THE EFFECT OF PHYSICAL ACTIVITY LEVEL ON BODY BUILD AND PHYSICAL FITNESS OF GIRLS AND BOYS AGED 10-19

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Abstract

Aim: The study was aimed to evaluate the somatic build and physical fitness of children and adolescents aged 10-19 depending on their physical activity.

Basic procedures: The survey was conducted in the years 2008-2009 among 925 girls and 1,016 boys aged 10-19 years, attending rural and urban schools in the Biała Podlaska county. The following basic anthropometric measures were taken: body height, body mass, arm and shank circumference, thickness of three skinfolds (over the triceps, over the scapula and over the iliac crest). The Body Mass Index (BMI) was computed from values of body height and mass measurements. Numeric values of somatotypological components were calculated as well; these including: endomorphy, mesomorphy and ectomorphy. Physical activity was evaluated based on the trials of the European Physical Fitness Test battery, and was stratified according to a 3-level scale: low activity – up to 1 hour, moderate activity – between 1 and 3 hours, and high activity – 4 and more hours. In groups of the physical activity of girls and boys, values of somatic traits and results of motor tests were normalized with the use of equations indicating dependencies of mean values and standard deviations from age, according to Stupnicki et al. [1]. Significance of differences between the studied groups was evaluated using ANOVA analysis of variance with the “post-hoc” Newman-Keuls test.

Results: The surveyed girls and boys with the highest physical activity were characterized by the lowest values of somatic traits, except for body height, and by the best results of physical fitness. Greater differences between results were observed in the girls.

Conclusions: A correlation was demonstrated between the physical activity and somatic build and physical fitness of the surveyed girls and boys.

Introduction

In the modern world, one can observe a continuous decline in physical activity in favour of passive forms of spending free time. This phenomenon applies to people of all ages, including children and adolescents [2-4]. Young people’s level of participation in physical activity during their free time is insufficient and far from the recommended 60 minutes a day of moderate to high physical activity [5]. Research at the Institute of Mother and Child in Warsaw [6] shows that only every tenth student in Polish schools meets the guidelines for physical activity. A common phenomenon is exemption from Physical Education classes accepted by parents. Young people spend a significant number of hours on activities related to low energy expenditure. According to a study by Stankiewicz et al. [7], Polish children spend an average of 2 hours a day in front of a TV screen, and 1.4 hours in front of a com-
puter screen, i.e. a total of 3.4 hours a day. This exceeds the recommended time for these activities which should be no longer than 2 hours a day [5].

Low physical activity and the prevalence of a sedentary lifestyle are the causes of many health problems, which are becoming more and more common among children and adolescents. There is growing obesity among children and adolescents. There is growing obesity among younger and younger children, and this causes a significant risk of being overweight or obese in adulthood as well. In children and adolescents with excessive body mass, arterial hypertension, type 2 diabetes and postural defects can be observed [8-10], as well as more cases of neuroses and behavioural disorders [11]. A low level of physical activity also has negative effects on the structure and functioning of some organs and systems [12], reducing physical fitness [13].

The aim of the study was to evaluate the somatic structure and physical fitness of children and adolescents aged 10-19 depending on their level of physical activity.

Material and methods

The research was carried out between 2008-2009. It included 925 girls and 1,016 boys aged 10-19 years from rural and urban schools of the Biała Podlaska county (north-eastern part of the Lublin province). The schools in which the research was conducted were deliberately selected – they were the same schools that were randomly selected for research 10 years earlier (KBN Grant No. P05D02314). The research was carried out in the following rural schools: in Cicibor, Janów Podlaski, Komarno, Konstantynów, Leśna Podlaska, Rokitno and Zalesie, and in municipal schools in Biała Podlaska and Międzyrzec Podlaski. Prior to the study, consent informing about the purpose and scope of the research was obtained from the AWF Ethics Committee in Warsaw, school authorities and parents or guardians of the children who were involved in the study.

During the research, basic anthropometric measurements were conducted in accordance with the requirements of the International Biological Research Committee [14]. They concerned measurements of the following somatic features: body height, body mass, arm and shank circumferences, thickness of three skinfolds (above the triceps muscle, below the shoulder blade and above the iliac crest). The body mass index (BMI) was calculated using height and body mass values. In addition, the numerical values of somatotypic components were calculated: endomorphs, mesomorphs and ectomorphs using the Sheldon method modified by Heath and Carter [15].

Physical fitness was assessed by performing trials included in the European Physical Fitness Test [16]. This work uses the results of measurements defining the following motor skills: static force (measurement using a hand dynamometer), explosive force (standing long jump distance), trunk strength (number of performed sits from lying position), agility (10 x 5 m zig-zag run time), speed of the upper limb movements — tapping (alternating touching two appropriately spaced discs), flexibility (trunk forward bow while seated), balance (number of repetitions needed to stay on a beam for one minute), functional strength (overhang with arms bent).

