

# EVALUATION OF THE EFFECT OF PHYSICAL ACTIVITY ON THE PREVALENCE OF OVERWEIGHT AND OBESITY IN SCHOOL-AGED CHILDREN

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<sup>A</sup> Study Design; <sup>B</sup> Data Collection; <sup>C</sup> Statistical Analysis; <sup>D</sup> Manuscript Preparation; <sup>E</sup> Funds Collection

**Abstract** Introduction: Physical activity is one of the essential factors in maintaining health and healthy body weight. As the pandemic of overweight and obesity continues to grow, it is crucial that children follow the recommended standards for physical activity from an early age. Both overweight and obesity are associated with an increased risk of diseases such as diabetes, hypertension and cancer. Excess body weight in childhood favors the maintenance of this problem in adulthood.

Purpose of the study: The aim of the study was to evaluate the physical activity among school-aged children, to analyze individual components of body composition and to determine the influence of physical activity on maintaining normal body weight.

Material and methods: We undertook to assess of the frequency of participation of children in additional sports activities of 245 school-aged children (7–15 years) was examined and analyzed the body composition of the study participants, and then the correlation of the additional physical activity with the maintenance of normal individual components of body composition was calculated.

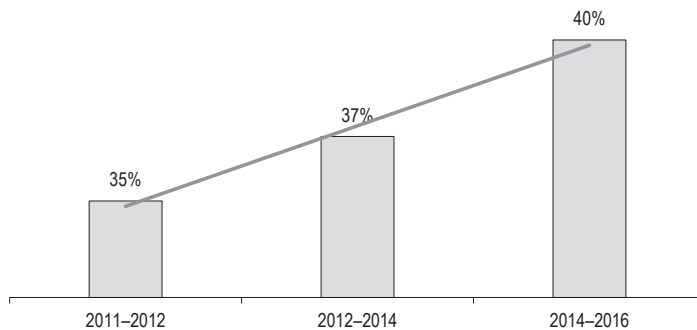
Results: 61% of childrens were characterized by normal body weight appropriate for their age. In the group of children declaring participation in extracurricular sport activities, the number of subjects with normal body weight was 65%, while in the group of subjects who declared no extracurricular activity of any kind, the percentage was 58%.

Conclusions: It turned out that the number of children engaged in physical activity outside of school is alarmingly low. The study found that children who participated in any extracurricular sports activity did not show a statistically significant difference in the frequency of maintaining a normal body weight ( $p > 0.05$ ). However, on detailed percentage analysis, we can see a slight advantage among those who undertook additional physical activity.

**Key words** overweight, obesity, physical activity, children

## Introduction

Obesity is one of the most alarming problems of the 21st century. Although the health consequences of obesity are widely recognized, the situation continues to worsen and the number of people with excessive body weight is increasing. The World Health Organization data show that between 1980 and 2008 the number of people whose body weight exceeds certain norms has doubled (Ritchie, Roser, 2017). Over the following years, the problem continued to grow and in 2016, 39% of men and women worldwide were overweight (Ritchie, Roser, 2017). Research conducted in 2011–2016 by the National Center of Health Statistics (NCHS, 2021) and Ogden et al. (Ogden, Carroll, Kit, Flegal, 2013; Ogden, Carroll, Fryar, Flegal, 2015) leads to similar conclusions (Figure 1), which shows that in 2011–2012 the problem of obesity or overweight affected 35% of citizens, in 2012–2014 the percentage was 37%, while in 2014–2016 it was already 40%. The situation in Poland is not optimistic either, as according to the Central Statistical Office in 2014, 30% of women and 44% of men were overweight and 15.6 women and 18% of men were obese (Zgliczyński 2017).



**Figure 1.** The changing number of overweight and obese people worldwide from 2011 to 2016

As the problem worsens, children and infants are also increasingly affected by excessive body weight. A 2016 report on the nutritional status of children worldwide reported that 40 million children under the age of five and 330 million aged 5–19 were overweight or obese (Di Cesare, Sorić, Bovet, 2019). Studies conducted in the United States show that the number of children who are overweight or obese, increases with age. Data presented by Kumar indicate that 22.8% of preschool children and 34.2% of school-aged children in the United States are overweight or obese (Kumar, Kelly, 2015). Both overweight and obesity carry a number of negative health consequences. Studies show that overweight individuals are significantly more likely to have health problems related to the respiratory system, cardiovascular system, musculoskeletal system, mental disorders, diabetes, and cancer (Bogucka, 2017; Bray, 2004; Brown, Kuk, 2015; Felson, Anderson, Naimark, Walker, Meena, 1988; Leitner et al., 2017; Lindström et al., 2003; Malone, Hansen, 2019; Margaret, 2011; Poirier et al., 2006; Rankin et al., 2016; Strohl, Strobel, Parisi, 2004).

