.005), yet logical significance has not confirmed these differences (Fig. 2). In total, men spend on average 393 minutes and women 415 minutes sitting during one working day.

Table 4. The evaluation of physical activity of different intensity for various weight groups (based on BMI) – women aged 15–69 (MET · min^{-1} · week^{-1})

Activity	Weight (based on BMI)	n	Mdn	IQR	H	p	η^2
Vigorous PA	underweight	73	1080	2160	**17.20**	**0.001**	**0.021**
	normal	488	540	1440			
	overweight	191	120	1080			
	obesity	79	0	1080			
Moderate PA	underweight	73	480	960	0.45	0.930	0.001
	normal	488	480	1080			
	overweight	191	480	1440			
	obesity	79	480	1920			
Walking	underweight	73	1386	2970	1.55	0.670	0.002
	normal	488	1584	2772			
	overweight	191	1980	3465			
	obesity	79	1584	3465			

PA – physical activity, n – the size of the (sub)sample, Mdn – median, IQR – inter-quartile range, H – testing criterion of Kruskal-Wallis test, p – the level of statistical significance, η^2 – coefficient of effect size

Table 5. The evaluation of physical activity of different intensity for various weight groups (based on BMI) – men aged 15–69 (MET · min^{-1} · week^{-1})

Activity	Weight (based on BMI)	n	Mdn	IQR	H	p	η^2
Vigorous PA	underweight	48	720	2295	**15.35**	**0.002**	**0.019**
	normal	431	1440	2700			
	overweight	270	1080	2520			
	obesity	69	360	2160			
Moderate PA	underweight	48	720	1080	3.51	0.320	0.004
	normal	431	720	1680			
	overweight	270	720	1680			
	obesity	69	840	1200			
Walking	underweight	48	1386	2376	0.11	0.990	0.000
	normal	431	1386	2178			
	overweight	270	1386	2524			
	obesity	69	1485	2871			

PA – physical activity, n – the size of the (sub)sample, Mdn – median, IQR – inter-quartile range, H – testing criterion of Kruskal-Wallis test, p – the level of statistical significance, η^2 – coefficient of effect size

The greatest differences between underweight women, women with normal weight, overweight women and obese women have been identified in vigorous physical activity ($H_{3, 831} = 17.2$, $p = 0.001$, $\eta^2 = 0.021$). We can say that women with a low BMI perform more vigorous physical activity. Times spent performing moderate physical activity and walking are similar in all BMI groups (Tab. 4). Analogous results are also found in men (Tab. 5). Significant differences between the BMI groups are identified only in vigorous physical activity ($H = 15.35$, $p = 0.02$, $\eta^2 = 0.019$). Significant differences we not reported between the individual BMI categories in men for moderate physical activity and walking.

Upon assessing the correlates of physical activity such as the size of residence (number of inhabitants) and lifestyle (single, in family, in family with children), the most frequently appearing significant differences were reported in the age category of 15–29 years. For example, participants living in residences of smaller sizes are reported to show significantly higher level of physical activity ($H_{3,1165} = 19.83$, $p < 0.001$, $\eta^2 = 0.12$) (Tab. 6).

Despite a general expectation that smokers perform less physical activity than non-smokers, this premise has been proved only in the age category of 15–29 ($H_{1, 691} = 5.509$, $p = 0.019$, $\eta^2 = 0.008$). However, according to the coefficient η^2, the differences are not logically significant. In the other age categories, physical activity of smokers and non-smokers is similar. Out of the total sample, 75% were non-smokers, 24% were smokers and 1% did not answer.

Table 6. Assessing physical activity in relation to the size of residence (number of inhabitants) and age category (MET · min^{-1} · week^{-1})

Age category	Size of residence	*n*	Mdn	IQR	H	*p*	η^2
Aged 15–29	> 100 000	141	3516	3348	**17.30**	**0.001**	**0.025**
	30 000–100 000	208	3362	4079			
	1 000–29 999	228	4554	4011			
	< 1 000	111	5199	4725			
Aged 30–49	> 100 000	90	3746	4212	6.19	0.103	0.010
	30 000–100 000	187	3024	4068			
	1 000–29 999	241	3972	4452			
	< 1 000	110	4128	4743			
Aged 50–69	> 100 000	59	3399	4398	2.48	0.479	0.008
	30 000–100 000	87	3465	4269			
	1 000–29 999	130	3251	5091			
	< 1 000	43	4986	5754			
Aged 15–69	> 100 000	290	3621	4056	**19.83**	**0.000**	**0.012**
	30 000–100 000	482	3318	4066			
	1 000–29 999	599	4035	4572			
	< 1 000	264	4553	4548			

n – the size of the (sub)sample, Mdn – median, IQR – inter-quartile range, H – testing criterion of Kruskal-Wallis test, *p* – the level of statistical significance, η^2 – coefficient of effect size

