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# The incidence of physical deficiencies among 11-12 year old children, in relation with the body weight category
# Incidenţa deficienţelor fizice la elevii de 11-12 ani, în relaţie cu categoria de greutate corporală

**Melania Câmpeanu [1], Anca Vădan [1], Bogdan Crişan [2], Oana Maria Nemeti [2], Alexandra Varga [2]**
*[1] Faculty of Physical Education and Sport, "Babeş-Bolyai" University, Cluj-Napoca, Romania*
*[2] Faculty of Physical Education and Sport, "Babeş-Bolyai" University, Cluj-Napoca, Romania, students*

**Abstract**

*Background.* This paper is part of a larger study on growth parameters and *physical development of school age children*. In this study we investigated whether there is a link between body weight and the incidence of child physical deficiencies of the spine and lower limbs.

*Aims.* The incidence of physical deficiencies among 11-12 year old children, in Cluj-Napoca, in relation with body weight was studied.

*Methods.* 149 children were evaluated. The subjects' age was 11-12 years. For physical deficiency assessment we used the plummet and the digital method. The body-mass-index-for-age-and-sex percentile was assessed. Statistical processing was performed with the Excel application (Microsoft Office 2007) and the OpenEpi 3.01 X application. The graphical representation of the results used the Excel application (Microsoft Office 2007).

*Results.* In the obese group, a statistically significant association between the physical deficiencies incidence and the weight category (p=0.011) was observed. In the obese group, there was observed a statistically highly significant association between the lower limb deficiency incidence and the weight category (p=0.001). In the underweight group, there was observed a statistically significant association between lower limb deficiency incidence and the weight category (p=0.0236).

*Conclusions.* In obese children, the incidence of physical deficiencies is significantly higher compared to healthy weight children. In obese children, lower limb deficiency incidence is very significantly higher compared to healthy weight children. In obese children, spine deficiency incidence is not significantly higher compared to healthy weight children. In underweight children, lower limb deficiency incidence is significantly higher compared to healthy weight children.

**Key words:** children, physical deficiencies, body mass index.

**Rezumat**

*Premize.* Cercetarea de faţă reprezintă un studiu pilot din cadrul unei cercetări mai ample ce vizează *dezvoltarea fizică a populaţiei şcolare*. În acest studiu am investigat dacă există o legătură între greutatea corporală a copiilor şi incidenţa deficienţelor fizice ale coloanei vertebrale şi ale membrelor inferioare.

*Obiective.* Studiul incidenţei deficienţelor fizice la elevii de 11-12 ani din Cluj-Napoca, în relaţie cu greutatea corporală.

Metode. Au fost evaluaţi 149 de copii. Vârsta subiecţilor a fost de 11-12 de ani. Pentru evaluarea deficienţelor fizice am folosit metoda firului cu plumb şi metoda digitală. Percentila indice-de-masă-corporală-pentru-vârstă-şi-sex a fost evaluată. Prelucrarea statistică s-a efectuat cu aplicaţia Excel (Microsoft Office 2007) şi aplicaţia OpenEpi 3.01 X. Reprezentarea grafică a rezultatelor s-a făcut cu aplicaţia Excel (Microsoft Office 2007).

*Rezultate.* Pentru copiii obezi, a fost observată o asociere statistic semnificativă între existenţa unor disabilităţi fizice şi categoria de greutate corporală (p=0,011). În ceea ce priveşte copiii obezi, a fost observată o asociere statistic foarte semnificativă între existenţa unor disabilităţi ale membrelor inferioare şi categoria de greutate corporală (p=0,0012). Pentru copiii subponderali, indiferent de gen, a fost observată o asociere statistic semnificativă între existenţa unor disabilităţi ale membrelor inferioare şi categoria de greutate corporală (p=0,0236).

*Concluzii.* În cazul copiilor obezi, incidenţa deficienţelor fizice este semnificativ crescută faţă de copiii cu greutate normală. În cazul copiilor obezi, incidenţa deficienţelor fizice ale membrelor inferioare este foarte semnificativ crescută faţă de copiii cu greutate normală. În cazul copiilor obezi, incidenţa deficienţelor fizice ale coloanei vertebrale nu diferă semnificativ faţă de copiii cu greutate normală. În cazul copiilor cu deficit ponderal, incidenţa deficienţelor fizice ale membrelor inferioare este semnificativ crescută faţă de copiii cu greutate normală.