## Purpose of the study

The aim of the study was to assess the frequency of participation in extracurricular physical activity among school-age children, to analyze individual components of body composition and to determine the influence

of additional physical activity on maintaining normal body weight. A hypothesis was formulated that children who participate in additional physical activity are more likely to maintain normal body weight than inactive children.

## Materials and methods

The study was approved by the Bioethics Committee at the Medical University of Karol Marcinkowski in Poznań, resolution number 427/17. The study was conducted in an elementary school in February 2020. Any child in grades 1–8 whose parents provided consent was eligible to participate. Written consents were provided to each parent. 245 children participated in the study. The mean age of the subjects was 10 years (SD = 2.2). There were 124 boys and 133 girls among all participants. Of all the children surveyed, two were disabled. The questionnaire consisted of questions about the place of residence in the country or in the city, then about the participation in additional extracurricular sports activities and in case of declaration of participation there was a request to indicate what kind of activity it was. 76% of the respondents lived in the city and 24% in the country. The questionnaire provided information that 40% of people participating in the study declared participation in the above mentioned sport activities. 60% of people declared that they do not participate in any extracurricular sport activities. Among the chosen forms of extracurricular physical activity, there were sports such as: soccer (43%), gymnastics (19%), dance (9%), horse riding (6%), martial arts (5%), athletics (5%), badminton (5%), table tennis (3%) and others (3%).

The Tanita BC-418 MA segmental body composition analyzer was used for detailed body composition analysis. This device uses a non-invasive method of electrical bioimpedance. It consists in measuring the total resultant electrical resistance of the body, which is the derivative of resistance (passive resistance) and reactance (active resistance) using a set of surface electrodes connected to a computer analyzer and using a current of a given frequency and intensity (Lewitt, Mądro, Krupienicz, 2007). Individual components of body composition such as body weight (kg), BMI (weight/height<sup>2</sup>), adipose tissue (%), fat-free tissue (%), muscle mass (%), and water (%), were analyzed.

All calculations and data visualization were performed using Statistica 13 package, the administrator of which is the Academy of Physical Education in Poznań. In addition, centile grids, created during the OLA and OLAF project conducted in Poland in 2007–2013 (Kułaga et al., 2010, 2013), were used to interpret the BMI (Body Mass Index) score.

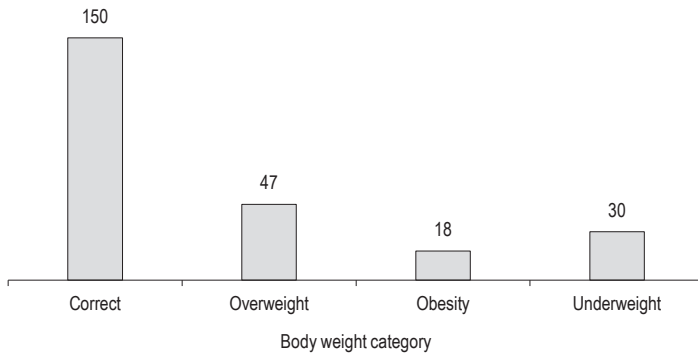
## Results

After collecting all data, the mean, maximum, and minimum values were calculated for selected body composition components (Table 1).

**Table 1.** Results of body composition measurements of participants

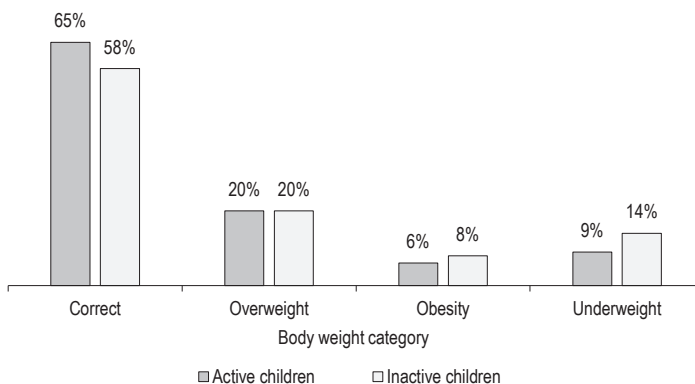
Selected components of body composition	Mean (M)	Standard deviation (SD)	Minimum value (min)	Maximum value (max)
Height (cm)	145.8	14.2	115.0	186.0
Weight (kg)	40.4	15.5	18.0	103.1
BMI (weight/height <sup>2</sup> )	18.5	4.4	12.5	38.3
Adipose tissue (%)	22.8	6.6	11.5	47.1
Muscle mass (%)	74.0	6.5	50.6	85.3
Water (%)	56.6	4.8	38.7	64.8

After analyzing the body composition components of 245 children, we found that 61% of them were characterized by normal body weight appropriate for their age. Overweight was present in 19% of the subjects, while obesity was present in 8% of the subjects. Among those classified as “underweight” were 12% of the children (Figure 2).



