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Obesity and Physical Fitness among Moscow Schoolchildren: 6-years Follow-up

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Authors' contributions

This work was carried out in collaboration between all authors. Authors KGG and VAO designed the study. Authors EVB and DAP managed the study. Author ANO performed the statistical analysis, wrote the protocol and wrote the first draft of the manuscript. All authors read and approved the final manuscript.

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ABSTRACT

Aim: To assess study the prevalence of obesity and physical fitness among Moscow schoolchildren.
Subjects and Methods: During the 2004-5, 2007-8, and 2010-11 school years, about 20% of Moscow schoolchildren were studied in all districts of the town. Both anthropometric and physical fitness data were collected. Obesity was determined according to international recommendations, observed physical fitness in accordance with national norms.
Results: During the observation period the number of schoolchildren with obesity increased 1.5 times and reached about 20%. Obesity was observed 1.6 times more frequently in boys than in girls. In the 2004-5 school years a total of 66% of boys and 58% of girls undertook vigorous physical fitness. By the 2010-11 school years the number of schoolchildren undertaking vigorous

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physical fitness had decreased by 10%. The number of boys undertaking vigorous physical fitness was 1.8 times lower in the obesity group than in the normal weight group. The corresponding difference for girls was 1.4 times.
Conclusion: Findings of this study suggest an increase in the prevalence of obesity among Moscow schoolchildren which could be attributed to their low level of physical fitness.

Keywords: Obesity; physical fitness; schoolchildren; Moscow; Russian federation.

1. INTRODUCTION

Obesity has come to resemble a world-wide epidemic that touches all countries. During the past decades this disease has affected progressively younger people [1]. This explains the number of recent scientific publications concerning childhood and teenage obesity and its influence on public health. It is closely related to possible future health problems and the development or prevention of non-communicable diseases [2].

It has been shown that *the* number of children who are overweight or obese is rising. An increasing number of schoolchildren with obesity have been reported in the European region. In present-day Europe about 20% of children are obese [3]. Childhood obesity seems to be a risk factor for the development of obesity in adults [4].

It is believed that nutrition [3] and physical activity [5] are the main causes of obesity development in childhood [4,6]. Many countries monitor the prevalence of obesity among schoolchildren. This monitoring helps to demonstrate developments and identify the main risk factors, and in future it will be possible to influence such negative processes [7].

The main component of obesity prevention is physical activity [5]. The decrease in the level of physical activity is probably the main cause of obesity in childhood. Physical inactivity, e.g. watching TV, playing computers, seems to be an additional risk factor for schoolchildren. Most reports about effective interventions for obesity prevention among schoolchildren include physical activity as an essential component [8].

Unfortunately, monitoring of childhood obesity in the Russian Federation has not kept pace with that in Europe. The most recent monitoring in the central part of the country was more than 20 years ago [9]. An investigation in Velsk in 2010 included only 1066 schoolchildren in the western part of the country living near Polar circle [10]. The present article summarizes the results of a six-year follow-up monitoring of obesity prevalence and physical fitness among Moscow schoolchildren (central part of the country).

2. METHODS

2.1 Participants

The population survey included about 20% of all Moscow schoolchildren 7-16 years old, with the mean number 14,619. Data were collected in all urban districts (n=10) of the town with equal regional representation of schoolchildren. The data collection was performed three times: during the winter period of 2004-5, 2007-8, and 2010-11 school years. In those three surveys number of schoolchildren, age distribution and gender representative were equal. Only typical state schools[1] were included in investigation (mostly the same schools). It was random chosen of schools, the sampling framework stratified by districts. In the school all schoolchildren of appropriate age were included in investigation.

The investigation was approved by the local ethics committee of Moscow State University of Medicine and Dentistry (No 6 from 29.11.04, No 5 from 26.02.2008, No 1 from 29.09.09, No 1 from 28.09.10). In accordance with Russian regulatory documents, written informed consent for the 7-14 years old children was taken from their parents; the 15-16 years old children wrote their own informed consent.