The work also uses the method of diagnostic survey with an original questionnaire, based on which information regarding the date of birth of each examined person (enabling calculation of calendar age) and their physical activity. In this study, the only information used from the questionnaire was the number of hours spent on physical activity per week apart, from Physical Education classes. The level of physical activity was rated on a 3-point scale: low activity – up to 1 hour, moderate – from 1 to 3 hours, high activity – 4 hours and more.

Statistical calculations were preceded by determination of the distribution value regarding the analysed somatic traits and the results of motor tests. Body height belonged to the features with normal distribution. The other parameters were logarithmically transformed to obtain normal distribution. In the physical activity groups of girls and boys, the age of the subjects was precipitated by normalizing the values of somatic features and the results of motor tests with the aid of different equations for mean dependencies and standard deviations from age according to Stupnicki et al. [1]. When evaluating the statistical significance of differences between separate groups, ANOVA analysis and the Newman-Keuls post-hoc method were used.

Results

Analysing the percentage distribution of the studied girls and boys depending on physical activity levels, it was noted that the highest percentage of the surveyed girls and boys declared from 1 to 3 hours a week (moderate physical activity) spent on physical activity. Only 40% of the girls and a quarter of the boys declared low physical activity levels. Merely 14.5% of the girls and 28% of the boys spent four and more hours on physical activity (Tab. 1).

Analysing the values of normalized somatic features in groups separated on the basis of physical activity showed that in girls, there were no significant differences in body height. Among the other analysed somatic features, the group with high physical activity was characterized by the lowest values of body mass, BMI, arm and shank circumference, while between the groups with low and moderate activity, there were no clear differences in somatic structure. This is confirmed by the results of ANOVA: statistically significant differences occurred mainly between groups of girls with low and high physical activity levels (Fig. 1, Tab. 2).
The effect of physical activity level on body build and...

Table 1. Number of surveyed girls and boys in groups distinguished on the basis of physical activity level (number/percentage)

<table>
<thead>
<tr>
<th>Sex</th>
<th>Up to 1 h (low activity)</th>
<th>1-3 h (moderate activity)</th>
<th>4 h and above (high activity)</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>n</td>
<td>%</td>
<td>n</td>
<td>%</td>
</tr>
<tr>
<td>Girls</td>
<td>380</td>
<td>41.08</td>
<td>411</td>
<td>44.43</td>
</tr>
<tr>
<td>Boys</td>
<td>264</td>
<td>25.98</td>
<td>467</td>
<td>45.97</td>
</tr>
</tbody>
</table>

Table 2. Results of ANOVA analysis of variance conducted for dependencies between physical activity, somatic build and physical fitness of girls and boys

<table>
<thead>
<tr>
<th>Girls</th>
<th>Boys</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td>ANOVA</td>
<td></td>
</tr>
<tr>
<td>I-II</td>
<td>I-III</td>
</tr>
<tr>
<td>I-II</td>
<td>I-III</td>
</tr>
<tr>
<td>height</td>
<td>0.50</td>
</tr>
<tr>
<td>mass</td>
<td>2.86</td>
</tr>
<tr>
<td>BMI</td>
<td>3.97</td>
</tr>
<tr>
<td>arm circumference</td>
<td>1.59</td>
</tr>
<tr>
<td>shank circumference</td>
<td>2.81</td>
</tr>
<tr>
<td>endomorphism</td>
<td>8.35</td>
</tr>
<tr>
<td>mesomorphism</td>
<td>3.80</td>
</tr>
<tr>
<td>ectomorphism</td>
<td>3.46</td>
</tr>
<tr>
<td>hand strength</td>
<td>3.36</td>
</tr>
<tr>
<td>balance</td>
<td>4.32</td>
</tr>
<tr>
<td>tapping</td>
<td>12.53</td>
</tr>
<tr>
<td>agility</td>
<td>5.60</td>
</tr>
<tr>
<td>long jump</td>
<td>8.78</td>
</tr>
<tr>
<td>sit from lying</td>
<td>8.49</td>
</tr>
<tr>
<td>overhang</td>
<td>3.58</td>
</tr>
<tr>
<td>10 x 5 m run</td>
<td>7.69</td>
</tr>
</tbody>
</table>

I – group with low physical activity (up to 1 h)
II – group with moderate physical activity (1-3 h)
III – group with high physical activity (4 h and above)
* statistically significant differences at confidence level of p<0.05

In boys, it was noticed that subjects with low physical activity obtained the highest normalized values of the analysed somatic features with the exception of body height. The group with high physical activity, similarly to girls, was characterized by the lowest values of body mass, BMI, shoulder and shank circumference, but statistically significant differences occurred only in the case of BMI (Fig. 2, Tab. 2).

