PREDICTIVE PARAMETERS OF CARDIOVASCULAR RISK IN YOUNGER SCHOOL-AGE CHILDREN

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SUMMARY

Objectives: Overweight and obesity are important concerns for global health. They are characterized by excessive fat accumulation that can harm health. Childhood obesity has reached alarming levels around the world due to urbanization and changes in lifestyle. This trend highlights an urgent need for effective public health strategies to promote healthier lifestyles, prevent chronic diseases, and support the wellbeing of future generations. This study aimed to monitor the impact of the risk factors on blood pressure and lipid profile parameters.

Methods: Data were collected from 267 school-age children from Slovakia. The study assessed blood pressure using the sphygmomanometer technique, where systolic (SBP) and diastolic (DBP) blood pressure were measured in a seated position and repeated three times. The pulse rate was evaluated using Ruffier's physical fitness test. Anthropometric measurements included body weight, height, waist circumference, hip, and chest circumference, body mass index (BMI), and fat skinfolds measurement. The children's parents completed a comprehensive questionnaire. The data were statistically evaluated using IBM-SPSS version 19.

Results: Our analysis showed a statistically significant difference in SBP between obese and non-obese children ($p < 0.001$), but no significant differences for DBP and total cholesterol. Similar results were found between normal-weight and overweight children for SBP ($p < 0.001$), with overweight children showing higher SBP. No significant differences were noted for DBP or total cholesterol. Among children with "bad fitness", 57.9% had elevated SBP, compared to 37.86% with "good fitness" ($p < 0.01$). Additionally, 41.67% of children with bad fitness had elevated DBP, versus 23.05% in good fitness ($p < 0.001$). Significant differences in total cholesterol were also observed in these two groups ($p < 0.05$).

Conclusions: The results of this study confirm the importance of monitoring risk factors that significantly influence cardiovascular parameters.

Key words: risk factors, systolic blood pressure, diastolic blood pressure, cholesterol, obesity, school-age children

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INTRODUCTION

Overweight and obesity represent a pressing global health issue, characterized by the excessive accumulation of body fat that may have detrimental effects on health. The World Health Organization (WHO) defines overweight and obesity as abnormal or excessive fat accumulation that may impair health (1).

Globally, the WHO estimates that over 390 million children and adolescents aged 5–19 years were overweight in 2022, including 160 million who were living with obesity. In 2022, an estimated 37 million children under the age of 5 years were overweight. While just 2% of children and adolescents aged 5–19 were obese in 1990 (31 million young people), by 2022, 8% of children and adolescents were living with obesity (160 million young people) (1).

Effective prevention strategies for childhood overweight and obesity encompass a wide range of interventions aimed at promoting healthier lifestyles and environments. These strategies often include promoting physical activity, encouraging healthy eating habits, reducing sedentary behaviours, and improving overall lifestyle choices among children and adolescents. For instance, implementing school-based programmes incorporating physical and nutrition education effectively prevents obesity (2).

The management of childhood overweight and obesity requires a multifaceted approach that combines lifestyle modifications, behavioural therapies, and in some cases medical or surgical interventions. Primary care providers play a crucial role in the early identification and management of overweight and obesity in children. They are responsible for assessing the risk factors, counselling on diet and physical activity, and monitoring the progress (3).

Family involvement is also critical in managing childhood overweight and obesity. Parents and caregivers should exemplify healthy behaviours, provide nutritious meals, and encourage physical activity. Research has shown that family-based interventions, where parents and children work together to make lifestyle changes are more effective than interventions targeting the child alone (4). Additionally, policy measures such as regulating food advertising to children, improving the nutritional quality of school meals, and promoting active transport to and from school can create an environment that supports healthy choices (5).

Addressing this epidemic through comprehensive prevention and management strategies is essential for safeguarding health of future generations.

This study aimed to examine the impact of risk factors on blood pressure and lipid profiles in young children of school age. It focuses on assessing systolic and diastolic blood pressure and overall physical condition. It compares the results between obese and non-obese children, as well as between good and bad physical condition.

MATERIALS AND METHODS

General Information

The research was conducted from May 2018 to December 2019 with school-age children from Považská 12 Elementary School in Košice and a paediatric clinic in Levice. The parents signed an informed consent form explaining the research, measurement methods, and how data would be kept anonymous. The data were entered anonymously into a spreadsheet, with each child given a numerical code. The children were measured for height, body weight, chest, waist, and hip circumference, blood pressure, and skinfold thickness. Pulse rates under different conditions were also measured and physical fitness was assessed using the Ruffier test. Participation in the study was voluntary and only the children whose parents signed the informed consent were included.