**Figure 2.** Distribution of individual body mass categories among all children examined (n = 245)

A Chi-square test was used to assess the relationship between the prevalence of abnormal or normal body weight and participation in additional sports activities. The relationship was not statistically significant ( $p > 0.05$ ). In the group of children declaring participation in extracurricular sport activities, the number of subjects with normal body weight was 65%, while in the group of subjects who declared no extracurricular activity of any kind, the percentage was 58%. In both the active and inactive groups, the percentage of overweight subjects was 20%. A difference was observed among the percentages of obese and underweight subjects. The portion of active children classified as obese was 6%, while among inactive children, 8% of them were obese. The underweight respondents were 9% for the active group and 14% for the inactive group, respectively (Figure 3).



**Figure 3.** Percentage of subjects classified into each weight category (n = 245)

The lack of statistical significance in the above analysis may indicate that additional physical activity alone is not sufficient to maintain a healthy body weight. However, as we can look at above (Figure 3) the percentage analysis shows that those who participated in additional physical activity were more likely to maintain a normal body weight and were less likely to be overweight or underweight.

## Discussion

The current World Health Organization (WHO) recommendation for the minimum recommended level of physical activity in children aged 5–17 years is 60 minutes of moderate activity per day. Daily activity should include aerobic exercise and it is additionally recommended that children should do strength training, strengthening the whole body, at least 3 times a week (Bull, Al-Ansari, Biddle, 2020). Taking into account the above recommendations it can be concluded that the percentage of 40% of students participating in extracurricular sport activities of students participating in extracurricular sports activities is a very alarming figure. In a study conducted in 2005–2006, Chabros et al. (2008) evaluated the level of physical activity in 1,054 students aged 11–15 years. They found that 38.6% of boys and 34.7% of girls participated in extracurricular sports activities. In the cited study, it was noted that the frequency of participation in extracurricular sports activities decreases with the age of students (Chabros et al., 2008). Similar results were presented by the Australian Institute of Health and Welfare, indicating that the percentage of children meeting recommendations for minimal physical activity decreased with age, from 61% at ages 2–5 to 26% at ages 5–12 and to 7.9% at ages 13–17 (McCarthy et al., 2021). As shown by studies conducted in the United States, the situation there looks much worse than in Poland, as 20% of the examined children meet the minimum level of physical activity (DiPietro et al., 2019). Insufficient levels of physical activity among children may be one of the components contributing to the ever-increasing problem of overweight and obesity in this age group. Numerous studies indicate that the problem of abnormal body weight in school-aged children is a common phenomenon (Chabros et al., 2008; McCarthy et al., 2021; DiPietro et al., 2019; Weker et al., 2017). However, it should be noted that the occurrence of overweight and obesity can also occur at earlier ages. A 2016 study conducted by Weker et al. (2017) on more than 1050 Polish children found that nearly 10% of children aged 1–3 years were overweight or obese. Weker also reports that 18% of the children studied are at risk of excessive weight in the future, and this is due to poor nutrition (Weker et al., 2017). The data presented in the above results section presents that 20% of the examined school-aged children, were overweight and 7% were obese. In the previously mentioned study by Chabros et al. (2008) the weight level of the subjects was also assessed. 18.4% of boys and 11.9% of girls were overweight, while obesity was found in 2.8% of boys and 3.4% of girls. Gołąbek and Majcher (2019) also undertook to assess body weight among school-aged children. They checked the prevalence of overweight and obesity among girls and boys aged 11–12 years. Gołąbek and Majcher study yielded similar results to those presented above. Overweight was present in 23% of both girls and boys (Gołąbek, Majcher, 2019). Obesity was present in 6% of girls. A significant discrepancy was observed only in the case of overweight boys, since the study by Gołąbek showed obesity in 21% of boys (Gołąbek, Majcher, 2019). Few Polish authors have attempted to show the correlation between the level of physical activity in children and the prevalence of overweight and obesity. The study by Bojar, Wojtyła and Owoc (2010) showed that children who participated in all or most of the physical education classes were more likely to have a normal body weight. Among those who participated in all or almost all PE classes, obesity was present in 11%, while in those who missed more PE classes, the percentage

of children with obesity was 21%. In a study conducted in 2020 by Pysna et al., 1,073 elementary school children were examined. This study also aimed to evaluate the level of physical activity of children and its effect on their body weight. They found that children who spend more time on physical activity are more likely to have a normal body weight (Pyśná, 2020). However, there is not much work evaluating the relationship between physical activity and body weight, so further research in this area is needed.

## Conclusions

1. The number of children taking up extracurricular physical activity (40% of examined children) is definitely too low.
2. 61% of examined children were characterized by normal body weight and 39% were characterized by abnormal body weight.
3. The hypothesis that children who participate in additional physical activity are more likely to maintain normal body weight than inactive children was unconfirmed.

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