**Cuvinte cheie:** copii, deficienţe fizice, indicele de masă corporală.

*Received:* 2013, July 10; *Accepted for publication:* 2013, September 3;
*Address for correspondence:* Faculty of Physical Education and Sport, "Babeş-Bolyai" University, Cluj-Napoca, Pandurilor Str. no. 7
*E-mail:* ubbpalestra@yahoo.com

## Introduction

Obesity is an increasing problem of epidemic proportion, and it is associated with various musculoskeletal disorders, including spine and lower limb impairment.

Physical development is a dynamic action with multifactorial determination that depends on genetic inheritance, environmental features and socio-economic conditions (Au & Yu, 2012). The correct attitude of the body is characterized by optimal space projection of the musculoskeletal elements (Cordun, 2009).

In the process of growth and development, the child's physical and mental parameters are usually normal and corresponding to age groups. However, the action of various factors (internal, external, pathological, functional, etc.) can cause deviations from proper and harmonious development.

When the physical development is inadequate in terms of quality and quantity, or when it does not fall within the normal range of growth, deviation from normal development occurs (Fozza, 2003).

A physical or somatic deficiency is represented by any deviation from normal in the harmonious growth and development of the body, which changes the appearance of the body, the ability to adapt to environmental conditions, reducing the physical and mental fitness of the individual (Antonescu et al., 1993).

This paper is part of a larger study on the growth parameters and physical development of school age children (Câmpeanu et al., 2012).

## Hypothesis

In this study, we investigated whether there was a connection between the incidence of physical deficiencies and body weight among 11-12 year old children, in Cluj-Napoca.

## Material and method

In accordance with the Declaration of Helsinki, the Amsterdam Protocol and Directive 86/609/EEC, in order to conduct research on human subjects, we obtained the approval of the Ethics Commission of the "Babes-Bolyai" University of Cluj-Napoca and the informed consent from the children's parents.

*Research protocol*

*a) Period and place of the research*

The research was conducted between April 2012 and May 2013 in the "Liviu Rebreanu" School in Cluj-Napoca.

*b) Subjects and groups*

One hundred and forty-nine (149) children aged 11 and 12 years from Cluj-Napoca were evaluated. Sixty-eight (68) were boys and eighty-one (81) were girls. After assessing the weight category as described below, the groups were divided as follows:

Group Uw - underweight subjects, n=5

Group Hw - healthy weight subjects, n=83

Group Ow - overweight subjects, n=47

Group OB - obese subjects, n=14.

*c) Tests applied*

BMI-for-age-and-sex percentile assessment. The body mass index (BMI) was calculated using the formula: BMI=Weight (kg)/Height$^2$(m).

Then, using the BMI-for-age-and-sex Percentile Growth Chart, the BMI-for-age-and-sex percentile was asssessed. The BMI-for-age-and-sex percentile shows how the child's weight compares to that of other children of the same age and sex. The subjects are assigned to four weight categories, as follows:

Underweight – less than 5$^{th}$ percentile;

Healthy weight - 5$^{th}$ percentile up to less than 85$^{th}$ percentile;

Overweight - 85$^{th}$ percentile up to less than 95$^{th}$ percentile;

Obese – equal to or greater than 95$^{th}$ percentile (1).

*d) Assessment of physical deficiencies*

In order to assess kyphosis, lordosis and scoliosis, the plummet method and the digital method were used. We used the term spine deficiencies for kyphosis, lordosis and scoliosis all together and the term lower limb deficiencies for genu valgum and genu varum all together. In order to assess genu valgum and genu varum, the intercondylar and intermalleolar distance measurement methodology and the digital method were used (Câmpeanu, 2008).

The digital method is based on photographing the patient with a professional camera and lenses that avoid distortion or technical aberrations (Full-Frame Nikon D700, Nikon Nikkor AF 50 mm) (2). Over this image we applied a digital unit grid of 1 cm, which takes a linear unit (graduated in cm) placed in front of the patient. This technique has proved useful in the detection of kyphosis, lordosis, scoliosis, genu valgum and genu varum.

Using this technique, we were able to demonstrate in a digital image some data collected with the classical diagnostic methods such as the plumb line and the distance measurement between anatomical landmarks.

