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# Gender Differences in Obesity, Postural Status, Body and Foot Deformities, and Leisure Activities Among Primary School Students

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**Abstract**

**Background:** Correct body posture should be at the very top, because it is an essential prerequisite for good health, normal growth and development, and good looks of every student. Inadequate spending of free time leads to the appearance of obesity, improper posture, and the appearance of physical deformities.
**Aims:** This research aims to determine the prevalence of obesity, improper body posture, body deformities, and the way of spending free time among primary school students according to gender.
**Methods:** The research was carried out on a sample of a total of N=1,850 primary school students, of which there were N=989 (53%) male respondents and N=861 (47%) female respondents. Analyzing the results of morphological characteristics, it was determined that boys have a higher body mass index (BMI) than girls.
**Result:** The obtained results are statistically significant at the level of less than 1% ($p<0.01$), and the results were in favor of girls. Obesity and excessive nutrition are more prevalent in boys than in girls. By measuring the lateral curve of the spinal column, the following results were obtained: 67.24% of boys have improper posture, and 37.52% of girls.
**Conclusion:** Classroom data show children spend substantial free time on electronic devices, especially boys gaming on computers and tablets. Girls more often engage in sports, television viewing, reading, and mobile communication. Preventive action is needed through regular student monitoring, testing, and measurement to track developmental changes and promote healthier lifestyle patterns in school contexts.

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## INTRODUCTION

Automation and computerization in all spheres of life lead to hypokinesia, which is one of the primary prerequisites for poor posture. In addition, bad habits, improper posture, improper sitting, inadequacy of school desks, school chairs, as well as excessive body weight, school bags affect the appearance of various forms and an increasing number of body deformities. In the period of growth and development, i.e., between the ages of 6 and 18, children are exposed to various health problems, including the problem of proper posture (Bogdanović & Milenković, 2008). It was found that pain in the lumbar part of the spine in school children occurs in 20% to 51% of the total school population of children. Also, back pain is associated with prolonged sitting, weakness of certain muscle groups, poor posture, etc. (Lafond, 2007). Teachers should recognize improper posture, so that they can adequately combat it. Also, based on the research, a high percentage of incorrect posture was found in school children, as well as the occurrence of postural disorders on the spinal column (scoliosis and kyphosis) and deviations on the longitudinal arch of the foot (Bogdanović & Bešović, 2012). The main

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role in preventing and suppressing the resulting deformations is played by the physical and health education teacher, who must work on the corrective work of postural disorders (Nikšić et al., 2015).

The foot is one of the most important organs of the human body, which has a great influence on the functional state of the locomotor apparatus, especially the lower extremities. It carries the entire human body, which consists of bones, muscles, joints, tendons, and ligaments that successfully carry and move the body in all directions and on different terrains. Disturbances occur in the form of pain, and limited mobility of certain joints can have a great impact on the foot itself (Nikšić, 2016). Posture of the body is a movement habit that is formed and changes during the entire life span. The status of students is becoming more and more relevant, considering today's modern way of life with too little physical activity, and more and more sedentary. Teachers should be able to detect improper posture in time, so that they can adequately suppress and prevent the occurrence of physical deformities (Nikšić & Beganović, 2020). Contemporary life circumstances, which are largely initiated by technological development, affect people's lives from an early age (Bajrić, 2018).

The sedentary lifestyle of children and youth has increased due to the use of various technologies, and physical activity has decreased. Such a situation leads to an increased amount of food intake, and therefore to excessive body mass (obesity), as well as to the appearance of improper body posture and body deformities. Bad posture and deformities increase in children starting school. Due to school obligations, physical activity is reduced because children spend most of their time in an irregular sitting position. Physical deformities that appear in childhood and are not corrected in time remain as a permanent handicap and significantly affect the entire life of the child. Teachers should know how to identify improper body posture, so that they can combat it sufficiently. Because of this versatile importance, posture stands out in the physical culture of all ages, as a starting goal and as a basic element of movement culture, because bad posture essentially represents an initial stage of a certain physical deformity (Nikšić, 2023). With well-chosen exercises and their daily application by students in class, it is possible to significantly prevent deviations from normal posture, that is, eliminate bad posture and significantly prevent and alleviate the occurrence of physical deformities. In the teaching of physical and health education, teachers should apply shaping exercises as preventive measures, which are like corrective exercises used to correct a certain deformity.

For a specific task for correct body posture, those exercises should be consistently applied that at the given moment best correspond to the student's level of condition and appearance. In addition to shaping exercises using different types of physical and health education, such as games, sports, and gymnastics, we achieve a significant effect for the all-round development of the student's organism, and thus maintain a favorable appearance in the posture of certain body parts. The spine is the main factor of upright posture and the weight bearer of all upper parts of the body. It is precisely because of this that it is often exposed to the occurrence of numerous deformations, which can affect the entire spinal column or only certain parts. The foot carries the entire human body, which consists of bones, muscles, joints, tendons, and ligaments that successfully carry and move the body in all directions and on different terrains. Over 60% of the population has minor or major foot anomalies, especially school children. The biggest reason for this is that the foot carries the biggest load (Nikšić et al., 2019a). Reduced physical activity in children contributes to the frequent appearance of improper posture, and the consequence of this is the appearance of body deformities and obesity (Nikšić et al. 2019b). It has been proven that the frequency of postural disorders can be significantly reduced through a planned and continuous corrective procedure. It is necessary to develop awareness of a healthy lifestyle that includes appropriate corrective exercises, which have a preventive and corrective effect on the posture of young people (Nikšić & Beganović, 2020). Any sporting activity leads to a certain transformation of the morphological status. The most important thing is to adapt a certain sports activity to the age at which it is worked, so that the activity affects the transformation of students (Rašidagić et al., 2000). The nutritional status of children can be evaluated based on clinical examination, laboratory procedures, and anthropometric measurements. Height and body mass are most often used to determine the degree of nutrition.