Characteristics of the Sample

The study included children aged 5 to 13 years. A total of 267 children were examined, 174 (65.2%) boys and 93 (34.8%) girls. The children's chronological ages were calculated from the date of birth and the date of examination. The COVID-19 pandemic limited the number of children we could include in our research and stopped us from collecting more data. Our study was conducted in collaboration with the Regional Public Health Authority in Košice (module Healthy Heart Test) under the auspices of the Public Health Authority of the Slovak Republic. This project is registered under the code ITMS: NFP311070T621.

Anthropometric Examination

The anthropometric examination used an altimeter, a digital personal scale, a tailor's measuring tape, and a Harpenden brand calliper. Body weight was measured with the personal scale with an accuracy of half a kilogram. Body weight was measured in kilograms. Measurement was carried out, when the child had minimum clothing items, without shoes or heavy accessories such as mobile phones, coins, cases, etc. Children were weighed in a standing position. Height was measured with an altimeter on a horizontal floor, with half a centimetre accuracy. Children were barefoot, standing upright, with the back of the head, shoulders, and buttocks touching the altimeter.

The percentage of body fat was determined by measuring the thickness of four skinfolds according to the methodology of Parizkova (6). The sum of the thickness of these skinfolds (scapula, spina iliaca anterior, biceps muscle, and triceps muscle) was used to find the corresponding percentage of body fat in tables by Durnin and Rahaman (7), adjusted for gender. This examination was performed using the calliper device Harpenden with a calibration dowel – to measure the thickness of substantial fat stores. Despite its utility, the skinfold measurement technique has several limitations. Results can vary significantly between technicians due to inconsistencies in identifying the measurement site and correctly pinching the skin to isolate only the fat tissue. This variability can result in an error margin of approximately ± 8% among technicians. To mitigate this bias in our study, all skinfold measurements were conducted by a single skilled technician to ensure consistency and reduce individual measurement errors.

Parents' Questionnaires

The anthropometric examination was completed with a questionnaire addressed to parents. The children's parents completed a comprehensive questionnaire that included basic demographic and socioeconomic characteristics of the family, details of dietary habits, and smoking within the family. The parents also provided information about their child's health status, disease occurrence, and chronic illnesses within the family. The questionnaire data included assessments of the child's age, gender, breastfeeding status, birth order, and neonatal weight and length.

Measurement of Blood Pressure and Pulse Rate

Blood pressure was measured using a mercury sphygmomanometer connected to a children's cuff. Blood pressure was measured after a short rest (after at least 10 minutes of sitting quietly with the back supported and feet flat on the floor) and repeated three times, at 5-minute intervals. The average value of systolic and diastolic blood pressure was then calculated. Hypertension in children is defined as the average SBP and DBP ≥ 95th percentile for gender, age, and height on 3 or more occasions. Prehypertension in children is defined as average SBP and DBP levels that are ≥ 90th percentile but < 95th percentile (Table 1) (8).

The heart rate was evaluated using the Ruffier test, which assessed the fitness of the cardiovascular system. Three heart rate measurements (HR1, HR2, HR3) were taken. After 5 minutes of sitting, the resting heart rate (HR1) was measured before the load. This was followed by a load test of 30 deep squats with outstretched arms and landing on the heels within 30 to 45 seconds. Immediately after the load, the heart rate (HR2) was measured. After 1 minute of rest, the final heart rate (HR3) was measured. The fitness index was calculated from the measured values using the formula (HR1+HR2+HR3–200)/10. Based on the result, the child's fitness was categorized as excellent (≤ 3), good (3.1–7), average (7.1–12), poor (12.1–15), or insufficient (> 15) (9).

Assessment Standards for Selected Cardiovascular Indicators – BMI and Cholesterol

The weight of children across all age categories was assessed using BMI percentiles. BMI percentiles were calculated based on gender, age, weight, and child height (10). They were converted to percentiles allowing for a more accurate representation of the distribution of the observed trait values within specific age groups. Overweight status according to BMI was assessed at the 90th to 97th percentile of the group (Table 1). Obesity was assessed at the 97th percentile and over of the group (Table 1) (11). The ideal value of total blood cholesterol was up to 4.85 mmol/L (Table 1) (12).