2.2 Anthropometric Data

Weight in kg (±100g) by weight-scale, height in cm (±0.5cm) by height-meter and waist circumference in cm (±0.2cm) by tape measure

[1] *Russian school system has several types of school. First one is "city school" which is open for everybody. This is the most prevalent type of scholls (about 90%). Second type is school with attendees to some subjects (i.e. Math, English, Chemistry and so on). To become schoolchildren of such schools you have to pass special exam. The third type is for schoolchildren with limited reserves of health (i.e. blind). The forth type is for schoolchildren without parents. The fifth type is for children who made up something crime.*

were directly measured for all participants once. The body mass index (BMI) was calculated. Obesity was determined in accordance with the International Obesity Task Force [11] on the basis of age- and gender-specific BMIs. Waist circumference was used to verify abdominal obesity.

2.3 Physical Fitness

A physical work capacity test was used to determine physical fitness among the schoolchildren [12]. We followed a standard protocol with age- and gender-adjusted national norms [13]. This protocol is designed to elicit heart rates of 120, 150 and 170 beats per minute (bpm) at the end of each of three 2-minute exercise stages (total time was 6 minutes). Each schoolchild fitted a heart rate monitor. Schoolchildren with a heart rate lower than 160bpm at the end of the third stage performed a fourth stage to bring their heart rate to approximately 170bpm. Schoolchildren with heart rate approximately 170bpm, which was observed on the third step, we had recognized as "vigorous physical fitness" group. Schoolchildren with heart rates of 120 and 150bpm, which was observed on the third step, we had recognized as "moderate physical fitness" group.

2.4 Statistical Analysis

Data were analyzed using IBM SPSS version 11.0. Three-way ANOVA to determine the influence of the factors studied and associations between variables. Spearman linear correlation was calculated. All p-values were based on two-sided tests and compared with a significance level of 0.05.

3. RESULTS

3.1 Obesity Prevalence among Moscow Schoolchildren

In the 2004-5 school years, 8.5% of girls and 15% of boys in the Moscow population were obese (Fig. 1). Over the observation period the number of schoolchildren with obesity increased 1.5 (95%CI 1.3-1.6) times. There was a gender difference in obesity prevalence: obesity was observed 1.6 (95%CI 1.4-1.8) times more frequently in boys than in girls.

There was no gender difference in schoolchildren who were overweight. During the follow-up period the number of schoolchildren in this group did not change significantly. Over the same time course, the number of schoolchildren with normal weight decreased. More girls than boys were found to have normal weight. The number of schoolchildren who were underweight did not change and there was no gender difference.

We found no regional differences in obesity prevalence.

We found age-depended obesity prevalence (Table 1 above). All the boys with obesity seem to have the abdominal type of obesity due to extend of waist circumference in comparison to age-related norms. Up to 85% of girls with obesity also probably had the abdominal type of obesity.

3.2 Physical Fitness of Moscow Schoolchildren

In the 2004-5 school years, totals of 66% of boys and 58% of girls undertook vigorous physical fitness (Fig. 2). During the 6-year period of investigation the number of schoolchildren undertaking vigorous physical fitness decreased by 10% (95%CI 7.9-12.0), which is close to the increase in number of schoolchildren with obesity. We found no gender or regional differences in the decrease in physical fitness. Throughout the follow-up period, vigorous physical fitness was more prevalent among boys than girls.

We found no significant linear correlation between obesity and physical fitness. On the other hand, obesity was recognized as a significant factor influencing physical fitness. As illustrated in (Fig. 2), the number of boys undertaking vigorous physical fitness was 1.8 (95%CI 1.6-1.9) times lower in the obesity group than the normal weight group. The corresponding difference for girls was 1.4 (95CI% 1.3-1.5) times. There were more girls than boys with obesity and vigorous physical fitness, while in the group with normal weight this difference was reversed.