Children and adolescents who are at risk of being overweight often become obese adults. It is necessary to carry out daily monitoring, measurements, and analysis of all segments of the anthropological status of students, to act preventively in the fight against obesity, as the leading epidemiological health problem of today (Nikšić et al., 2021). Today, school children are provided with diverse and undoubtedly high-quality sports content, which they do not know how to use due

to the widespread use of electronic devices. There are many sports clubs, both collective and individual sports. Many primary school students do not play sports, but spend their free time on tablets, phones, computers, and the like. This research aims to determine the prevalence of obesity, improper body posture, body deformities, and the way of spending free time among primary school students according to gender.

## METHOD

*Sample of respondents*

The research included a sample of N=1850 primary school students, of which 989 (53%) were male and 861 (47%) were female. The research included students from a total of 8 primary schools, one school from each municipality at the level of the Sarajevo Canton. In each school, two classes of the same generation were included using a random sample of respondents.

*Sample variables*

Anthropometric variables used for this study are body height, body mass, and body mass index (BMI). The following measuring instruments/tests were used to determine body posture and body deformities:

1. Measurement of spinal curvature (cervical and lumbar curvature);
2. Measurement of lateral curvature of the spinal column (scoliosis, kyphosis, lordosis);
3. Checking foot structure using the plantography method (Thomsen's method).

*Research design*

Anthropometric variables were measured according to standard procedures of the International Society for the Advancement of Kinanthropometry (ISAK) (Marfell-Jones et al., 2006). Based on the variables of body height and body mass, the body mass index (BMI was calculated [BMI = BH (kg) / BW ($cm^2$)]. BMI values for both subsamples were classified into 4 nutritional levels, according to the recommendations of the Centers for Disease Control and Prevention, 2000 (Kuczmarski et al., 2002).

*Statistical Analysis*

Descriptive statistics were used as statistical methods. Statistical data processing in this study was performed using the computer software SPSS Statistics 20.0 in the Windows 10 operating system. The statistical program for personal computers, SPSS for Windows version 22, was used for data processing.

## RESULTS AND DISCUSSION

### Results

To provide a clear overview of the anthropometric characteristics of the sample, the results are first presented through descriptive statistical comparisons between boys and girls. The following table summarizes the distribution of body mass index values as an initial indicator of nutritional status within the observed population. Presenting these findings at the beginning of the Results section allows for a structured progression from basic morphological indicators toward more complex postural and behavioral variables. This sequence ensures that subsequent interpretations of posture, deformities, and leisure activities remain grounded in the fundamental characteristics of physical development.

**Table 1.** Differences in the BMI between boys and girls in class - Descriptive statistics

| Variables | Gender | Mean ± Std.Dev. | t-test | |
|---|---|---|---|---|
| | | | t-value | p |
| BMI (kg/m2) | ♂ | 19.64 ± 4.26 | 14.87 | 0.00 ** |
| | ♀ | 21.89 ± 3.86 | 18.18 | |

Note: Male – ♂; Female – ♀; Mean – arithmetic mean; Std. Dev. – standard deviation; p – significance level; * t – the test is statistically significant at less than 5% level; ** t - the test is statistically significant at less than 1% level.

Analyzing the results shown in Table 1, we can notice that there are statistically significant differences between boys and girls in the first grade in body mass index (BMI). Body mass index (BMI) represents the relationship between body mass and body height. It is widely used in assessing nutritional status.

**Table 2.** Frequencies and percentage values of BMI by category for students by gender

| Nutritional status | ♂N | Percentiles | % | ♀N | Percentiles | % | Nutritional status |
|---|---|---|---|---|---|---|---|
| **Obesity** | 338 | ≥95 | 34.18 | 169 | ≥95 | 19.63 | |
| **Overweight** | 67 | 85-95 | 6.78 | 48 | 85-95 | 5.57 | |
| **Normal weight** | 219 | 5-85 | 22.14 | 375 | 5-85 | 43.56 | |
| **Malnutrition** | 365 | <5 | 36.90 | 269 | <5 | 31.24 | |
| **Total** | 989 | | 100.0 | 861 | | 100.0 | |

Note: Male – ♂; Female – ♀; % - percentages

Table 2 shows values for the BMI variable, based on which it is possible to see the state of nutrition of primary school students according to gender and level of nutrition. Looking at boys and girls separately, it can be noted that obesity and overnutrition are more prevalent in boys than in girls. Out of a total of 989 (53.46%) boys, 338 of them belong to the category of obese, 67 boys to the category of excessive nutrition, 219 boys are normally nourished, while 365 boys are malnourished. Out of a total of 861 (46.54%) girls, 169 of them belong to the category of obese, 48 girls to the category of excessive nutrition, 375 girls are normally nourished, while 269 girls are malnourished. Today's big problem is not only obesity in children, but also malnutrition.