In this work, the type of body structure examined using the Heath and Carter method was also determined [15]. Girls with high physical activity were characterized by low endomorphism and mesomorphism, and the highest values of ectomorphs. Similarly as in the case of somatic features, there were no significant differences between the two remaining groups (with low and moderate physical activity) regarding the type of body structure, which is confirmed by the Newman-Keuls test results – the differences were statistically significant, but only between the first and third, and second and the third groups separated on the basis of physical activity (Fig. 3, Tab. 2).

Boys with low physical activity levels were characterized by the highest values of normalized endomorphs and mesomorphs, and the lowest ectomorphs. The group with moderate physical activity levels had body component values close to the average norm of all groups, while the boys who were physically active, similarly to girls, had the lowest values of endomorphism and mesomorphism, and the highest ectomorphs (Fig. 4, Tab. 2).
Fig. 1. Normalized values of somatic traits of girls in groups with various levels of physical activity

Fig. 2. Normalized values of somatic traits of boys in groups with various levels of physical activity
Apart from somatic build, physical fitness was assessed in girls and boys representing different levels of physical activity. There was a greater variation in the results for girls than the boys. Girls with high physical activity levels obtained the best results in all analyzed motor trials except for balance. Girls with low physical activity proved to be the least physically fit. Differences in the results were statistically significant in all the analyzed physical fitness tests, and the Newman-Keuls test showed the significance of differences mainly between the first and second, and the first and third groups of girls (Fig. 5, Tab. 2).

In boys, there was a similar pattern of dependence between physical activity and fitness, but the normalized values were lower than in the girls. The smallest intergroup differentiation was observed in hand strength and flexibility. The statistical significance of differences occurred only in the long jumps, sits from laying and the overhang, which mainly resulted from the very low results of boys with low physical activity (Fig. 6, Tab. 2).
Discussion

Undertaking physical activity is of particular importance during the development of the human body, that is during childhood and youth. To ensure physical and mental health during this period, all forms of physical activity are desirable. In combination with changes in external environment, it is a factor modelling the morphological and functional state of an organism. Applied for a longer period of time, it causes adaptive changes that include both physical and mental characteristics. Understanding the determinants of physical activity is the basis for taking action to counteract the decline in its level in children and adolescents [17].

Conducted research shows that about 45% of girls and a similar percentage of boys from Bialski county allocate from 1 to 3 hours per week, and up to 1 hour per week as much as 41% of girls and 26% of boys, to extracurricular physical activity. Most of the subjects do not meet the criteria of recommended physical activity. A similar situation was noted in the research carried out at the Institute of Mother and Child in Warsaw, concerning physical activity of school youth aged 9-17 [6]. Almost a quarter of respondents perform moderate physical activity for a minimum of 60 minutes less than 3 days a week, and only about 20% high physical activity 4 and more hours a week.

Physical exercise causes many beneficial changes in the human body. It stimulates general development and determines physical fitness, which is highly dependent on training. Physical activity influences, among others, bone growth in children and adolescents, strengthens and stabilizes joints and has positive influence on muscularity while reducing the amount of adipose tissue. Regularly performed physical activity affects pace of development, as well as dimensions of the body. Already after a few months of moderate, but regularly undertaken physical exercise, children performing motor activity classes have greater height and weight gain, they mature earlier and are more resilient to infections [13]. In our own research, there was no correlation between physical activity and body height.

In the other analysed somatic traits (body mass, arm and shank circumference) and BMI values, the groups of girls and boys with high physical activity were characterized by the lowest values of these features. In girls with low activity levels, high values of the analysed somatic features were observed, especially in the case of BMI, while in boys, there were no differences in somatic structure between groups with low and moderate physical activity.

Physical activity is closely related to physical fitness, but the strength of this relationship is seldom studied. In our own research, it was observed that girls and boys who spend more time on physical activity are characterized by a higher level of physical fitness. The abovementioned relationship was observed in the results of all fitness tests except for balance. Girls and boys with low physical activity turned out to be the least physically fit. Similar relationships are indicated in the case of research among boys aged 13-15 from Radom [18]. The boys with a higher level of physical activity obtained better results in all attempts included in Zuchory’s Physical Fit-
ness Index. In turn, in the research by Kubusiak-Slonina et al. [19], it was also found that among children aged 11-12 from Rzeszów and Kosina, along with an increase in physical activity, the level of physical fitness assessed by the Zuchory test also increased.

The presented results of our research and the studies by other authors indicate that physical activity is a factor modelling the development of children and adolescents, which is why following nutrition, movement should be the most important element of a healthy lifestyle for each individual.

Conclusions

1. A relationship was found between physical activity and somatic build as well as physical fitness of the studied girls and boys.
2. The boys and girls with high physical activity levels were characterized by the lowest values of somatic features except for body height, and had the best results of physical fitness.
3. Greater variation in the results was observed among girls.

References


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