During the 6-year period of observation the number of schoolchildren with vigorous physical fitness decreased in the whole population, as in the normal weight or obesity groups. No significant differences for underweight or overweight schoolchildren were found. There was no gender difference in the extent to which the number of schoolchildren undertaking vigorous physical fitness decreased.

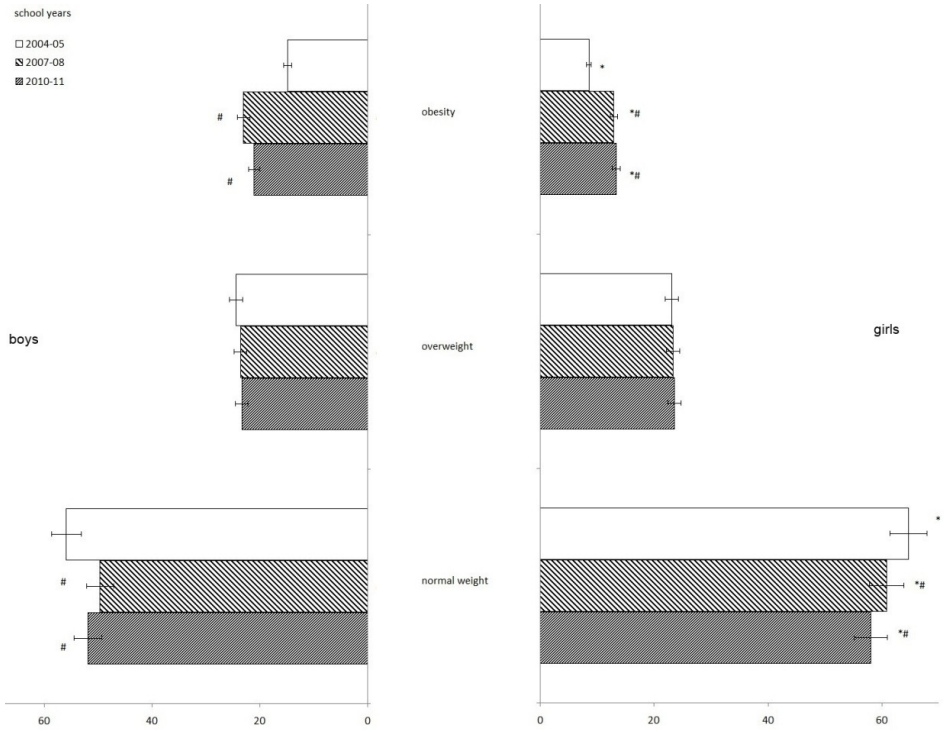

Fig. 1. Percentage of schoolchildren with different BMI

** Gender difference, p<0.05 # Difference from 2004-5 school year, p<0.05*

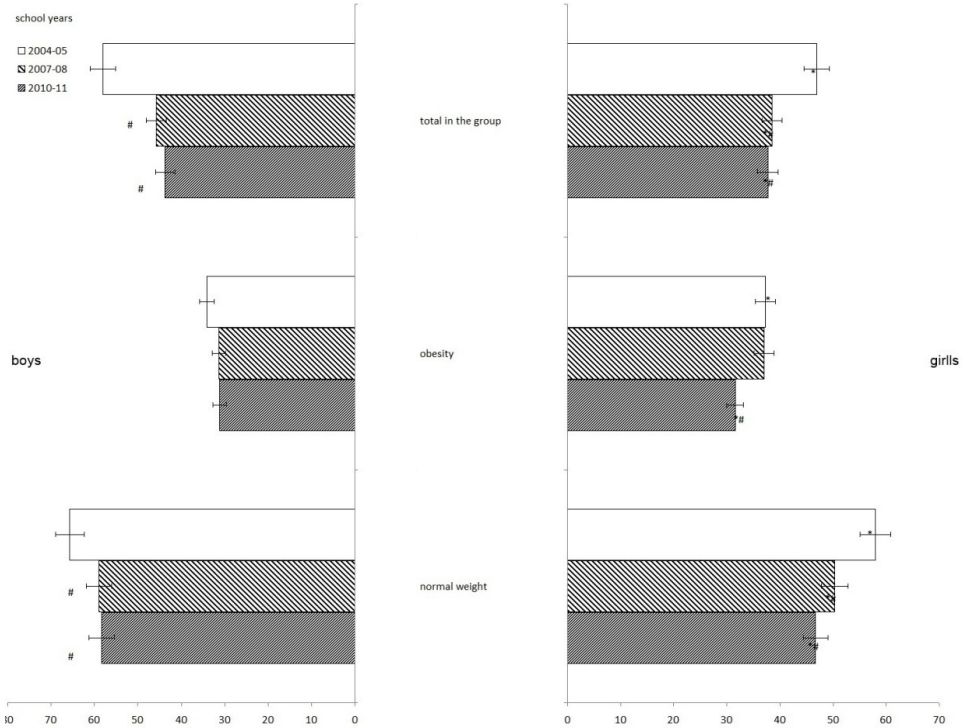

Fig. 2. Percentage of schoolchildren with vigorous physical fitness

** Gender difference, p<0.05 # Difference from 2004-5 school year, p<0.05*

Table 1. Mean percentage of schoolchildren with obesity in different age groups

Age, years	Boys									Girls								
	2004-05			2007-08			2010-11			2004-05			2007-08			2010-11		
	Mean	Mean-95%CI	Mean +95%CI	Mean	Mean-95%CI	Mean +95%CI	Mean	Mean-95%CI	Mean +95%CI	Mean	Mean-95%CI	Mean +95%CI	Mean	Mean-95%CI	Mean +95%CI	Mean	Mean-95%CI	Mean +95%CI
7	14.1	13.72	15.28	26.6	25.52	27.68	21.8	20.83	22.77	8.5	7.91	9.09	21.8	20.83	22.77	16,2	15.37	17.03