Table 7. Assessing physical activity of smokers and non-smokers in relation to age category (MET · min^{-1} · week^{-1})

Age category	Smoking	*n*	Mdn	IQR	H	*p*	η^2
Aged 15–29	smokers	157	3300	4331	**5.509**	**0.019**	0.008
	non-smokers	534	4239	4059			
Aged 30–49	smokers	163	3546	4137	0.122	0.727	0.000
	non-smokers	461	3750	4489			
Aged 50–69	smokers	77	4128	5646	0.622	0.430	0.002
	non-smokers	241	3519	4539			
Aged 15–69	smokers	397	3486	4509	0.739	0.390	0.000
	non-smokers	1236	3966	4369			

n – the size of the (sub)sample, Mdn – median, IQR – inter-quartile range, H – testing criterion of Kruskal-Wallis test, *p* – the level of statistical significance, η^2 – coefficient of effect size

Similarly, we cannot confirm that physical activity is influenced by the way a respondent lives (single, in a family, in a family with children). Significant differences are affirmed only in the age category of 15–29 ($H_{2, 683} = 6.608$, $p = 0.037$, $\eta^2 = 0.009$), where the single living respondents performed less physical activity than the other respondents but the differences were not logically significant. In the other age categories and in the total sample the correlate of lifestyle does not influence physical activity.

Discussion

Our study has not proved the premise that men are more physically active than women in all age categories. Men perform more physical activity in total and in relation to age categories in the category of 30–49. Previous studies reported differences also in the age category of 15–29, but this study has not confirmed it. The study by Trost et al. [3] and other studies that applied monitoring of physical activity using the accelerometer CSA have usually reaffirmed the differences in physical activity in boys and girls. At the same time, the authors point out the fact that the magnitude of significance of the differences between physical activity in boys and girls is smaller than that documented in studies using questionnaire methods. Based on the analysis of physical activity, we can observe that women perform less vigorous physical activity than men, but on the contrary they walk more.

Regarding the individual self-reported results, the level of physical activity of the inhabitants in the Liberec region appears satisfactory. Only 7% of the inhabitants are insufficiently active, 11% are sufficiently active and 82% are highly active. In comparison to this, for example, the study by Muntner et al. [14] of Chinese population reported that only 66.3% of the subjects were physically active.

Defining the levels of sufficient and high physical activity is in compliance with the general recommendations for physical activity. The recommendations issued by the "IPAQ Executive Committee 2003" are based on the short version of the IPAQ questionnaire. Abu Omar et al. [9] regard subjects to be sufficiently active if they perform vigorous physical activity at least three times a week for the minimum of 20 min per day, or if they perform at least five times a week moderate physical activity or walking for the minimum of 30 min a day, or if they perform any combination of moderate or vigorous physical activity reaching the minimum of 600 MET·min^{-1}·week^{-1}. In addition to that the authors consider the subjects to be highly physically active if they perform vigorous physical activity at least three times a week and reach the minimum of 1500 MET·min^{-1}·week^{-1} or if by the combination of moderate and vigorous activity they reach the minimum of 1500 MET·min^{-1}·week^{-1}. The translation of physical activity into MET·min^{-1}·week^{-1} is based on the compendium by Ainsworth et al. [15]. With regard to the specifics of questionnaire surveys, we consider the established levels for sufficient activity (600 MET·min^{-1}·week^{-1}) and high activity (1500 MET·min^{-1}·week^{-1}) as being too low.

Wilcox et al. [16] report the subjects to be active when they carry out at least three times a week running, cycling, swimming or dancing for the minimum of 20 min at a time or if they perform at least five times a week walking, gardening, calanetics, etc., for the minimum of 30 min at a time.

The median of performed physical activity in the inhabitants of the Liberec region in MET·min^{-1}·week^{-1} was 3822 MET·min^{-1}·week^{-1}, which corresponds to 63.7 MET·hour^{-1}·week^{-1}. In comparison to other European countries, we reached even higher levels than it was reported for The Netherlands in the study by Rütten and Abu-Omar [17] using the IPAQ questionnaire where the identified value was 39.4 MET·hour^{-1}·week^{-1}, which was the highest out of total of 15 countries participating in the study, whereas the average median of all the states was 24 MET·hour^{-1}·week^{-1}.

One of the diseases commonly associated with the lack of physical activity and the imbalance between the energy incomes and expenditure is obesity. The most obvious measure identifying obesity and overweight is the BMI, which denotes overweight as the range of 25–29.9 kg·m^{-2} and obesity as 30 and more kg·m^{-2} [18]. Obesity in American population amounts to 20–30% [19]. Over the past 20 years obesity has increased from 14.5% to 22.5% in the adult American population [20].