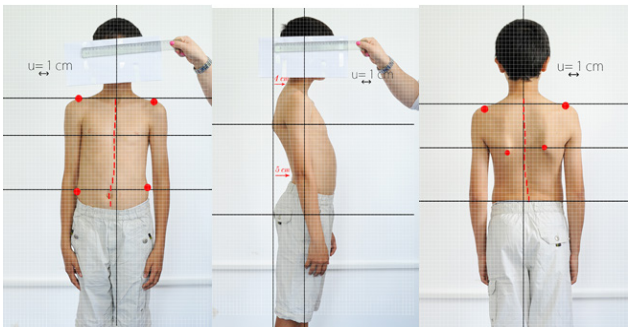

**Fig. 1** – Evaluation of spine deviations using the digital method.

*e) Statistical processing.*

Statistical processing was done with the $\chi 2$ test (chi square), a non-parametric correlation test, used to test the degree of "closeness" between an empirical and a theoretical distribution, which tests the difference between the two structures. Yates correction or, where imposed, Mid-P exact was considered. The significance threshold was set at $p<0.05$.

Statistical processing was performed with the Excel application (Microsoft Office 2007) and the OpenEpi 3.01 X application. The graphical representation of the results was performed with the Excel application (Microsoft Office 2007) (3).

## Results

The research results reveal that of 149 evaluated subjects, 64 subjects had physical deficiencies and 85 had no physical deficiencies. Of the 64 subjects with physical deficiencies, 28 were boys and 36 were girls. Figure 3 shows the percentage of deficiencies in the studied groups.

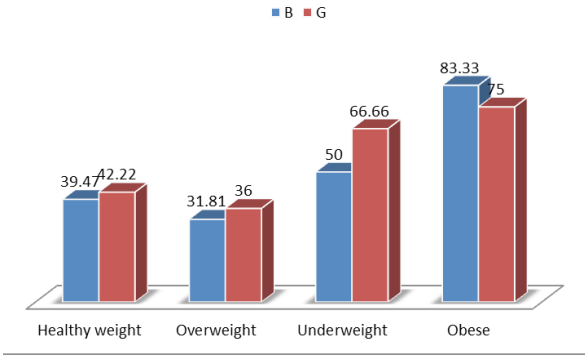


**Fig. 2** – Physical deficiencies within the studied groups, in percent.

Kyphosis as a single deficiency was found in 12 subjects, lordosis as a single deficiency was found in 18 subjects, scoliosis as a single deficiency was detected in 15 subjects, genu valgum as a single deficiency was found in 8 subjects, and genu varum as a single deficiency was detected in four subjects. There were 3 subjects with kyphosis + scoliosis, 1 subject with kyphosis + genu valgum, 1 subject with kyphosis + scoliosis + genu varum, 1 subject with lordosis + genu valgum and 1 subject with scoliosis + genu varum (Fig. 3).

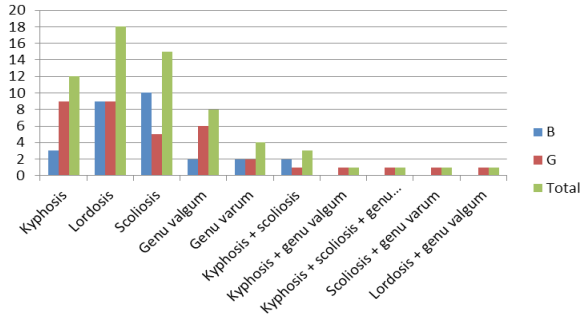


**Fig. 3** – Physical deficiencies identified in the studied groups, for boys and girls.

**Table I**
Comparative statistical analysis of the gender and weight category.

| Body weight category | Boys | Girls | p |
|---|---|---|---|
| Uw+Ow+OB | 30 | 36 | 0.900 |
| Hw | 38 | 45 | |

A statistically insignificant association between the two genders of the subjects and the belonging to the healthy or the non-healthy weight category was observed (p=0.900) (Table I).

**Table II**
Comparative statistical analysis of the gender and the incidence of physical deficiencies.

| With or without physical deficiencies | Boys | Girls | p |
|---|---|---|---|
| Physical deficiencies | 28 | 36 | 0.814 |
| Without physical deficiencies | 40 | 45 | |

A statistically insignificant association between the two genders of the subjects and the presence or the absence of physical deficiencies was found (p=0.814) (Table II).

**Table III**
Comparative statistical analysis of the incidence of physical deficiencies and the weight category.

| Body weight category | Physical deficiencies | Without physical deficiencies | p |
|---|---|---|---|
| Ow | 16 | 31 | 0.554 |
| Hw | 34 | 49 | |
| OB | 11 | 3 | 0.011 |
| Hw | 34 | 49 | |
| Uw | 3 | 2 | 0.447 |
| Hw | 34 | 49 | |

In the overweight group and in the underweight group, there was a statistically insignificant association between the incidence of physical deficiencies and the weight category (p=0.554 and p=0.447).