8	25.6	24.54	26.66	25.7	24.64	26.76	24.4	23.37	25.43	20.0	19.07	20.93	15.0	19.07	20.93	17,2	19.07	20.93
9	22.5	21.51	23.49	26.4	25.32	27.48	25.9	24.83	26.97	16.9	16.05	17.75	15.8	16.05	17.75	19.0	16.05	17.75
10	15.8	14.98	16.62	30.3	29.13	31.47	27.3	26.20	28.40	10.4	9.74	11.06	18.0	9.74	11.06	18.4	9.74	11.06
11	20.5	19.56	21.44	29.9	28.74	31.06	29.5	28.35	30.65	6.1	5.60	6.60	17.0	5.60	6.60	18.1	5.60	6.60
12	13.3	12.55	14.05	19.2	18.29	20.11	23.7	22.68	24.72	8.3	7.72	8.88	15.6	7.72	8.88	12.4	7.72	8.88
13	16.7	15.86	17.54	23.0	22.00	24.00	18.1	17.22	18.98	6.9	6.37	7.43	9.7	6.37	7.43	12.0	6.37	7.43
14	9.6	8.97	10.23	21.0	20.05	21.95	14.2	13.43	14.97	3.9	3.50	4.30	6.9	3.50	4.30	8.6	3.50	4.30
15	10.8	10.13	11.47	12.9	12.17	13.63	14.3	13.52	15.08	2.3	2.00	2.60	4.4	2.00	2.60	7.1	2.00	2.60
16	10.0	9.36	10.64	15.7	14.89	16.51	11.6	10.90	12.30	2.2	1.90	2.50	5.0	1.90	2.50	4.3	1.90	2.50

4. DISCUSSION

Over the past three decades, the prevalence of childhood obesity has increased in almost all countries for which data are available. It is demonstrated that obesity and overweight has increased more dramatically in economically developed countries and in urbanized populations. There is a growing global childhood obesity epidemic, with a large variation in secular trends across countries [6].