**Table 3.** Body posture of primary school students according to gender

| Measuring spinal curvature | ♂(f) | % | ♀(f) | % |
|---|---|---|---|---|
| **Correct body posture** | 324 | 32.76 | 538 | 62.48 |
| **Incorrect body posture** | 665 | 67.24 | 323 | 37.52 |
| **Total** | 989 | 100.0 | 861 | 100,0 |

Legend: Male – ♂; Female – ♀; f-frequency; % - percentages

Inspection of the obtained results in Table 3 clearly shows the results obtained by measuring the curvature of the spinal column. It was shown that 32.76% of male grade school students, by measuring the neck and lumbar curve with a 1 cm deviation, have a correct body posture, and 67.24% of male grade school students, by measuring the neck and lumbar curve, have an incorrect body posture. 62.48% of female primary school students, by measuring the neck and lumbar curve with a deviation of 1 cm, have a correct body posture, and 37.52% of female primary school students, by measuring the neck and lumbar curve, have an incorrect body posture.

**Table 4.** Presentation of the frequency distribution of the presence of spinal deformities (kyphosis, scoliosis, lordosis) in primary school students by gender

| Measuring spinal curvature | ♂(f) | % | ♀(f) | % |
|---|---|---|---|---|
| **Correct body posture** | 324 | 32.76 | 538 | 62.48 |
| **Kyphosis** | 245 | 24.77 | 107 | 12.43 |
| **Scoliosis** | 215 | 21.74 | 123 | 14.29 |
| **Lordosis** | 205 | 20.73 | 93 | 10.80 |
| **Total** | 989 | 100.0 | 861 | 100,0 |

Legend: Male – ♂; Female – ♀; f-frequency; % - percentages

By measuring (Table 4) the curvature of the spinal column of male students, and according to the type of deformity, data were obtained that show that out of 989 respondents, 324 (32.76%) students have symmetrical shoulders, even shoulder blades and a straight line of the spinal column, which means that they have good posture. 245 (24.77%) students have the following characteristics: head bent forward, shoulders bent forward, increased stooping, chest drawn in, shoulder blades prominent, abdomen slightly bulging, knees somewhat bent and moved forward, indicating a kyphosis deformity. 215 (21.74%) students have an irregular position of the shoulders, different levels of the shoulder blades, which shows the curvature of the spinal column in the lateral plane, which is known as scoliosis. In 205 (20.73%) students, the head is slightly away from the vertical line, the chest is flat or bulging, and somewhat lowered, the pelvis is moved forward and downward, the belly is bulging and soft, the hips are slightly moved forward, which indicates a deformation called lordosis. 538 (62.48%) female students have symmetrical shoulders, even shoulder blades, and a straight line of the spine, which means they have good posture. 107 (12.43%) female students have the following characteristics: head bent forward, shoulders bent forward, increased hunchback, chest drawn in, shoulder blades prominent, abdomen slightly bulging, knees somewhat bent and moved forward, which indicates a deformity called kyphosis (Figure 1). 123 (14.29%) female students have an irregular position of the shoulders, different levels of the shoulder blades, which shows the curvature of the spinal column in the lateral plane, which is known as scoliosis (Figure 2). In 93 (10.80%) schoolgirls, the head is slightly away from the vertical line, the chest is flat or bulging, and somewhat lowered, the pelvis is moved forward and downward, the belly is bulging and soft, the hips are slightly moved forward, which indicates a deformation called lordosis (Figure 3).

**Figure 1.** Kyphosis in boys and girls

**Figure 2.** Scoliosis in boys and girls

**Figure 3.** Lordosis in boys and girls

Research on the population of school children, students from grades I to VIII of primary schools, confirms my research that many students of both sexes have postural disorders in the spinal column in the sagittal plane and deviations in the longitudinal arch of the foot. Out of the total number of 1309 examinees with postural disorders, 1060 students, which is 80.9%, while the remaining 249 examinees, or 19.1%, do not have postural disorders. Among students from grades, I to IV, out of the total number of 435 examinees with postural disorders, 365 (83.8%) have postural disorders, and only 70 (16.1%) have no postural disorders. Among students from grades V to VIII, out of the total number of 874 examinees with postural disorders, 695 (79.5%) have postural disorders, and only 179 (20.5%) have no postural disorders. The results of the study showed that among students from the first to the fourth grade of primary schools, the frequency of occurrence of spinal deformity of kyphosis was present in 246 (56.5%) students of both sexes. Lordosis was present in 9 (2.0%) students of both sexes. In the first grade, it was recorded that there were no differences in postural disorders between boys and girls. In the second grade, the percentage of deformities is higher in boys, and in the third and fourth grades, the percentage of these changes is higher in girls.

**Table 5.** Presentation of the frequency distribution of the presence of foot deformities (flat and raised feet) in primary school students according to gender

| Foot deformities | ♂(f) | % | ♀(f) | % |
|---|---|---|---|---|
| **Correct arch of the foot** | 324 | 32.76 | 538 | 62.49 |
| **Pes planus (Flat foot)** | 460 | 46.51 | 217 | 25.20 |
| **Pes cavus (Raised foot)** | 205 | 20.73 | 106 | 12.31 |
| **Total** | 989 | 100.0 | 861 | 100,0 |

Legend: Male – ♂; Female – ♀; f-frequency; % - percentages

By measuring the structure of the foot using the method of plantography, i.e., based on the students' footprints (Table 5 and Figure 4), data was obtained that shows that 324 (32.76%) male students have a well-formed foot, that is, that the tread surface of the foot is only 1/3 of the transverse line. 460 (46.51%) students have flat feet, while 205 (20.73%) students have raised feet. 538 (62.49%) female students have a well-formed foot, that is, the tread surface of the foot is only on 1/3 of the transverse line. 217 (25.20%) female students have flat feet, while 106 (12.31%) female students have raised feet.

