PHYSICAL ACTIVITY AND SEDENTARY SCREEN TIME IN OBESE AND OVERWEIGHT CHILDREN LIVING IN DIFFERENT ENVIRONMENTS

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SUMMARY

Aim: To assess the relationship of children's physical activity and sedentary screen time with overweight and obesity in children living in different environments (town and city) in Lithuania.

Methods: An analysis of anthropometric data from 532 children living in town and city areas was performed. A youth physical activity questionnaire (YPAQ) was conducted to evaluate physical activity and sedentary screen time.

Results: The prevalence of overweight and obesity among the children was 25.5% in the town and 18.6% in the city. Children living in the town on average engaged 9.3 min/day less in moderate to vigorous physical activity ($p = 0.050$) and had 33.2 MET-min/day lower energy expenditure than children living in the city. Sedentary screen time was extremely high on weekends in both town and city children.

Conclusions: A higher prevalence of overweight and obesity and a lower amount of moderate-to-vigorous physical activity was found in children living in the town compared to children living in the city.

Key words: obesity, physical activity, sedentary screen time, town, city, children

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INTRODUCTION

Physical activity, sedentary behaviour of children and childhood overweight are among the most important current public health concerns (1–6). Several factors contribute to the imbalance between energy intake and energy expenditure that influences weight gain (1).

In childhood physical activity and sedentary behaviour habits begin to form (2). Levels of habitual physical activity and sedentary behaviour are well established as important to both the current and future health of children and adolescents (3–5). However, studies reveal that physical activity declines before adolescence (6).

Research has highlighted important socioeconomic differences in children's physical activity. For instance, youth from higher socioeconomic backgrounds have been found to engage in more physical activities than youth from lower socioeconomic backgrounds (7). However, studies that assess the prevalence of obesity and physical activity in children living in different environments have yielded controversial results. Some studies show higher prevalence of overweight and obesity among rural children than urban children (8, 9). Hodgkin et al. on the contrary reported that urban children were 1.3–1.4 times more likely to be overweight or obese than rural children (10). A systematic review by Sandercock et al. (11) showed that rural children were significantly more active than urban children. Studies carried out in Canada (12–14) and Australia (15, 16) found no significant difference in physical activity between rural and urban children. Kristjansdottir and Vilhjalmsson found that rural students in Iceland were more sedentary and less involved in strenuous exercise during their leisure time than students in urban areas. The authors suggest that relatively high activity levels among students in town may perhaps be explained by good sports facilities and a strong emphasis on youth sport in many municipalities as well as by the absence of many leisure time attractions found in metropolitan areas (17).

Ogunleye et al. suggest that simple rural versus urban divisions of environment may be too simplistic to study physical activity patterns in youth. Specifically, classifying suburban (or town and fringe) along with rural areas may be misleading. At least a trilateral division of the environment, including suburban areas as a discrete classification, appears preferable (18).

Suburban or town contexts are often neglected in research. Suburban neighbourhoods have characteristics of both rural and urban environments and they are better connected to urban centres than rural environments, yet they may sit at a distance from points of interest that are not within walking distance (19). Ogunleye et al. concluded that town and fringe environments appear to support physical activity in both children and adolescents. More importantly, these environments appear to attenuate the reduction in physical activity commonly observed between childhood and

adolescence (18). Therefore, the aim of this study was to assess the relationship of children's physical activity and sedentary screen time with overweight and obesity in children living in different environments (town and city) in Lithuania. The objectives of the study were to assess the prevalence of children's overweight and obesity in different environments; to evaluate the duration of children's moderate to vigorous physical activity, energy expenditure and sedentary screen time in different environments; and to analyse the correlations between children's physical activity, sedentary screen time and anthropometric data.