In Moscow the total number of schoolchildren with overweight and obesity did not exceed 5% 20-30 years ago [9]. Since then, the number of children and adolescents with obesity has risen catastrophically. Nowadays the number of schoolchildren with obesity in Moscow is comparable to that in the main industrial European countries [14], though it is still lower than in USA [15] and several Arabian counties [16]. Over the same period, the number of schoolchildren with obesity in Moscow was three times higher than in Brazil [17] and India [18] and 1.5-2.0 times higher than in Turkey [19].

Study's results suggest a rise in the prevalence of obesity among the studied schoolchildren. A similar increase has been observed in several European countries [20] and in Argentina [21], but it is not proceeding so rapidly. It can be concluded that if the number of schoolchildren with obesity continues to be as high and if the increase does not stop, the prevalence of obesity in Moscow could become comparable with that in the USA in the next 10-15 years.

We found gender differences in obesity prevalence: there were more obese boys than girls. The same finding was demonstrated in Greece [22]. However, in India, the prevalence of obesity in girls was comparable to that in boys [23].

We demonstrated a high prevalence of abdominal obesity among Moscow schoolchildren, which corresponds to findings in China [24]. It seems that some obesity cases in Moscow arise during pre-puberty and at the age of puberty, which is similar to the situation in India [25].

There are socio-economic differences among Moscow districts, but we found no significant influence of region on the prevalence of obesity. Perhaps this is because we studied only urban districts. The prevalence of obesity among schoolchildren in Sweden was comparable between urban and rural regions but not between districts in the town during the same time period [26].

The observed increase in the number of schoolchildren with obesity during the follow-up period probably corresponds to the observed decrease in vigorous physical activity, because the former seems to be equal to the latter. Similar findings have been demonstrated in Tunis [27].

The mean number of schoolchildren in Moscow undertaking vigorous physical activity was lower in the obesity group than in the normal weight group. The same was found among Chinese schoolchildren [28]. A lack of any physical activity among schoolchildren with obesity was demonstrated in Poland [29].

More boys than girls undertook vigorous physical fitness, but there was prevalence of obesity among boys. This could be due to the aspiration of girls to attain svelte figures with the help of diets. On the other hand, Portuguese boys reported greater enjoyment of games and sports participation than did girls. Boys with normal weight and overweight were also more successful and physically competent than girls in Portugal. It was demonstrated that normal-weight girls enjoyed participation in vigorous physical activity more than did overweight and obese girls [30].

We demonstrated a decrease in the number of schoolchildren undertaking vigorous physical fitness during the six years of observation, which corresponds to findings in some EU countries [20]. Physical fitness also decreased in the normal weight group. Probably, schoolchildren with BMIs corresponding to age and gender norms and low levels of physical fitness have problems with whole body fat tissue distribution (for example, a prevalence in the abdominal area), but this is a matter for future investigation.

4.1 Perspective

Our data demonstrated a high prevalence of obesity among Moscow schoolchildren. The situation seems near to critical from the public health point of view. We observed a concurrent increase in the number of schoolchildren with obesity and a decrease in the number

undertaking vigorous physical fitness. The observed gender- and age-related prevalence of obesity might correspond to hormonal changes, but this possibility requires further study. It is obvious that prevention programs are needed to increase physical fitness among schoolchildren [31]. Due to data received by Ogunleye, and Sandercock [32], Moscow schoolchildren with low physical activity have to have risk of metabolic diseases.

5. CONCLUSION

Findings of this study suggest an increase in the prevalence of obesity among Moscow schoolchildren which could be attributed to their low level of physical fitness.

CONSENT

No case reports were published. The article did not contain any personal data.

ETHICAL APPROVAL

The investigation was approved by the local ethics committee of Moscow State University of Medicine and Dentistry (No 6 from 29.11.04, No 5 from 26.02.2008, No 1 from 29.09.09, No 1 from 28.09.10). In accordance with Russian regulatory documents, written informed consent for the 7-14 years old children was taken from their parents; the 15-16 years old children wrote their own informed consent. All personal data are protected. The study is not against the public interest, or that the release of information is allowed by legislation.