**Figure 4.** Presentation of flat feet and raised feet in class students

Following the presentation of morphological and postural findings, it is important to examine behavioral patterns that may contribute to the observed physical characteristics. Leisure-time activities represent a contextual dimension that reflects daily movement exposure, sedentary tendencies, and gender-specific lifestyle preferences among primary school students. By transitioning from structural indicators such as spinal and foot status toward activity-based variables, the analysis expands from physiological outcomes to behavioral determinants. The next table therefore illustrates how students allocate their free time, providing complementary insight into potential factors influencing nutritional status and musculoskeletal health.

**Table 6.** Presentation of the free time of students in class according to gender

| Leisure activities | ♂ (f) | % | ♀ (f) | % |
|---|---|---|---|---|
| **Playing sports** | 192 | 19.41 | 397 | 46,11 |
| **Watching TV** | 53 | 5.36 | 81 | 9.41 |
| **Playing games** | 339 | 34.28 | 110 | 12,77 |
| **Using tablets and computers** | 237 | 23.97 | 66 | 7.67 |
| **Using mobile phones** | 128 | 12.94 | 140 | 16.26 |
| **Reading books and studying** | 40 | 4.04 | 67 | 7.78 |
| **Total** | 989 | 100.00% | 861 | 100.00% |

Note: Male – ♂; Female – ♀; f-frequency; % - percentages

Looking at Table 6, looking separately at boys and girls in primary school, boys spend more time playing games, as well as using tablets and computers, which was to be expected since these are primary school students who nowadays spend most of their time with electronic devices. Out of a total of N=989 male respondents, 192 students play sports in their free time, 53 students watch TV, 339 students play games, 237 students use tablets and computers for various purposes, 128 students use mobile phones, while only 40 students read books and study. Out of a total of N=861 female respondents, 397 students play sports in their free time, 81 students watch TV, 110 students play games, 66 students use tablets and computers for various purposes, 140 students use mobile phones, while 67 students read books and study. In their free time, students read books, play games on a computer, tablet, or PlayStation, and talk on their mobile phones. Girls spend more time than boys playing sports, watching TV, reading books, and talking on their mobile phones, while boys spend more time than girls playing games on a computer or PlayStation. Girls spend more time reading and talking on their phones because they are more focused on school achievements and social contacts. Parents and teachers often encourage girls to be active through dance, gymnastics, and recreational sports to maintain optimal body mass. Boys are more likely to encounter technology through video games, because they are designed to be attractive to them (action games, competitive spirit). Boys enjoy games that offer challenges, strategy and competition more, which attracts them to video games. Video games are often designed with themes that appeal more to boys (war games, sports, cars, fighting). Parents are more likely to limit girls' use of electronic devices and encourage them to be physically active, while boys are more likely to be allowed to play games, because this is considered a "typically male" way of having fun.

**Discussions**

Body mass index (BMI) represents the relationship between body mass and body height. It is widely used in assessing nutritional status. Although it does not provide information about body composition, when combined with other methods that determine body composition, information about the level of nutrition can be obtained (Mišigoj-Duraković et al., 2014). Dietary and lifestyle habits play a major role in maintaining optimal body mass (Kumar & Kelly, 2017).

The statistical differences observed in BMI between boys and girls should not be interpreted solely as isolated anthropometric findings, but rather as indicators of broader lifestyle transitions occurring during early school age. Contemporary research increasingly frames childhood obesity within an ecological perspective that integrates behavioral habits, technological exposure, and sociocultural environments. Therefore, interpreting the present data requires positioning it within global epidemiological trends and previously reported prevalence patterns. By situating these findings within wider international evidence, the discussion can move beyond descriptive outcomes toward a more contextualized understanding of gender-related nutritional risks and preventive implications.

The number of obese people is growing every day. The causes should be sought in poor nutrition, stressful lifestyle, technological progress and, above all, in hypokinesia. There are over a billion-overweight people in the world and about 300 million obese, and 2.5 million people die every year due to being overweight (Puska et al., 2003). The level of nutrition of children in the Sarajevo Canton shows that 78.10% have normal nutrition, 12.30% are overweight, 7.10% are obese, and 2.50% are malnourished (Taljić & Nikšić, 2016). The results of the Body mass index (BMI) research of children in Sarajevo Canton in 2016, looking at respondents separately by gender, obesity was more prevalent in boys. More specifically, out of a total of 1,840 boys, 405 (22.0%) were obese, while out of a total of 1,708 girls, 226 (13.2%) were obese (Abazović et al., 2016).

According to the Croatian Health Statistical Yearbook, published every year by the Croatian Institute of Public Health, based on data collected from the County Institutes of Public Health and the Institute of Public Health of the city of Zagreb obtained from the School Medicine Services, 3.73% of undernourished students, 12.85% overweight and 17.74% obese students in primary schools. If we exclude children of normal body weight, 34.32% of primary school children are in the other categories. The etiology of childhood obesity is very complex but eating and lifestyle habits play a very important role (Kumar & Kelly, 2017). Looking at the results of the study conducted to determine the obesity of primary school children in the City of Mostar, in which a total of 1,940 students participated, an extremely large number of children with increased body mass was recorded. Of the total number of students included in this study, as many as 36.4% (707) were obese, while 56.1% of children had a normal body mass. In addition, it is worth noting that 7.4% (144) of the respondents were malnourished. According to the results obtained, almost every second child has an eating disorder (43.9%), which is extremely worrying and alarming (Čolakhodžić et al., 2017).