In this study, 23% of the inhabitants were overweight and 10% were obese (Fig. 3). It is apparent that we are going along the same route as the advanced industrialized countries as far as these negative indicators are concerned.

Insufficient physical activity is a major cause of the rising prevalence of obesity in western countries [21]. Assessing the association between physical activity and the BMI, we have not found any differences in the lev-

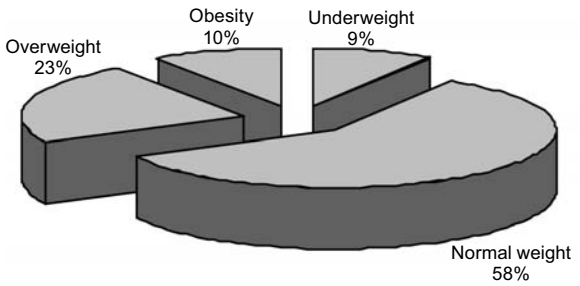

Figure 3. Percentage proportion of the inhabitants in Liberec region adjusted for BMI categories

els of moderate physical activity and walking between the groups of respondents who were underweight, with normal weight, overweight and obese. As opposed to that the findings indicate that overweight and obese respondents perform significantly less vigorous physical activity.

Based on the findings, we foster the assumption that since the groups of underweight subjects and subjects with normal weight perform more vigorous PA than the other groups, the maintenance of "healthy" body weight or body weight reduction could be achieved through vigorous physical activity.

Overweight has become a worsening health problem even in children as a study carried out in 2630 children in Great Britain showed. The findings from this study point out that overweight is observed in the range from 22% in 6 year old children to 31% in 15-year-olds and the range of obesity is from 10% in 6 year old children to 17% in 15 year old children [22]. The dispositional factors for obesity are of both genetic and environmental origin. The risk of becoming obese in a child whose both parents are obese is 80%, in a child who has one parent obese that risk is 40%, and if the parents are not obese the risk is 20% [23]. Heredity amounts to 25–40% in the inter-individual differences in adiposis [24].

When identifying the correlates of physical activity, we investigated the associations between the population density of the residence and physical activity. We have found differences only in the age group of 15–29. As for this age group, we can conclude that the smaller the residence was, the higher the levels of physical activity were observed. Different results, however, were found in a study of leisure time physical activity of women aged 40–49 [16], which showed that women living in villages performed more sedentary behavior and encountered more barriers to participation in physical activity as opposed to women in towns. Batch and Baur [21] assume that in some developing countries and in pure children a greater risk for becoming obese is associated with living in a village, whereas in countries going through economic transition obesity in children is attributed to a more wealthy lifestyle and living in urban areas.

Differences in physical activity between smokers and non-smokers have been identified only in the age category of 15–29, where non-smokers showed significantly more physical activity. In the total number of subjects in the Liberec region, 75% were non-smokers, 24% were smokers and 1% did not answer. In comparison to the results across the nation, the age category of 15–29 in Liberec region comprises 23% of smokers and 77% of non-smokers. On the other hand, Chmelík et al. [25] identified only low number of smokers (17.41%) in a questionnaire survey carried out on a representative sample of the Czech population (n = 3549). The authors found that youths regarding themselves as non-smokers have performed moderate and vigorous physical activities more frequently than youths regarding themselves as smokers.

Conclusions

1. Men are in total more physically active than women.

2. Women perform less vigorous activity than men but they are more active in walking.

3. The total time spent sitting on a working day is 6.5 hours in men and 7 hours in women. To improve the conditions in this area, we recommend to design physical activity regimes for working days and to intervene primarily in sedentary-type of jobs.

4. Based on self-reported data, 7% of the inhabitants of the Liberec region are insufficiently physically active, 11% are sufficiently active and 82% are highly active.

5. Significant differences in relation to BMI are identified only in vigorous physical activity in both men and women. Subjects having lower weight-height BMI coefficient are more physically active.

6. 58% of the inhabitants in the Liberec region are of normal weight, 9% are underweight, 23% are overweight and 10% are obese. It is necessary to intervene in this area and to increase the awareness of the negative effects of physically inactive lifestyle and the positives of regular physical activity. Furthermore, it is important to establish conditions encouraging physical activity.

7. In relation to the size of residence, we have found differences in the age category of 15–29 as well as in total, where the inhabitants of smaller-sized residences (< 30.000) showed more physical activity.

8. Out of the total number of subjects in the Liberec region, 75% regard themselves as non-smokers and 24% as smokers.

9. Non-smokers aged 15–29 perform more physical activity than smokers of the same age.

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