Table 1. Borderline values of selected parameters in school-age children

Parameter	Value
Overweight by body mass index	90th–97th percentile
Obesity by body mass index	Over the 97th percentile
Increased systolic blood pressure	Over the 90th percentile
Increased diastolic blood pressure	Over the 90th percentile
Increased total cholesterol	Over 4.85 mmol/L

Statistical Analysis

Each child was given an identification number to ensure anonymity during the subsequent analyses. All the data were entered into MS Excel. Using MS Excel, the exact age of each child at the time of measurement was calculated. Decimal age distribution was used to categorize children into age groups (for example, children aged 8.00 to 8.99 were classified in the eight-year-old category). Statistical analysis was performed using IBM-SPSS version 19. The categorical variables were described by counts and percentages. For categorical data, chi-square tests were performed.

In our research, we applied the principles of the Helsinki Declaration concerning medical research involving human subjects capable of giving informed consent. Each potential subject's parent or caregiver was thoroughly informed about the study's aims, methods, funding sources, possible conflicts of interest, the researchers' institutional affiliations, the anticipated benefits, potential risks, and any discomfort the study might entail. The parents of the participating children were informed of their right to refuse participation or withdraw consent at any time without reprisal. After ensuring that the subjects understood the information provided, a physician or researcher obtained freely given written informed consents.

RESULTS

Characteristics of Study Participants

A total of 267 school-age children participated in our study. The participants' minimum and maximum ages were 5 and 13, respectively. Table 2 presents the age composition of the cohort. Boys constituted more than half of the participants (65.2%), compared to girls (34.8%).

Table 2. Age distribution of participants (N = 267)

Age	n (%)
5.00–5.99	12 (4.5)
6.00–6.99	10 (3.7)
7.00–7.99	46 (17.2)
8.00–8.99	40 (15.0)
9.00–9.99	45 (16.9)
10.00–10.99	66 (24.7)
11.00–11.99	29 (10.9)
12.00–12.99	19 (7.1)
Total	267 (100.0)

Most participants lived in urban areas (71.5%), compared to rural areas – village/community (28.5%). The most common parental education level was secondary – 66.3% of fathers and 64% of mothers have graduated from secondary schools. Demographic characteristics of the sample confirmed that maternal unemployment (22.1%) was higher than paternal unemployment (8.6%). Single-parent families, where the child is growing up in a family of one parent (mostly the mother), occurred in 14.2% of the cases. Low income per capita (less than 400 € per person) was confirmed in 26.6% of the families.

According to the findings in Table 3, obesity in family history was reported in 14.2% of the participants, and hypertension in family history was represented in 34.8% of the participants. The prevalence of smoking in family history was 30%. The family members most commonly smoke 10 cigarettes per day (Table 3). Additionally, 96.3% of the children watched television for over 2 hours a day. Among extracurricular facilities, the children most frequently attended sports clubs (53.6%) and language/art schools (16.5%). Additionally, 30% of the children did not participate in any extracurricular activities.

Regarding dietary habits, it was found that 72.3% of the children ate five times a day. Regular breakfast consumption was reported by 59.6% and 97% of the participants had a mid-morning snack. However, 61% of the children had irregular fruit and vegetable intake. The parents predominantly included meat (80.9%) and pasta (65.2%) in their cooking, with cheese (40.4%) and sweet dishes (20.6%) being less frequently incorporated. A significant finding was that 75.3% of the parents took their children to fast food restaurants and 11.2% drank sugary beverages.

Assessment of Blood Pressure

Blood pressure in the children was assessed using percentile norms based on the distribution of blood pressure values within the paediatric population. This percentile system allows for a more accurate representation of the distribution of the measured values within a specific age group. Normal blood pressure was defined as a systolic and diastolic pressure below the 90th percentile for sex, age, and height. Values above the 90th percentile were

Table 3. Socioeconomic evaluation and risk factors in the family history of school-age children

Parameter		n (%)
Income per capita	Low (< 400 €)	71 (26.6)
	High (> 400 €)	196 (73.4)
Obesity in history	Yes	38 (14.2)
	No	229 (85.8)
Hypertension in history	Yes	93 (34.8)
	No	174 (65.2)
Birth order of the child	Firstborn child	61 (22.8)
	Second born child	138 (51.7)
Smoking in family	Yes	80 (30.0)
	No	187 (70.0)
Watching TV	Yes (> 2 hours daily)	257 (96.3)
	No	10 (3.7)

considered elevated (13). We observed a high percentage of the children (40.4%) with elevated SBP, of which 29.2% were in the hypertension range. For DBP, 24.8% of the children had elevated values, with 7.9% classified within the hypertension range.