MATERIALS AND METHODS

Study Population

The cross sectional study was performed at three Eastern Lithuanian schools: two schools in the town and one school in the city. All children from the 5th–7th grades were invited to participate in the study. The study population consisted of 118 children living in the town and 414 children living in the city (total n = 532), aged from 11–14 years (12.99 ± 0.96). In our study we used two categories of living place/living environment: "town" and "city". Category "rural" (or "village") is another category that has not been explored in this study. A town is a settlement larger than a village but smaller than a city. According to the Law of Republic of Lithuania on territorial administrative units and their boundaries, a town has 500 to 3,000 inhabitants.

The study was conducted with the approval of the Lithuanian Bioethics Committee (Protocol No.1, 6/4/2003). Written informed consent was obtained from the parents of each participating child.

Anthropometric Measurements

Body Mass Index (BMI)

Body height was measured according to the standard procedure, with the children standing upright, without shoes, with hips and shoulders perpendicular to the central axis, feet and knees together, and the head in the Frankfurt plane to the nearest 0.5 cm. Body weight was measured using a doctor's scale to the nearest 0.5 kg. Body mass index was calculated as body weight in kilograms divided by body height in square metres.

Obesity, overweight, normal weight, and underweight were defined according to WHO child growth characteristics (20).

Waist to Hip Ratio (WHR)

Waist circumference (WC) was measured to the nearest 0.5 cm at the midpoint between the lower border of the rib cage and the iliac crest at the end of a normal expiration. Hip circumference (HC) was measured to the nearest 0.5 cm at the widest part of the hip at the greater trochanter. WHR was calculated by dividing WC by HC (21).

Body Fat (%)

Skinfold thickness was measured to the nearest 0.5 mm by using a Saehan calliper. Triceps (midway between the olecranon process and the acromion process on the posterior aspect of the arm) and subscapular (the inferior angle of the scapula) skinfold thickness was measured by highly trained technicians following recommended procedures (22). All measurements were taken on the right side of the body. Body fat percentages were calculated with the following formulas (23):

Body fat (%) for children with triceps and subscapular skinfolds < 35 mm:

Boys = 1.21 (sum of 2 skinfolds) −0.008 (sum of 2 skinfolds)^2 −3.4

Girls = 1.33 (sum of 2 skinfolds) −0.013 (sum of 2 skinfolds)^2 −2.5

Body fat (%) for children with triceps and subscapular skinfolds > 35 mm:

Boys = 0.783 (sum of 2 skinfolds) + 1.6

Girls = 0.546 (sum of 2 skinfolds) + 9.7

Assessment of Physical Activity and Sedentary Screen Time

A youth physical activity questionnaire (YPAQ) was used to assess physical activity and screen sedentary time in children. YPAQ contains a list of 47 different activities, and participants are asked to report the frequency and duration of each activity over the preceding seven days. YPAQ assesses mode, frequency and duration of physical activities and sedentary activities throughout all domains, including school time and leisure time over the preceding seven days (24).

In the study the duration of time (min/day) spent on moderate to vigorous physical activity (MVPA) and sedentary screen time (SST) were used. MET (metabolic equivalent) minutes of physical activity were calculated as duration × frequency × MET intensity (25).

Statistical Analyses

In the study, descriptive statistics are presented as absolute data numbers (n) and mean with standard deviation (SD). The Kolmogorov-Smirnov test was used to check hypotheses for regularity of distribution of parameters. For comparisons of the quantitative variables of two independent groups, the parametric Student's t-test and non-parametric Mann-Whitney test were applied. Receiver operating characteristic (ROC) curves were used to find out the optimal cut-off values of moderate to vigorous physical activity and energy expenditure. Spearman's correlation coefficient (r) was used to estimate correlations. A p-value ≤ 0.05 was regarded as statistically significant. The data was analysed using SPSS Statistics 21.0 for Windows software.

RESULTS

The anthropometric data of children living in the town is presented in Table 1. Anthropometric data showed that boys living in the town had a higher mean value of BMI in all age groups (20.1 ± 4.6) compared with the girls' mean value of BMI (19.2 ± 3.5), but this difference was not statistically significant (p = 0.236). It was found that the girls' mean values of WC (63.8 ± 7.5) and WHR (0.75 ± 0.04) were lower than the boys' mean values of WC (68.2 ± 9.9, p = 0.015) and WHR (0.79 ± 0.05, p < 0.001).