According to data from the World Health Organization (WHO 2018), childhood obesity is one of the greatest global public health challenges of the 21st century. It is estimated that in the last 40 years, the number of obese school-age children and adolescents has increased tenfold. Baranowski & Taveras (2018) point out that the current approach to the problem of childhood obesity has not produced the expected results, and that it is necessary to strengthen preventive activities at all levels, starting with parents. Nutrition and school are connected for some reasons and therefore affect the analysis of the nutritional status and body composition of elementary school-aged students. Their ability to choose and consume food, nutrition is no longer completely under the control of their parents, they eat at least one meal a day or even several snacks without supervision, the modern, fast-paced lifestyle also affects the way of eating, the lack of time, the dynamics of life and the increasing employment of parents influence that children and youth consume food outside the home more often, meals that are rich in energy in terms of nutritional composition are eaten more often, but do not contain a sufficient amount of nutrients and protective substances - vitamins and minerals (Taljić, 2019).

In the research conducted on the ITOF criteria, most children, 165 or 65.74%, were normally nourished, 21.51% were malnourished, while 7.97% and 4.78% of children with increased body mass were obese (Paić, 2019). Today's modern society is characterized by significantly reduced

motor activity and improper nutrition, and there is an increasing number of people whose lifestyle can be described as "sedentary". It is necessary to act preventively promptly through more frequent monitoring and analysis of proper growth and development and motivating students to engage in sports actively or recreationally. Proper habits that are adopted in childhood, in most cases, remain in other developmental stages (Nikšić, Beganović & Mekić, 2020). It was also found that 19.70% of boys are obese, as well as 17.40% of girls. Combined with the percentage of overweight respondents, a total of 61.50% of boys were not normally nourished, as were 37.70% of girls (Nikšić et al., 2021).

Beyond the numerical comparison of postural status between boys and girls, it is essential to interpret these results through a functional and biomechanical perspective. Posture is not merely a static anatomical condition but a dynamic interaction between neuromuscular control, growth processes, and daily movement habits. The observed differences in spinal alignment may therefore reflect cumulative behavioral patterns rather than isolated structural deviations. For this reason, the following discussion draws on foundational concepts of musculoskeletal balance and developmental posture to clarify how early deviations may evolve into more complex deformities if left unaddressed.

Good posture in an upright position or another position, whether in motion or at rest, represents a state of good musculoskeletal balance (Protić–Gava & Šćepanović, 2014). The prevalence of postural disorders is a frequent occurrence in school-age children. Fortunately, this is a higher percentage of the functional stage where structural changes have not yet occurred. The periods of starting school and entering puberty are considered periods in which postural disorders occur and develop, and the results of this study confirm this. Namely, children aged 7 to 8 have worse posture than their peers, while in other periods up to the age of 14, boys have a higher prevalence of postural disorders (Protić–Gava, 2015). Reduced physical activity in children affects not only functional and biomotor abilities, but also contributes to the frequent occurrence of poor posture, and as a result, the development of body deformities.

Therefore, it is necessary to detect the deformity in the initial stage and do everything possible to prevent its further development (Nikšić, 2016). Active forces of the organism (muscles) and passive forces (ligaments), joint connections, and bone parts participate in maintaining an upright posture. In the case of spinal deformities, it is necessary to establish the following: In which plane is the curvature located (frontal or sagittal), because all curves located in the frontal plane belong to the type of scoliotic curves, and those in the sagittal plane belong to kyphotic and lordotic curves. What is the degree of curvature (measurement is made using a plumb line), in centimeters, from the plumb line? What is the position of the spine when standing, sitting, and squatting. In different postures, the spine can show different positions. The postures are also selected according to the progress of the correction. Are there structural changes in the spine that indicate a poor prognosis with less chance of successful correction? Is it a congenital or acquired spinal deformity? Congenital deformities are more complicated and worsen faster. Acquired deformities can also have a poor prognosis, but they can also have a good prognosis (Nikšić et al., 2019c).

While the present findings highlight gender-based disparities in postural status, a comprehensive interpretation requires comparison with broader epidemiological evidence on spinal deformities among school-age populations. Previous studies have demonstrated that early functional deviations often precede structural changes, emphasizing the importance of early identification within educational settings. Integrating these results with longitudinal and cross-sectional research allows for a deeper understanding of how developmental stages, physical inactivity, and environmental factors collectively influence spinal health. Consequently, the following synthesis of empirical studies serves to situate the current outcomes within a wider scientific framework.

The obtained data indicate a high percentage of deviations in the studied postural disorders (Živković et al., 2011). The results of the study showed that in a population of 320 students from grades I to VIII, when assessing the posture of the spine, 30 students or 9% had no deviations, the physiological curvature was normal in both the sagittal and frontal planes, which indicates proper posture of the spinal column. 231 students or 72% had a slight deviation, a deviation of the first degree was present: kyphosis, scoliosis, or lordosis, while 59 students or 19% had a pronounced deviation, a combination of deviations was present or even individually, but at the level of the second degree (Bogdanović & Bešović, 2012).