In Slovakia, we do not have a suitable database of reference blood pressure values for children (14). Consequently, American norms' tables and charts were used (8). Nevertheless, the paediatric population in Slovakia varies from the American one in terms of ethnicity, socio-demographics, genetics, diet, and physical characteristics. We propose that these distinctions may lead to the increased occurrence of prehypertension and hypertension among schoolchildren in our research (Fig. 1).

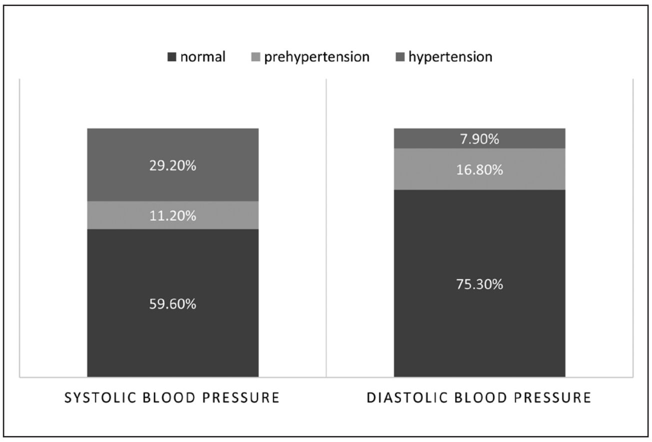

Fig. 1. Frequency of systolic and diastolic blood pressure of participants (assessed in percentiles for gender, age and height).

Assessment of Weight (BMI Percentile)

We evaluated the children's weights across all age groups using the percentile system. The BMI percentile was calculated considering the influence of gender, age, weight, and height of the children (10). Converting to percentiles allowed for a more precise representation of the distribution of the observed values, independent of gender and age.

In our analysis (Fig. 2), the children below the 3rd percentile were classified as underweight, those between the 3rd and 25th percentiles as thin/lean, those between the 25th and 75th percentiles as proportional, those between the 75th and 90th percentiles as robust, those between the 90th and 97th percentiles as overweight, and those above the 97th percentile as obese. Alarmingly, 21.8% of the children were categorized as overweight or obese. Specifically, 15.4% were overweight and 6.4% were obese.

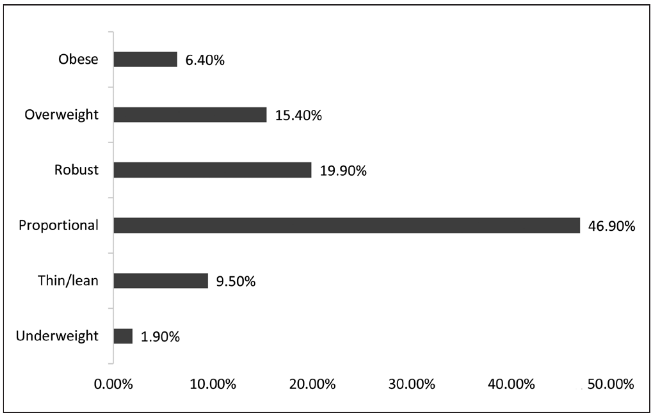

Fig. 2. Frequency of overweight and obesity of participants (BMI percentile).

Relationship between Obesity and Selected Cardiovascular Indicators

In the children, obesity according to BMI was assessed at the 97th percentile or higher for gender, age, weight, and height. Normal blood pressure was defined as a systolic and diastolic pressure value below the corresponding 90th percentile for gender, age, and height. Ideal total cholesterol levels were considered up to 4.85 mmol/L.

According to the results of our analysis, 17.6% of the obese children had SBP within the reference range. However, 82.4% of the obese children had elevated SBP. A statistically significant difference in SBP was confirmed between obese and non-obese children ($\chi^2 = 13.85$, $p < 0.001$) (Table 4). For DBP ($\chi^2 = 3.51$, p = not significant) and total cholesterol ($\chi^2 = 0.45$, p = not significant), no statistically significant differences were observed between obese and non-obese children (Table 4).