Anthropometric data of the children living in the city is presented in Table 2. Boys living in the city had also higher mean value of BMI in all age groups (19.7 ± 4.3) compared with the girls'

Table 1. *Anthropometric data of children living in the town according to gender and age*

	Girls					Boys					p-value
	11 years	12 years	13 years	14 years	Total	11 years	12 years	13 years	14 years	Total	
	(n = 11)	(n = 13)	(n = 21)	(n = 21)	(n = 66)	(n = 4)	(n = 17)	(n = 13)	(n = 18)	(n = 52)	
Weight (kg)	41.3 ± 9.1	45.5 ± 15.4	48.2 ± 9.4	51.2 ± 11.8	47.5 ± 11.8	44.8 ± 12.9	43.3 ± 13.4	48.5 ± 13.0	57.5 ± 11.3	49.6 ± 13.6	0.367
Height (cm)	149.6 ± 6.6	151.4 ± 4.5	157.1 ± 8.8	160.1 ± 9.1	155.8 ± 8.8	150.8 ± 4.6	151.0 ± 7.1	156.9 ± 8.7	161.5 ± 7.2	156.1 ± 8.6	0.840
BMI (kg/m^2)	18.2 ± 3.0	18.8 ± 5.4	19.3 ± 2.3	19.7 ± 3.5	19.2 ± 3.5	19.5 ± 4.5	18.7 ± 4.6	19.4 ± 3.4	22.1 ± 4.9	20.1 ± 4.6	0.236
WC (cm)	61.1 ± 6.3	63.7 ± 10.8	63.7 ± 5.7	65.3 ± 7.3	63.8 ± 7.5	68.6 ± 15.9	66.9 ± 11.9	66.0 ± 9.4	70.5 ± 7.0	68.2 ± 9.9	0.015*
HC (cm)	82.0 ± 6.5	82.3 ± 10.7	84.6 ± 6.9	87.9 ± 8.0	84.8 ± 8.3	85.6 ± 11.5	81.0 ± 10.4	84.8 ± 10.7	89.8 ± 7.7	85.3 ± 10.0	0.792
WHR	0.74 ± 0.02	0.77 ± 0.05	0.75 ± 0.03	0.74 ± 0.05	0.75 ± 0.04	0.79 ± 0.07	0.82 ± 0.07	0.77 ± 0.02	0.78 ± 0.03	0.79 ± 0.05	<0.001*
Triceps SFT (mm)	19.0 ± 7.1	15.0 ± 6.9	19.2 ± 5.9	20.3 ± 6.7	18.7 ± 6.7	19.3 ± 8.7	20.0 ± 8.0	17.0 ± 7.1	18.4 ± 9.1	18.8 ± 8.1	0.953
Subscapular SFT (mm)	14.6 ± 8.3	11.9 ± 6.3	14.3 ± 5.7	16.0 ± 7.8	14.4 ± 7.0	16.6 ± 11.7	15.1 ± 10.7	13.4 ± 9.7	15.5 ± 9.9	15.0 ± 10.0	0.742
Body fat (%)	25.4 ± 8.8	21.4 ± 7.3	25.4 ± 6.6	27.1 ± 8.4	25.2 ± 7.8	27.4 ± 15.0	26.8 ± 13.4	23.3 ± 12.1	25.9± 13.6	25.9 ± 13.0	0.769

BMI – body mass index, WC – waist circumference, HC – hip circumference, WHR – waist to hip ratio, Triceps SFT – triceps skinfold thickness, Subscapular SFT – subscapular skinfold thickness
*p ≤ 0.050

Table 2. *Anthropometric data of children living in the city according to gender and age*