In the obese group, there was a statistically significant association between the incidence of physical deficiencies and the weight category (p=0.011) (Table III).

**Table IV**
Comparative statistical analysis of the incidence of spine deficiencies and the weight category.

| Body weight category | Spine deficiencies | Without spine deficiencies | p |
|---|---|---|---|
| Ow | 12 | 31 | 0.358 |
| Hw | 30 | 49 | |
| OB | 6 | 3 | 0.119 |
| Hw | 30 | 49 | |
| Uw | 0 | 2 | Cannot be calculated |
| Hw | 30 | 49 | |

In the overweight group and in the obese group, there was observed a statistically insignificant association between the incidence of spine deficiencies and the weight category (p=0.358 and p=0.119) (Table IV).

**Table V**
Comparative statistical analysis of the incidence of lower limb deficiencies and the weight category.

| Body weight category | Lower limb deficiencies | Without lower limb deficiencies | p |
|---|---|---|---|
| Ow | 4 | 31 | 0.219 |
| Hw | 2 | 49 | |
| OB | 4 | 3 | 0.001 |
| Hw | 2 | 49 | |
| Uw | 2 | 2 | 0.023 |
| Hw | 2 | 49 | |

In the obese group, there was a highly statistically significant association between the incidence of lower limb deficiencies and the weight category (p=0.001). In the underweight group, a statistically significant association

between the incidence of lower limb deficiencies and the weight category was seen (p=0.023) (Table V).

## Discussion

Postural defects most often concern children and adolescents of school age. The lack of prophylaxis and the neglect of adequate procedures may lead to limitations of physical and motor abilities, back pain, or the development of severe spinal deformities. There is a need for the creation of a system of education for parents and children concerning postural defects and the risks resulting from these defects (Latalski et al., 2013).

The importance of the early identification of the children's physical deficiencies is highlighted by many researchers. As risk factors for low back pain occurrence (Chanplakorn et al., 2012), physical deficiencies in school children should be identified, in order to begin early treatment (Wirth et al., 2013).

Gettys et al. (2011) have indicated that obesity is a rapidly expanding health problem in children and adolescents and is the most prevalent nutritional problem for children in the United States. Obesity has a negative impact on osteoarticular health by promoting biomechanical changes in the lumbar spine and lower extremities (de Sa Pinto et al., 2006).

Our study shows, as illustrated in Figure 1, that the incidence of physical deficiencies is 83.33% in the case of obese boys and 75% in the case of obese girls, much higher compared to 39.47% in the case of healthy weight boys and 42.22% in the case of healthy weight girls. There is a statistically significant increase of the incidence of physical deficiencies in the OB group, compared to the Hw group (p=0.011). However, the incidence of spine deficiencies in the OB group is not statistically significantly higher compared to the Hw group. In their study, Romero-Vargas et al. (2013) indicate that the obese spine is slightly different from the non-obese spine.

Jannini et al. (2011) conclude that obesity can cause osteoarticular system damage at the start of adolescence, particularly to the lower limbs. Our results show that in the OB group, there was a highly statistically significant increase of the incidence of lower limb deficiencies compared to the Hw group (p=0.001). These findings are confirmed by Bonet et al. (2003), who found that the incidence of genu valgum was much higher in overweight children than in non-overweight children of the same age, and by O'Malley et al. (2012), who concluded that obese children may present musculoskeletal impairments of the lower limbs. We also found that in the Uw group, there was a statistically significant increase of the incidence of lower limb deficiencies compared to the Hw group (p=0.023). The lower limb deficiency in Uw was genu varum. Some authors have found that practicing load bearing sports in general is associated with knee varus alignment in adolescent boys (Thijs et al., 2012). Ethnic variations of the tibiofemoral angle values were highlighted by Mathew & Madhuri (2013) for South Indian children. Also, Heshmatipour & Karimi (2011) highlighted the ethnic variations of the intercondylar and intermalleolar distance values, in Iranian children. These ethnic differences could be an interesting research issue.

Marcu & Chiriac (2009) also evidenced the importance of early intervention for detecting and correcting physical deficiencies.

## Conclusions

1. In obese children, the incidence of lower limb deficiencies is very significantly higher compared to healthy weight children.
2. In obese children, the incidence of spine deficiencies is not significantly higher compared to healthy weight children.
3. In underweight children, the incidence of lower limb deficiencies is significantly higher compared to healthy weight children.

**Conflicts of interest**

There are no conflicts of interest.

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