All authors hereby declare that all experiments have been examined and approved by the appropriate ethics committee and have therefore been performed in accordance with the ethical standards laid down in the 1964 Declaration of Helsinki.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

REFERENCES

1. Lau C, Stevens D, Jia J. Effects of an occupation-based obesity prevention program for children at risk. Occup. Ther. Health Care. 2013;27(2):163-175.
2. Bechard LJ, Rothpletz-Puglia P, Touger-Decker R, et al. Influence of obesity on clinical outcomes in hospitalized children: A systematic review. JAMA Pediatr. 2013;167(5):476-482.
3. van der Kruk JJ, Kortekaas F, Lucas C, Jager-Wittenaar H. Obesity: A systematic review on parental involvement in long-term European childhood weight control interventions with a nutritional focus. Obes Rev. 2013; doi: 10.1111/obr.12046
4. Chung AE, Perrin EM, Skinner AC. Accuracy of child and adolescent weight perceptions and their relationships to dieting and exercise behaviors: A NHANES Study. Acad. Pediatr. 2013;13(4):371-378.
5. Parízková J. The role of motor and nutritional individuality in childhood obesity. Coll. Antropol. 2012;36(1):23-29.
6. Wang Y, Lobstein T. Worldwide trends in childhood overweight and obesity. Int. J. Pediatr. Obes. 2006;1(1):11-25.
7. Newson L, Povey R, Casson A, Grogan S. The experiences and understandings of obesity: Families' decisions to attend a childhood obesity intervention. Psychol. Health. 2013; Jun 11. [Epub ahead of print]
8. Sobol-Goldberg S, Rabinowitz J, Gross R. School-based obesity prevention programs: A meta-analysis of randomized controlled trials. Obesity. 2013: Silver Spring. doi: 10.1002/oby.20515.
9. Alexandrov A, Isakova G, Maslennikova G et al. Prevention of atherosclerosis among 11-year-old schoolchildren in two Moscow administrative districts. Health Psychol. 1998;7(Suppl):247-252.
10. Khasnutdinova SL, Grjibovski AM. Prevalence of stunting, underweight, overweight and obesity in adolescents in Velsk district, north-west Russia: A cross-sectional study using both international and Russian growth references. Public Health. 2010;124(7):392-397.
11. Cole TJ, Bellizzi MC, Flegal KM, Dietz DH. Establishing a standard definition for child overweight and obesity worldwide: international survey. Br. Med. J. 2000;320:1240-1243.
12. Boreham CA, Paliczka VJ, Nichols AK. A comparison of the PWC170 and 20-MST

tests of aerobic fitness in adolescent schoolchildren. J. Sports Med. Phys. Fitness 1990;30(1):19-23.