	Girls					Boys					p-value
	11 years	12 years	13 years	14 years	Total	11 years	12 years	13 years	14 years	Total	
	(n = 18)	(n = 48)	(n = 62)	(n = 94)	(n = 222)	(n = 10)	(n = 43)	(n = 70)	(n = 69)	(n = 192)	
Weight (kg)	39.7 ± 8.9	45.0 ± 11.5	47.3 ± 8.8	51.0 ± 10.2	47.7 ± 10.5	40.0 ± 1.7	43.9 ± 14.3	50.0 ± 12.6	54.3 ± 15.1	49.9 ± 14.5	0.123
Height (cm)	150.5 ± 8.6	153.1 ± 6.0	156.3 ± 7.6	162.8 ± 7.0	157.9 ± 8.4	153.5 ± 0.8	150.5 ± 7.6	157.4 ± 7.9	163.8 ± 8.3	158.0 ± 9.4	0.898
BMI (kg/m^2)	17.2 ± 2.0	18.8 ± 4.0	19.2 ± 2.9	19.0 ± 3.0	18.9 ± 3.2	16.9 ± 0.5	19.1 ± 4.9	20.0 ± 3.4	20.5 ± 4.8	19.7 ± 4.3	0.065
WC (cm)	60.0 ± 4.1	64.3 ± 9.1	65.6 ± 6.8	65.7 ± 6.5	64.9 ± 7.2	61.2 ± 5.6	66.9 ± 11.4	67.7 ± 9.2	70.2 ± 10.9	68.3 ± 10.5	0.001*
HC (cm)	81.4 ± 5.6	83.6 ± 8.9	86.0 ± 7.6	89.0 ± 7.4	86.3 ± 8.1	79.5 ± 3.3	82.3 ± 12.3	86.6 ± 9.2	88.7 ± 9.4	86.1 ± 10.3	0.845
WHR	0.73 ± 0.02	0.76 ± 0.04	0.76 ± 0.03	0.73 ± 0.04	0.75 ± 0.04	0.76 ± 0.04	0.81 ± 0.12	0.78 ± 0.04	0.79 ± 0.05	0.79 ± 0.07	<0.001*
Triceps SFT (mm)	20.9 ± 7.4	20.0 ± 8.5	21.6 ± 7.9	21.5 ± 6.9	21.1 ± 7.6	14.2 ± 1.5	20.0 ± 6.7	20.0 ± 7.5	16.7 ± 9.0	18.7 ± 7.9	0.005*
Subscapular SFT (mm)	13.8 ± 6.3	17.1 ± 11.5	17.8 ± 8.9	16.5 ± 7.3	16.8 ± 8.8	8.7 ± 1.5	15.4 ± 10.0	17.4 ± 10.5	15.1 ± 9.3	15.9 ± 9.9	0.390
Body fat (%)	26.1 ± 8.0	27.6 ± 11.8	29.0 ± 9.9	28.2 ± 7.9	28.1 ± 9.4	17.9 ± 1.8	27.0 ± 11.9	28.6 ± 12.5	24.4 ± 13.0	26.4 ± 12.5	0.177

BMI – body mass index, WC – waist circumference, HC – hip circumference, WHR – waist to hip ratio, Triceps SFT – triceps skinfold thickness, Subscapular SFT – subscapular skinfold thickness
*p ≤ 0.050

mean value of BMI (18.9±3.2, p=0.065). However, differently from BMI, girls had a higher mean value of the percentage of body fat (28.1±9.4) than boys (26.4±12.5), but this difference was not statistically significant (p=0.177).

The distribution of weight status in the children according to gender is presented in Table 3. The classification of weight status according to the WHO child growth characteristics (20) showed that 25.5% of children living in the town were overweight and obese, while the prevalence of overweight and obesity among children living in the city was 18.6% (p=0.171). More boys than girls were obese or overweight: 30.8% of boys living in the town and 23.9% of boys living in the city were obese or overweight, compared to 21.2% and 14.0% of girls, respectively.