Relationship between Overweight and Selected Cardiovascular Indicators

In the children, overweight according to BMI was assessed at the 90th to 97th percentile for gender, age, weight, and height. Normal blood pressure was defined as systolic/diastolic pressure

***Table 4.** Impact of childhood obesity on selected cardiovascular indicators*

Parameter		Not obese children n (%)	Obese children n (%)	Pearson chi-square	p-value
SBP	To the 90th percentile	156 (62.40)	3 (17.60)	13.85	<0.001***
	Over the 90th percentile	94 (37.60)	14 (82.40)		
DBP	To the 90th percentile	188 (75.20)	13 (76.50)	3.51	0.173 n.s.
	Over the 90th percentile	62 (24.80)	4 (23.50)		
TCH	To 4.85 mmol/L	62 (89.90)	4 (100.00)	0.45	0.503 n.s.
	Over 4.85 mmol/L	7 (10.10)	0		

SBP – systolic blood pressure; DBP – diastolic blood pressure; TCH – total cholesterol
Not obese children – BMI to the 97th percentile; obese children – BMI over 97th percentile
p-values – ***<0.001; n.s. – not significant

below the 90th percentile for gender, age, and height. Ideal total cholesterol levels were considered up to 4.85 mmol/L.

Among the overweight children, 63.4% of the participants had elevated SBP, while the remaining 36.6% had SBP within the reference range. We observed statistically significant differences in SBP values between the overweight and other children ($\chi^2 = 15.67$, $p < 0.001$). The likelihood of elevated SBP occurrence was significantly higher in the overweight children ($p < 0.001$) (Table 5). No statistically significant differences were found between the overweight and non-overweight children in DBP and total cholesterol levels ($\chi^2 = 5.33/0.38$, p = not significant) (Table 5).

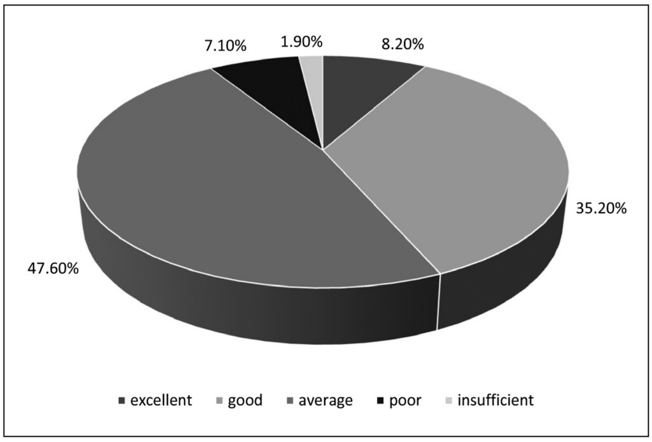

Fig. 3. Frequency of physical fitness levels in the children.

Relationship between Fitness of the Cardiovascular System and Selected Cardiovascular Indicators

We evaluated the fitness of the cardiovascular system using the Ruffier index. According to the results, our participants had excellent, good, average, poor, or insufficient physical fitness (Fig. 3). Those with excellent, good, and average fitness (Ruffier index between range 1–12) were classified as children with "good fitness". The children with poor and bad fitness were classified into the "bad fitness" group (Ruffier index between range 12.1–15). We considered the reference value of blood pressure to be lower than the respective 90th percentile for gender, age, and height. Normal total cholesterol levels were measured at values of up to 4.85 mmol/L.

In the children with bad fitness, it was confirmed that 57.9% had elevated SBP, while in the group of children with good fitness, it was elevated in only 37.86%. The differences between the children with bad fitness and good fitness in the SBP parameter were statistically significant ($\chi^2 = 23.082$, $p < 0.01$) (Table 6). In the DBP parameter, 41.67% of the children with bad fitness had elevated DBP, while in the children with good fitness, it was elevated in only 23.05%. A statistically significant difference was also reported in the children with bad fitness and good fitness in the DBP parameter ($\chi^2 = 34.500$, $p < 0.001$) (Table 6). A statistical significance was confirmed also in total cholesterol levels between the children with bad fitness and good fitness at the level of $p < 0.05$ (Table 6).