In older primary school students, spinal deformities are present to a large extent. The highest percentage is present in the frontal plane - scoliosis (38%) and the sagittal plane - kyphosis (28%),

and in a slightly smaller percentage compared to the previous two deformities, lordotic posture is present (19%). Out of a total of 204 examinees of both sexes, scoliotic posture was found in 78 (38%) examinees, of whom 66 (32%) had a minor deviation and 12 (6%) had a major deviation from normal posture. These data indicate that scoliotic posture is present in almost one-third of the examined sample. Kyphotic posture was found in 56 (28%) examinees, of whom 50 (25%) had a minor deviation and 6 (3%) had a major deviation from normal posture. Lordotic posture was found in 38 (19%) of the subjects, of which 34 (17%) had a minor deviation and 4 (2%) had a major deviation from normal posture. This state of incidence of poor posture (scoliotic, kyphotic, and lordotic posture) in primary school students indicates a condition that warns of the need for systematic examinations in schools to take preventive measures and develop corrective exercise programs (Bajrić et al., 2012). In a study conducted on a sample of 581 respondents (290 male and 291 female respondents), in grades 4, 5, and 6 of primary school, spinal deformity (kyphosis) was prevalent. In terms of the percentage of prevalence of this deformity in female respondents, 49 students or 17% of the sample had the first degree of deformity, 8 students or 3% of the sample had the second degree, while no deformities were recorded in the third degree. In terms of the percentage of prevalence of this deformity in male respondents, 68 students or 23% of the sample had the first degree of deformity, 20 students or 7% of the sample had the second degree, and 3 students or 1% of the sample had the third degree (Aščić et al., 2015).

In a study conducted on school-age children, N=515 (249 male and 266 female), aged 6 to 14 years, in the city of Knjaževac, the authors demonstrated that spinal deformities are highly prevalent. The results indicated the existence of kyphotic poor posture in 94 subjects (45 male and 49 female), lordotic poor posture in 76 subjects (38 male and 42 female), and kyphotic poor posture in 20 subjects (4 male and 16 female) (Jorgić et al., 2015). The results of the study showed that among students in grades 3, 5, and 7 of elementary school, the frequency of scoliosis spinal deformity was present in 12 (8.39%) female subjects and 3 (1.66%) male subjects (Gojković & Milanović, 2018). Spinal deformities are present to a large extent in children, as well as their combinations. In a sample of 120 students aged 6 to 7, both sexes, it was found that female students had more spinal deformities than male students (kyphosis, lordosis, and kypho-lordosis). 22 female students had kyphosis deformity, 33 lordosis and 11 kypho-lordosis. 19 male students had kyphosis deformity, 25 lordosis and 6 kypho-lordosis. Scoliosis deformity was present in 83 students of both sexes (Vukićević et al., 2018a).

In a sample of 61 first grade elementary school students, 33 boys and 28 girls, it was found that the students had impaired postural status. 3 female subjects had kyphosis deformity, 13 had lordosis, 2 had kypho-lordosis, 2 had flat back, and 20 had scoliosis. 7 male subjects had kyphosis deformity, 20 lordosis, 5 kypho-lordosis, 1 flat back, and 21 scoliosis (Vukićević et al., 2018b). Statistical data show that many people have spinal column deformation to some degree, and the reason for this is the so-called poor posture that has not been corrected in time. Functional disorders caused by improper posture are first reflected in the spinal column, and later in other parts of the locomotor apparatus. The spine is the main factor of upright posture and the weight-bearing part of all upper body parts. For this reason, it is often exposed to the appearance of numerous deformations, which can affect the entire spinal column or only individual parts (Nikšić et al., 2019a). The research aimed to determine the prevalence and gender differences in postural disorders of the spinal column in the sagittal and frontal planes of first-grade elementary school students. The sample of respondents consisted of 138 students, i.e., 73 male and 65 female respondents from the territory of the city municipality of Knjaževac, Serbia. The results indicated that in the sagittal plane, the presence of deformities in the total sample was 73.9% (in male subjects 72.6% and in female subjects 75.4%), while in the frontal plane, this percentage was generally 84.1% (in male subjects 84.9% and in female subjects 83.1%). Per the results obtained, it can be concluded that a high level of prevalence of postural disorders of the spinal column in the frontal and sagittal planes is equally present in subjects of both sexes (Đorđević et al., 2020).

The assessment of the posture of the spine of male students revealed data showing that in 262 (46.5%) students, the physiological curvature was normal in both the sagittal and frontal planes, which indicates correct posture. In 211 (37.5%) students, a first-degree deviation was present: kyphosis, scoliosis, or lordosis, and in 90 (16.0%) students, a combination of deviations or individually, but at the level of the second degree. In 211 (38.9%) female students, the physiological

curvature was normal in both the sagittal and frontal planes, which indicates correct posture, while in 211 (38.9%) female students a first-degree deviation was present: kyphosis, scoliosis or lordosis, and in 120 (22.1%) female students a combination of deviations or individually, but at the level of the second degree. The obtained research results lead to the conclusion that the postural status of the spinal column is severely impaired in many primary school students, of both sexes (Nikšić, Beganović & Gojković, 2020).

In addition to spinal alignment, the structure of the foot represents another critical component of postural integrity, as alterations in the lower extremities may influence biomechanical loading throughout the entire locomotor chain. The relationship between foot morphology and spinal posture suggests that deviations detected through plantography should be interpreted as part of an integrated musculoskeletal system rather than as isolated anatomical anomalies. Therefore, the discussion now shifts toward foot deformities to explore how variations in arch formation contribute to functional imbalance and potentially reinforce the postural differences identified earlier.