The data of children's physical activity is shown in Figure 1. The physical activity assessment revealed that children living in the town engaged in MVPA for less time (89.2±83.7 min/day) than children living in the city (98.5±90.1 min/day) (p=0.050). The mean value of energy expenditure was 473.8±442.0 MET-min/day for children living in the town and 507.0±388.7 MET-min/day for children living in the city (p=0.069). Both town and city children spend less time in MVPA during weekdays compared with weekends. The mean value of time spent in MVPA on weekdays was 29.6 minutes less for children living in the town and 16.4 minutes less for children living in the city (Table 4).

The moderate to vigorous physical activity (MVPA) receiver operating characteristic (ROC) curve shows that the optimal cut-off value in the children studied was 65 min/day. It was found that 60.8% of children in the city and 47.7% of children in the town engaged in MVPA for ≥65 min/day. Binary logistic regression analysis allowed predicting that the odds ratio, when MVPA is ≥65 min/day, is greater than 1.708 (1.108–2.628, p=0.015) for children living in the city.

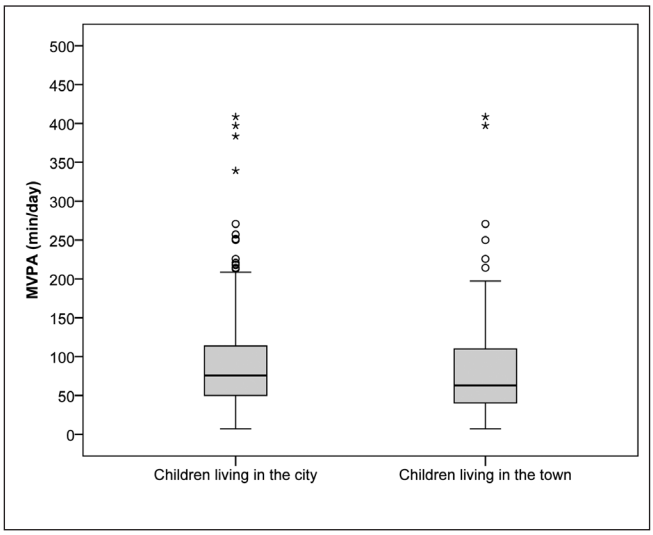

Fig. 1. *Moderate to vigorous physical activity (MVPA, min/day) in children living in the city and in the town (p = 0.050).*

According to the median of energy expenditure (MET-min/day) distribution, the optimal cut-off value, 403 MET-min/day, was defined. It was found that 52.6% of children living in the city and 41.7% of children living in the town had ≥403 MET-min/day

Table 3. *Weight status of children living in the town and the city according to gender*

	Children living in the town n=118			Children living in the city n=414			p-value
	Girls	Boys	Total	Girls	Boys	Total	
	n (%)	n (%)	n (%)	n (%)	n (%)	n (%)	
Obese	8 (12.1)	11 (21.2)	19 (16.1)	21 (9.5)	25 (13.0)	46 (11.1)	0.171
Overweight	6 (9.1)	5 (9.6)	11 (9.3)	10 (4.5)	21 (10.9)	31 (7.5)	0.171
Normal weight	47 (71.2)	32 (61.5)	79 (66.9)	178 (80.2)	134 (69.8)	312 (75.4)	0.171
Underweight	5 (7.6)	4 (7.7)	9 (7.6)	13 (5.9)	12 (6.3)	25 (6.0)	0.171

Classified according to the WHO child growth characteristics (20)

Table 4. *Moderate to vigorous physical activity (MVPA), energy expenditure, and sedentary screen time (SST) of children living in the town and in the city*