Table 5. Impact of childhood overweight on selected cardiovascular indicators

Parameter		Other children n (%)	Overweight children n (%)	Pearson chi-square	p-value
SBP	To the 90th percentile	144 (63.70)	15 (36.60)	15.67	< 0.001***
	Over the 90th percentile	82 (36.30)	26 (63.40)		
DBP	To the 90th percentile	176 (77.90)	25 (61.00)	5.33	0.070$^{n.s.}$
	Over the 90th percentile	50 (22.10)	16 (39.00)		
TCH	To 4.85 mmol/L	61 (91.00)	5 (83.30)	0.38	0.466$^{n.s.}$
	Over 4.85 mmol/L	6 (9.00)	1 (16.70)		

SBP – systolic blood pressure; DBP – diastolic blood pressure; TCH – total cholesterol
Overweight children – BMI from the 90–97th percentile
p-values – ***< 0.001; n.s. – not significant

Table 6. Impact of cardiovascular system fitness on selected cardiovascular indicators

Parameter		Good fitness n (%)	Bad fitness n (%)	Pearson chi-square	p-value
SBP	To the 90th percentile	151 (62.14)	8 (42.10)	23.08	0.003**
	Over the 90th percentile	92 (37.86)	16 (57.90)		
DBP	To the 90th percentile	187 (76.95)	14 (58.33)	34.50	< 0.001***
	Over the 90th percentile	56 (23.05)	10 (41.67)		
TCH	To 4 85 mmol/L	60 (92.00)	6 (66.70)	7.48	0.05*
	Over 4 85 mmol/L	4 (8.00)	3 (33.30)		

SBP – systolic blood pressure; DBP – diastolic blood pressure; TCH – total cholesterol
Good fitness– children with excellent, good, and average fitness (Ruffier index between range 1–12)
Bad fitness – children with poor and bad fitness (Ruffier index between range 12.1–15)
p-values – ***< 0.001; **< 0.01; *< 0.05

Summary of Anthropometric Parameters and Factors Impacting Cardiovascular Indicators

From anthropometric parameters and factors that affected SBP – age, weight, height, BMI, and overweight or obesity of the child play a significant role ($p<0.001$). The Ruffier index also contributes to elevated SBP at a statistical significance level of $p<0.05$.

The factors contributing to elevated DBP include the child's weight, BMI, and the Ruffier index ($p<0.001$). The child's height has statistical significance at the level of $p<0.01$. Statistically insignificant risk factors for DBP are the child's overweight and obesity status. The child's age is statistically insignificant for DBP.

DBP does not affect elevated cholesterol levels. Additionally, the overweight and obesity of the child are statistically insignificant factors. Conversely, factors contributing to elevated cholesterol levels include the Ruffier index ($p<0.001$), age and SBP ($p<0.01$), and the child's height ($p<0.05$).

DISCUSSION

Numerous factors influence the growth and development of children. Anthropometric parameters are crucial indicators of children's health status. Deviations from the norm may indicate improper eating habits, psychological disorders, hidden chronic diseases, or health disparities resulting from differing socioeconomic environmental factors. Today's modern lifestyle, characterized by a lack of physical activity, unhealthy eating habits, and a sedentary way of life, leads to increased body fat and rising obesity indices. Lifestyle risk factors directly impact an individual's growth and development. Current recommendations include increasing physical activity and altering eating habits – primarily by reducing overall calorie intake.

Assessment of Socioeconomic Status

Our results confirmed significant correlations with socioeconomic status. In the families of the children, a high prevalence of maternal (22.1%) and paternal (8.6%) unemployment was observed, as well as a high percentage of single-parent families (14.2%). These factors can significantly influence the anthropometric values of children and may also affect blood pressure values. Our sample's most common parental education level was secondary education (mothers 64%, fathers 66.3%), which was also confirmed by Rimárová et al. (15). Maternal unemployment included mothers on maternity leave or mothers caring for younger children.

The impact of the socioeconomic status on anthropometric indicators was confirmed by a nationwide survey in the Czech Republic, where maternal education was identified as a decisive factor influencing children's height (16). The influence of low parental education on children's anthropometric indicators has also been confirmed in the study of Randhir et al. (17). Studies conducted in developed countries indicate a relationship between low socioeconomic status and obesity (18). Brug et al. (19) also confirmed a significantly higher prevalence of overweight and obesity in children with low socioeconomic status. In our analysis, the impact of maternal and paternal education on all our monitored parameters (SBP, DBP, total cholesterol, obesity, and physical fitness) was statistically insignificant.

Assessment of Impact of Overweight and Obesity on Selected Indicators

In the nationwide anthropometric survey of children in Slovakia in 2011, an increase in body weight and BMI was observed (20). Preventing obesity in childhood is a key to preventing obesity in adulthood. Currently, obesity represents a global epidemic – a pandemic and is one of the most prevalent metabolic diseases worldwide (21).