Flat foot (pes planus) is a very common deformity of the lower extremities, especially in school children (Medojević et al., 2007). It should be noted that every child is born with a flat foot, and it is lost when the child actively starts to lean on his feet and thus shapes the arch of the foot. It can be congenital or acquired. The current way of life contributes to the formation of this deformation. In a normal foot, the longitudinal and transverse arches differ, where the longitudinal arch of the foot more often loosens, although both can loosen. This deformity causes pain in the foot itself and the lower legs, disturbances and pain in the head, and fatigue occurs quickly when walking and standing. This deformity can also negatively affect the spine (Bogdanović & Marković, 2010). The percentage of flat feet in school children is around 65% (Nikšić, 2016).

Pes cavus (hollow foot) – occurs more often in men (Krsmanović, 2007). In this deformity, the arches are more strongly raised. The inner arch of the foot is very pronounced, while the front part is more strongly developed and there are often calluses on the soles. This deformity begins to develop from the age of seven. It is rarely congenital and occurs due to weakness of the triceps surae muscle. The footrests on the heel and heads of the metatarsal bones, creating calluses in these places, depending on the place of support. The gait is stiff and inelastic, and after prolonged walking, severe pain occurs. It is necessary to strengthen the plantar flexors (m. triceps surae). In cavus, the impression of the outer edge narrows, in moderate cases it is partially lost, and in severe cases it disappears, so the support is reduced to the calcaneus and metatarsal part of the foot (Ćibo et al., 2001).

Research on the population of school children, students from grades I-VIII of primary schools, confirms my research that many students have changes in their feet. The number of students with deviations (low arch of the foot and flat foot) is 62.6%, while only 37.3% of students have no changes. The data obtained indicate a high percentage of deviations in the longitudinal arch of the foot (Živković et al., 2011). Foot deformities are present to a large extent in preschool children, especially before starting school, where the total percentage of children with foot deformities is 74.24%. The prevalence of foot deformities is higher in boys (51.52%) compared to girls (48.48%) (Bjeković, Arnaut & Gerdijan, 2011). By assessing the foot posture of students from grades 1 to 5 of primary school, data were obtained showing that 434 (39.3%) students have a well-formed foot, i.e., that the tread surface of the foot is only on 1/3 of the transverse line. It is assessed by measuring the footprint. In 416 (37.6%) students, the tread surface also covered the second third, while in 255 (23.1%) students, the tread surface covered the third third of the surface. From the results obtained, it can be concluded that in students from grades 1 to 5, the posture of the foot and the spinal column is most at risk (Nikšić et al., 2019b).

The fact is that the highest percentage of foot arch disorders refers to the functional form, where an adequate corrective exercise program can stop the further progression of the physical deviation to a more severe stage and largely correct it and bring it into a normal position. The prevalence of incompletely fixed and structural deformities is significantly lower. However, it is still worrying that the percentage of more severe forms of the disorder is significantly higher among primary school students. The frequency of postural disorders of the arch of the foot can be significantly reduced through planned and continuous corrective procedures (Nikšić, 2016).

Although morphological and postural findings provide important clinical insight, they cannot be fully understood without considering the behavioral context in which children grow and develop.

Patterns of leisure activity reflect daily movement exposure, social influences, and the increasing role of digital technology in shaping physical habits. The gender differences identified in recreational choices may therefore help explain variations observed in BMI, posture, and musculoskeletal health. For this reason, the following section examines leisure-time behaviors as a complementary dimension that connects anthropometric outcomes with lifestyle dynamics in contemporary childhood.

During puberty, girls have a strong urge for social contact, which could be the reason for more frequent use of cell phones to talk than is the case with boys. Girls are more oriented towards visual media than boys (Ilišin, 2001). In the conducted research (Đulić, 2021), data on the physical activities of the elementary school population were collected and presented. The data were collected using questionnaires, one part of which was related to the use of electronic devices. From them, it is possible to observe the continuity of low physical activity in children because: about 32.5% of students use a mobile phone, about 32.5% of students use a computer, and about 32.5% of boys and girls watch TV.

Boys are more active in this period of life, in terms of greater participation in games where physical activity is more dominant. Poor lordotic posture is equally prevalent in both boys and girls (Romanov et al. 2014). On the sample of students of IV. primary school class N=450, it can be observed that boys spend more time playing games, as well as using a tablet, computer, and phone. They watch more TV in their free time compared to girls. Girls read books and study more in their free time compared to boys. Out of a total of 238 male respondents, 102 (43%) participated in sports in their free time. Out of a total of 212 female respondents, 92 (43%) participated in sports in their free time (Nikšić, 2024). Free time is defined as the time in which the student is freed from the activities, he performs every day such as school duties and training, and he can fill his free time with content according to his own needs and wishes. As technology advances, students spend more and more of their free time on computers, cell phones, and other devices, therefore parents and schools need to encourage students through extracurricular and extracurricular activities to engage in daily physical activities that affect the proper growth and development of students (Rosić, 2015).