	Children living in the town n=118		Children living in the city n=414		p-value
	Minimum–maximum	Mean ± SD	Minimum–maximum	Mean ± SD	
MVPA (min/day)	7.1–397.1	89.2 ± 83.7	7.1–408.5	98.5 ± 90.1	0.050*
Weekdays MVPA (min/day)	2.0–436.0	84.1 ± 79.8	2.0–436.0	99.0 ± 89.1	0.003*
Weekends MVPA (min/day)	5.0–510.0	113.7 ± 122.7	0.5–990.0	115.4 ± 137.5	0.744
Energy expenditure (MET-min/day)	38.5–2482.2	473.8 ± 442.0	31.4–2634.2	507.0 ± 388.7	0.069
SST (min/day)	2.8–591.4	141.1 ± 111.2	2.8–642.8	149.0 ± 105.4	0.350
Weekdays SST (min/day)	2.0–612.0	117.1 ± 97.2	2.0–612.0	130.2 ± 96.15	0.189
Weekends SST (min/day)	5.0–810.0	232.7 ± 173.2	5.0–930.0	246.8 ± 170.9	0.319

MVPA – moderate to vigorous physical activity, MET – metabolic equivalent, SST – sedentary screen time
*p ≤ 0.050

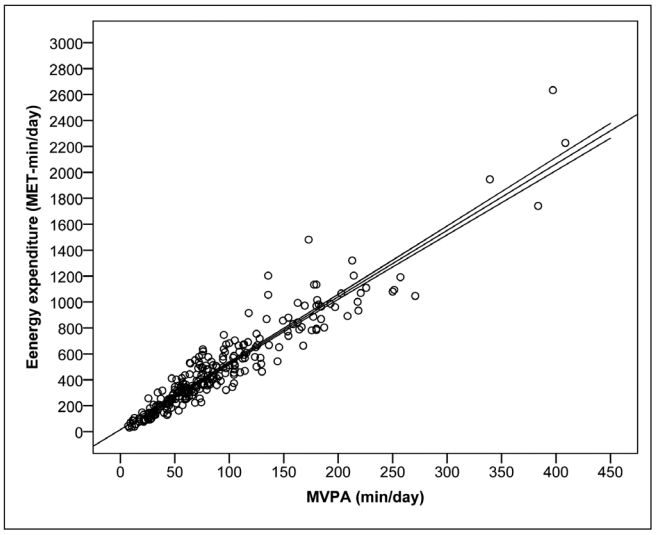

Fig. 2. *Correlation between children's moderate to vigorous physical activity (MVPA, min/day) and energy expenditure (MET-min/day) (r = 0.945, p < 0.001).*

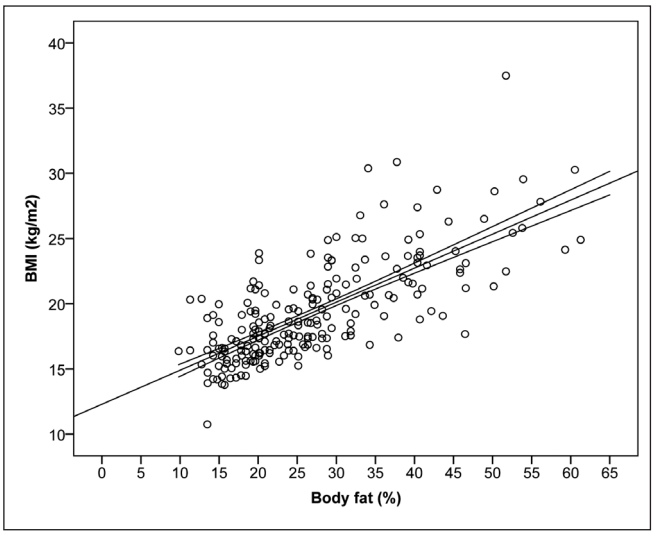

Fig. 3. *Correlation between children's body fat (%) and body mass index (BMI, kg/m²) (r = 0.723, p < 0.001).*

value of energy expenditure. Binary logistic regression analysis allowed predicting that the odds ratio, when energy expenditure is ≥403 MET-min/day, is greater than 1.547 (1.004–2.383, p = 0.048) for children living in the city.

Analysis of sedentary screen time revealed no significant difference (p = 0.350) in SST between children living in the town (141.1 ± 111.2 min/day) and in the city (149.0 ± 105.4 min/day) (Table 4). It is interesting that the time spent in front of a screen (such as television, computer, or video game player) was extremely high on weekends. The children spend an average of 3 hours 53 minutes in the town and 4 hours 6 minutes in the city in SST at weekends.