It is essential to understand the current prevalence of overweight and obesity among school-age children, as well as the complications associated with obesity. This knowledge is crucial for implementing preventive, diagnostic and therapeutic measures in the Slovak population. Therefore, our study focused on the BMI of school-age children. BMI indices provide only approximate data for children and adolescents, primarily used when percentile charts are unavailable. Consequently, we used BMI percentile evaluation to assess BMI. The percentile system allows for a more precise expression of the distribution of values for the observed characteristic within a specific age group. In our sample of school-age children, 15.4% were found to be overweight, and 6.4% were identified as obese.

According to the results of our statistical analysis, 82.4% of the obese children and 63.4% of overweight children had elevated SBP. A statistically significant difference in SBP was confirmed between the obese and overweight children and their non-obese peers ($p < 0.001$). Elevated SBP in overweight and obese children was also confirmed by Köchli et al. (22).

We hypothesize that family history and genetic factors contributed to the development of overweight and obesity in our children, with obesity being present in the family history of 14.2% of the cases. This finding is consistent with reports by other authors (23). Additionally, higher BMI values in the children may have been influenced by hypertension in the family history (34.8%) and by the socioeconomic status of the family, with 26.6% of the families having a low income. These parameters were also confirmed by Rimárová et al. (15). Other studies have demonstrated that BMI correlates with watching television (24), and diet and exercise habits (25).

Assessment of Blood Pressure

Blood pressure is a variable, especially during preschool, school-age, and adolescence. Blood pressure is primarily influenced by gender, height, weight, ethnicity, body indices, sociodemographic characteristics of the environment, genetic factors, and other variables.

In our overall assessment of the group of children (girls and boys), statistically highly significant ($p<0.001$) parameters for SBP were confirmed to be weight, height, BMI, and overweight/obesity ($p<0.001$). The Ruffier index also increased SBP at a statistical significance level of $p<0.05$. For DBP, weight, BMI, and the Ruffier index were statistically highly significant parameters ($p<0.001$). Height had statistical significance at the $p<0.01$ level. Ma et al. (26) found similar results in a sample of children and adolescents aged 7–18 years, where height, weight and BMI significantly influenced blood pressure values. A similar study by Dong et al. (27), conducted in the age group 6–17 years, yielded the same results. Additionally, Al-Agha and Mahjoub (28) confirmed that children's BMI significantly influenced their blood pressure values.

The results of our examined sample of school-age children highlighted the importance of anthropometric and social factors in blood pressure values. We demonstrated higher correlations in the assessment of SBP compared to DBP.

Assessment of Physical Fitness

We assessed overall physical fitness using the Ruffier test, which serves as an indicative measure of cardiovascular fitness (29). The differences between the children with poor and good fitness levels in SBP and DBP were statistically significant ($p < 0.01$, $p < 0.001$). Regarding total cholesterol levels in our school-age children, there was a statistically significant difference between the children with poor and good fitness levels ($p < 0.05$).

We hypothesize that insufficient physical activity and time spent in sedentary activities subsequently result in low physical fitness and developing prevalence of overweight or obesity, with all the associated negative consequences on cardiometabolic factors. These associations were also confirmed in the study by Faik et al. (30). Therefore, early detection is essential to prevent the progression of these issues into adulthood.

The findings and insights from this work are precious for paediatric practice and public health.

Limitations

The conclusions of this study should be considered with an awareness of the limitations of the dataset and the study design. Notably, the study did not investigate the type of lunch and where these probands ate their lunch (at home or school, or they did not have lunch) and we did not collect data on the BMI of the children's parents. In the future, we will focus on these parameters during the data collection to obtain this important information.

CONCLUSION

This study highlights the important role of monitoring key risk factors such as obesity and physical fitness in influencing the health of the cardiovascular system in school-age children. The findings revealed a significant association between obesity and increased SBP, highlighting the need for early intervention to address the growing public health problem. Furthermore, the study emphasizes the importance of physical fitness, as children with low physical fitness show higher SBP and DBP as well as high total cholesterol. These results strengthen the urgency of implementing effective public health strategies to promote healthier lifestyles, reduce the incidence of obesity, and reduce the long-term risk of cardiovascular disease in children. Early identification and targeted interventions are essential to improve cardiovascular outcomes and support future generations' overall health and wellbeing.

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Conflicts of Interest

None declared

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