13. Orlov VA. Quantification of somatic human health by the body morphofunctional parameters. Aviakosm. Ekolog. Med. 2008;42(3):3-8. Russian.
14. Herzig M, Dössegger A, Mäder U, et al. Differences in weight status and energy-balance related behaviors among schoolchildren in German-speaking Switzerland compared to seven countries in Europe. Int. J. Behav. Nutr. Phys. Act. 2012; DOI: 10.1186/1479-5868-9-139.
15. Youssef Agha AH, Lohrmann DK, Jayawardene WP. Use of data mining to reveal body mass index (BMI): patterns among Pennsylvania schoolchildren, pre-k to grade 12. J. Sch. Health. 2013;83(2):85-92. DOI: 10.1111/josh.12002.
16. Musaiger AO, Al-Mannai M, Tayyem R, et al. Prevalence of overweight and obesity among adolescents in seven Arab countries: A cross-cultural study. J. Obes. 2012; DOI: 10.1155/2012/981390.
17. Flores LS, Gaya AR, Petersen RD, Gaya A. Trends of underweight, overweight, and obesity in Brazilian children and adolescents. J. Pediatr. (Rio J.) 2013; DOI: 10.1016/j.jped.2013.02.021.
18. Bishwalata R, Singh AB, Singh AJ, et al. Overweight and obesity among schoolchildren in Manipur, India. Natl. Med. J. India. 2010:23(5):263-266.
19. Bereket A, Atay Z. Current status of childhood obesity and its associated morbidities in Turkey. J. Clin. Res. Pediatr. Endocrinol. 2012;4(1):1-7. doi: 10.4274/jcrpe.506.
20. Sigmundová D, Sigmund E, Hamrik Z, Kalman M. Trends of overweight and obesity, physical activity and sedentary behaviour in Czech schoolchildren: HBSC study. Eur. J. Public Health. 2013;28. [Epub ahead of print]
21. Orden AB, Bucci PJ, Petrone S. Trends in weight, height, BMI and obesity in schoolchildren from Santa Rosa (Argentina), 1990-2005/07. Ann. Hum. Biol. 2013;40(4):348-54. DOI: 10.3109/03014460.2013.778329.
22. Birbilis M, Moschonis G, Mougios V, Manios Y; Healthy Growth Study' group. Obesity in adolescence is associated with perinatal risk factors, parental BMI and socio demographic characteristics. Eur. J. Clin. Nutr. 2013;467(1):115-121. DOI: 10.1038/ejcn.2012.176
23. Misra A, Shah P, Goel K et al. The high burden of obesity and abdominal obesity in urban Indian schoolchildren: A multicentric study of 38,296 children. Ann. Nutr. Metab. 2011;58(3):203-211. DOI: 10.1159/000329431.
24. Ying-Xiu Z, Ya-Lin L, Jin-Shan Z et al. Distributions of waist circumference and waist-to-height ratio for children and adolescents in Shandong, China. Eur. J. Pediatr. 2013;172(2):185-191. DOI: 10.1007/s00431-012-1862-x.
25. Pauline M, Selvam S, Swaminathan S, Vaz M. Body weight perception is associated with socio-economic status and current body weight in selected urban and rural South Indian school-going children. Public Health Nutr. 2012;15(12):2348-2356. DOI: 10.1017/S1368980012000134.
26. Sjöberg A, Moraeus L, Yngve A, et al. Overweight and obesity in a representative sample of schoolchildren - exploring the urban-rural gradient in Sweden. Obes. Rev. 2011;12(5):305-314. DOI: 10.1111/j.1467-789X.2010.00838.x.
27. Boukthir S, Essaddam L, Mazigh Mrad S, et al. Prevalence and risk factors of overweight and obesity in elementary schoolchildren in the metropolitan region of Tunis, Tunisia. Tunis Med. 2011;89(1):50-54.
28. Zhang YX, Chen M, Xue LH, et al. Comparison of body shape and physical activity among adolescents with normotensive and elevated blood pressure in Shandong, China. Ann. Hum. Biol. 2013;40(1):88-93. DOI: 10.3109/03014460.2012.740073.
29. Sygit K, Kołłątaj W, Goździewska M, et al. Lifestyle as an important factor in control of overweight and obesity among schoolchildren from the rural environment. Ann. Agric. Environ. Med. 2012;19(3):557-561.
30. Seabra A, Mendonça D, Maia J, et al. Gender, weight status and socioeconomic differences in psychosocial correlates of physical activity in schoolchildren. J. Sci. Med. Sport. 2013;16(4):320-326. DOI: 10.1016/j.jsams.2012.07.008.

31. Sánchez-López M, Salcedo-Aguilar F, Solera-Martínez M, et al. Physical activity and quality of life in schoolchildren aged 11–13 years of Cuenca, Spain. J. Sci. Med. Sport. 2008;9(6):879–88. DOI: 10.1111/j.1600-0838.2008.00839.x.

32. Ogunleye AA, Sandercock GR. Metabolic risk profile of schoolchildren and joint physical activity with an adult in the household: Multilevel analysis. J. Sci. Med. Sport. 2012;23(1):e56–e64. DOI: 10.1111/j.1600-0838.2012.01528.x.

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