MVPA (min/day) and SST (min/day) weakly correlated with children's anthropometric data (Table 5). MVPA showed weakly significant negative relationships with body weight (r = −0.095, p = 0.049), BMI (r = −0.116, p = 0.017) and body fat (r = −0.129, p = 0.010). SST demonstrated very weak positive correlation with the children's age (r = 0.097, p = 0.043) and body height (r = 0.105, p = 0.039).

MVPA (min/day) had strong positive correlation with the energy expenditure (MET-min/day) of the children studied (r = 0.945, p < 0.001) (Fig. 2). Strong positive correlation was also found between the children's body fat (%) and BMI (r = 0.723, p < 0.001) (Fig. 3).

DISCUSSION

Analysis of the anthropometric data of children studied showed a higher prevalence of overweight and obesity in children living in the town (25.5%) than in children living in the city (18.6%), but this difference was not statistically significant (p = 0.171). Researchers in the USA and Canada (8, 9) assessed the prevalence of overweight and obesity in children living in different environments and found that overweight was more prevalent among rural than urban children. The prevalence study in Greece (26) revealed that childhood obesity rates were 1.4% higher in rural areas than

Table 5. *Correlations between MVPA (min/day), SST (min/day), age (years), and anthropometric data in children*

	MVPA (min/day)		SST (min/day)	
	r	p-value	r	p-value
Age (years)	−0.001	0.975	0.097	0.043*
Weight (kg)	−0.095	0.049*	−0.018	0.725
Height (cm)	−0.016	0.750	0.105	0.039*
BMI (kg/m²)	−0.116	0.017*	−0.075	0.145
WC (cm)	−0.079	0.109	−0.017	0.750
HC (cm)	−0.074	0.133	−0.010	0.846
WHR	−0.036	0.466	0.002	0.973
Triceps SFT (mm)	−0.078	0.118	−0.009	0.864
Subscapular SFT (mm)	−0.054	0.277	−0.032	0.548
Body fat (%)	−0.129	0.010*	−0.023	0.660

MVPA – moderate to vigorous physical activity, SST – screen sedentary time, BMI – body mass index, WC – waist circumference, HC – hip circumference, WHR – waist to hip ratio, Triceps SFT – triceps skinfold thickness, Subscapular SFT – subscapular skinfold thickness
*p ≤ 0.050

in urban areas for children of both genders ($p < 0.05$) aged 10–12 years. The prevalence of overweight (including obese) was 40.2% for Greek rural children and 38.5% for Greek urban children.

In general, the current study revealed a higher prevalence of overweight and obesity in Eastern Lithuanian children than other similar studies in this country. A study of schoolchildren in the five biggest cities and surrounding settlements in Lithuania in 2000–2002 showed that the prevalence of overweight and obesity was 11.50% and 13.62% for 7–13 years old girls and boys, and 6.60% and 9.50% for 14–18 years old girls and boys, respectively (27). The international report from HBSC 2009–2010 survey (28) showed that the prevalence of overweight and obesity in 15 years old Lithuanians was less than 10% for girls and 10–14% for boys. The significant difference between findings on the prevalence of overweight and obesity in our study and earlier national Lithuanian studies shows the increasing tendency in the prevalence of overweight and obesity in Lithuanian children.

Analysis of physical activity revealed that children living in the town engaged in an average of 9.3 min/day less MVPA than children living in the city ($p = 0.050$). Furthermore, it was found that energy expenditure during physical activities of children living in the town was on an average of 33.2 MET-min/day lower than of the children living in the city ($p = 0.069$).

These findings are in contrast with the study by Ogunleye et al., where the authors found that adolescents from towns and surrounding areas in the Eastern England were more physically active than urban dwellers (18). These authors concluded that towns and surrounding areas with mixed areas of rural and urban land use appear to facilitate and sustain physical activity in both children and adolescents.