*Implications*

The findings of this study provide important practical implications for physical education practice, school health promotion, and early preventive strategies. The higher prevalence of obesity, improper posture, and musculoskeletal deviations observed particularly among boys suggests the necessity of integrating structured corrective and preventive programs within the school environment. Physical education teachers should not only focus on performance-oriented activities but also emphasize posture awareness, functional movement quality, and balanced motor development. Regular monitoring through simple anthropometric and postural assessments may enable early detection of deviations before they progress into structural deformities. From a pedagogical perspective, the differences identified in leisure-time behavior highlight the need to design gender-sensitive interventions that encourage active lifestyles while reducing excessive sedentary screen exposure. Schools may adopt multidisciplinary approaches involving teachers, parents, and healthcare professionals to create supportive environments that promote physical activity beyond formal class hours. Furthermore, incorporating corrective exercises, recreational sports, and movement-based learning into daily routines may help mitigate the negative consequences of technological dependence. Ultimately, preventive education that integrates physical literacy, healthy nutrition, and active leisure habits can contribute to more sustainable long-term developmental outcomes among primary school students.

*Research Contribution*

This study contributes to the growing body of literature on childhood health and physical development by providing a comprehensive analysis that integrates anthropometric, postural, structural, and behavioral variables within a single research framework. Unlike many previous investigations that focus on isolated aspects of obesity or posture, the present research offers a multidimensional perspective that highlights the interconnected nature of nutritional status, musculoskeletal alignment, and leisure-time activities. The large sample size and inclusion of both

male and female primary school students strengthen the ecological validity of the findings and provide valuable reference data for future comparative studies.

Additionally, this research advances understanding of gender-related differences in early developmental stages by demonstrating how lifestyle patterns may influence physical outcomes. The combination of plantography, spinal curvature assessment, and behavioral analysis represents a holistic methodological approach that aligns with contemporary models of health-oriented physical education. By emphasizing both structural indicators and behavioral context, the study expands current knowledge regarding the mechanisms through which modern sedentary lifestyles affect children's physical well-being. Consequently, the findings may serve as a foundation for developing targeted intervention models aimed at improving posture, reducing obesity risk, and fostering healthier movement behaviors in school populations.

*Limitations*

Several limitations should be considered when interpreting the results of this study. First, the cross-sectional design restricts the ability to establish causal relationships between lifestyle behaviors and the development of postural or morphological deviations. Although significant gender differences were identified, longitudinal investigations would be necessary to determine whether these patterns persist over time or change during later stages of growth and maturation. Second, the reliance on descriptive statistical analysis, while appropriate for prevalence assessment, limits deeper exploration of potential predictive relationships among variables.

Another limitation concerns the contextual scope of the sample, which was restricted to primary school students within a specific geographic region. Cultural, environmental, and socioeconomic factors may influence lifestyle behaviors and access to physical activity opportunities, thereby affecting the generalizability of the findings to broader populations. In addition, although standardized measurement procedures were applied, the use of field-based assessments may introduce minor observational bias compared to advanced biomechanical or clinical diagnostic tools. Future studies integrating objective monitoring technologies could provide a more comprehensive understanding of the underlying mechanisms associated with postural and nutritional outcomes.

*Suggestions*

Future research is encouraged to adopt longitudinal and experimental designs to better understand the developmental trajectories of posture, obesity, and musculoskeletal health throughout childhood and adolescence. Investigations examining the effectiveness of school-based corrective exercise programs or lifestyle interventions may provide stronger evidence regarding strategies capable of reducing the prevalence of deformities and sedentary behaviors. Expanding the sample to include diverse age groups, rural and urban settings, and different educational contexts would also enhance the external validity of subsequent findings.

Moreover, integrating advanced assessment tools such as motion analysis, electromyography, or digital posture evaluation systems may offer deeper insights into functional movement patterns and neuromuscular adaptations. Researchers are also encouraged to explore psychosocial factors, including motivation, parental influence, and digital media exposure, as potential mediators of physical activity behavior. From an applied perspective, collaborative programs involving educators, health professionals, and families should be further developed to promote sustainable lifestyle changes. Such interdisciplinary efforts may contribute not only to improved physical health outcomes but also to the holistic well-being and quality of life of future generations.

## CONCLUSION

This research was conducted to determine the prevalence of obesity, improper posture, physical deformities, and ways of spending free time among primary school students by gender. It was found that boys have a higher body mass index than girls. Obesity and overweight are more common in boys than in girls. By measuring the lateral curvature of the spinal column, data were obtained that boys have a higher prevalence of improper posture than girls. By measuring the curvature of the spinal column of primary school students, and by type of deformity, data were obtained that show that all spinal deformities (kyphosis, scoliosis, and lordosis), as well as foot deformities (flat and raised feet), are more common in boys. By analyzing the results of spending free

time, data were obtained that indicate a major problem today, where children spend most of their time on electronic devices, computers, and tablets playing games, especially boys. More than boys, girls play sports, watch TV, read books, and talk on mobile phones in their free time.

Based on the results obtained, it can be concluded that all the data in the tables indicate a high percentage of obesity, improper posture, physical deformities, and inadequate leisure time. Given the seriousness and consequences that these disorders can cause, parents, teachers, and children still do not have a sufficiently developed awareness of the necessity of taking certain measures to prevent and correct these disorders. It is necessary to act preventively on time and conduct more frequent testing and measurements of primary school students to monitor changes in growth and development. The cause of this situation largely lies in the unlimited use of technology, insufficient physical activity, and inadequate nutrition. To prevent and reduce obesity, improper posture, and physical deformities in students, education on the importance of exercise and proper nutrition is necessary, which should primarily come from their living environment, their parents and relatives, as well as constructive encouragement from teachers at school. Only those who are sufficiently educated can spread knowledge and promote healthy lifestyles. Habits that were adopted in childhood, in most cases, remain in other developmental stages.

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All authors (EN, AK, AB, NP, and FR) contributed equally to the writing of the manuscript.

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