Many other studies reported differences between the physical activity of children in rural and urban areas. A study in Greece conducted by Tambalis et al. (26) showed that rural children had a significantly higher total physical activity (138 ± 60 min/day) than urban children (118 ± 56 min/day) ($p < 0.001$) and more frequently met physical activity guidelines than their urban counterparts, despite a higher prevalence of obesity (26). Huang et al. (29) investigated the influence of the perceived environment in the neighbourhood on physical activity among schoolchildren in urban and rural areas in Taiwan. The authors reported that there was a difference in accessibility to places for physical activity between urban and rural areas, with urban children reporting greater accessibility. The urban children reported more physical activity after school, on holidays and at weekends and also in total amount of physical activity compared with rural children (29). However, all these findings only prove that suburban areas and towns are often neglected in research, and perhaps the prevention of childhood obesity and physical inactivity in these areas should be a priority.

The study results also showed that the optimal cut-off value of moderate to vigorous physical activity (MVPA) in the children studied was 65 min/day, which is close to the international MVPA guidelines: the World Health Organization recommends (30) that school-aged children and youth accumulate at least 60 minutes of moderate to vigorous intensity physical activity (MVPA) every day for health benefits.

The analysis of sedentary screen time did not show a significant difference in SST between the town (141.1 ± 111.2 min/day) and the city (149.0 ± 105.4 min/day) children ($p = 0.350$). However, an interesting finding was that the time spend in front of a screen was extremely high on weekends.

The correlation analysis revealed that MVPA weakly correlated with body weight ($r = -0.095$, $p = 0.049$), BMI ($r = -0.116$, $p = 0.017$) and body fat ($r = -0.129$, $p = 0.010$). SST very weakly correlated with age ($r = 0.097$, $p = 0.043$) and body height ($r = 0.105$, $p = 0.039$), meaning that older children spend more time in front of the screen than younger children.

Cross-sectional studies examining the relationship between various measures of body fat and physical activity in children have usually indicated a negative relationship between activity levels and body fat (31). Some studies however show evidence that screen time is more strongly associated with overweight and obesity in childhood than physical activity. Ortega et al. (32) reported that sedentary activities are associated with adiposity in adolescents. These authors found that sedentary activities were independently and directly related to waist circumference in both boys and girls ($p \leq 0.05$) and to BMI in boys ($p \leq 0.05$), while no relationship was found between leisure-time physical activity and BMI or waist circumference. Stamatakis et al. (33) found that TV watching, but no other form of screen time (using a personal computer or playing electronic games), was positively associated with two common adiposity markers among Portuguese children. A longitudinal study carried out in the USA by Mitchell et al. (34) provided evidence that spending more time in objectively measured sedentary behaviour is associated with greater increases in BMI during childhood. Importantly, these observed associations were independent of time spent in MVPA (34).

The Strength and Limitations of the Study

In this study, children's physical activity, sedentary screen time and the prevalence of obesity and overweight were compared in two different living environments – town and city areas. This division of the living environments, including town area as a discrete classification, enabled us to investigate an area which is often neglected in these types of studies. This is the strength of the study.

The main limitation of the study is the absence of research in the rural area.

CONCLUSIONS

A higher prevalence of overweight and obesity was found in children living in the town (25.5%) compared with children living in the city (18.6%). The children living in the town engaged in an average of 9.3 min/day less moderate to vigorous physical activity and had 33.2 MET-min/day lower energy expenditure than children living in the city. The children's moderate to vigorous physical activity had weak negative relationships with body weight, BMI, and body fat. Sedentary screen time had a very weak positive correlation with the children's age and body height.

Our study results emphasize the need of preventive strategies on children overweight and obesity in Lithuania especially in town environment (for instance, health-enhancing physical activity programmes at school and community level). In further studies we suggest to include the assessment of other lifestyle factors (such as nutrition, psychosocial factors, etc.) influencing the prevalence of overweight and obesity in children in different settings.

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Conflict of Interest

None declared

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