Summary

**Purpose.** The aim of the research is to investigate the link between the level of physical fitness and motor skills in 6-year-old children in the Małopolska Province and the place where they live.

**Basic procedures.** The study encompassed 6,409 children, including 3,117 girls and 3,292 boys. To evaluate their level of physical fitness, several tests from the EUROFIT test battery were carried out. In addition, children were evaluated on how they performed simple motor tasks, which are usually part of games involving physical movement. The following activities were assessed: throwing a PE bean bag with left and right hand, throwing a ball with both hands, catching a PE bean bag with left and right hand, kicking a ball with right and left leg, hopping on the right and left foot, and hopping on both feet. In addition, coordination during exercises was evaluated. A four-point scale was used for measurement. Basic statistical characteristics were calculated (means and standard deviations, normalized values). A Student’s t-test was used in order to assess environmental diversity.

**Main findings.** The level of children’s physical fitness varies depending on where a child lives. Both boys and girls inhabiting rural areas achieve significantly better results in tests of arm muscle strength (p=.000) and running speed (girls p=.000, boys p=.050). Furthermore, in the group of boys, there were significant differences in the level of flexibility (p=.015). Urban preschoolers achieve better results in the balance test (p=.000). As reported by the Physical Education teachers, rural children scored significantly better for the performance of all motor tasks (all points in total, girls p=.000, boys p=.049) and catches (p=.000). Rural girls were better at hops (p=.000).

**Conclusions.** The results suggest that the level of development of preschool age children’s motor skills in terms of their motor potential is becoming very similar.

Introduction

In accordance with the recommendations of pediatric societies and the societies promoting physical education and physical activity [1984], physical fitness is an integral part of health and is necessary for an individual to be able to function during the day as well as to take up various forms of physical activity in leisure time. Therefore, professionals highlight a significant role that is played by such fitness components as cardiorespiratory endurance, flexibility, strength, and body build [1]. Like other lifestyle factors, poor physical fitness is believed to be one of the risk factors contributing to a number of general non-communicable diseases, including cardiovascular diseases, hypertension, diabetes, certain cancers, overweight and obesity [2-4]. In most cases, these diseases develop in adulthood, but some of them, such as overweight and obesity, are present from an early age.
skills play an important role in the life of every child. A lot of complex motor skills. Health-related fitness and motor control, but also the correct acquisition of simple and processes associated with the development of motor skills. Undeniably, family plays a crucial role, too. The most important family factors include parents’ education, habits, social values, their ideas about education and upbringing, what they think a proper children’s diet is and whether they know the role of food in child development, and, finally, to what extent they satisfy their children’s intellectual and psychomotor needs [7]. However, when considering the influence of individual variables on the level of children’s physical fitness and skills, one must take into account the impact of a wider environment. Numerous aurological studies point to the fact that each environment in which a child grows up is a kind of ecological niche with specific distribution of different variables that are distinctive of that environment [8]. Hence, examining the impact of individual sociodemographic indicators on the level of development of child physical fitness and motor skills does not really show what role is played by the environment in which children live and are brought up. Therefore, it becomes important to use a single and more general indicator. Most often, it is a place of residence expressed by its size. The most popular differentiation is a dichotomous division into urban and rural areas.

Nowadays, there is a large concentration of people in urban areas. This phenomenon applies to all highly-developed and developing countries [9]. The migration shift towards cities is not only due to economic reasons. Urban areas provide more opportunities in terms of general quality of life than rural settings, as they offer better access to educational institutions at all levels and to recreational, sports, cultural, and health facilities. However, different studies indicate that cities carry far more health risks. It is believed that leisure activities in urban areas are not very much focused on physical activity, thereby causing differences in physical fitness between rural and urban dwellers, which is particularly evident in the groups of children and adolescents [11-12]. Despite better access to recreation and sports, urban children achieve lower average results in tests of strength and endurance. However, they score higher in running speed and flexibility than their peers from the countryside [13-15].

Given these environmental differences in physical fitness, it seems important to monitor the morphofunctional development of children, especially during their preschool years. Therefore, the aim of this study is to assess the variations in the level of physical fitness and motor skills in children aged 6-7 in the Małopolska Province caused by the environment they live in. The study seeks to answer two research problems: 1) Are there gender differences in 6-year olds? and 2) Does the environment in which a child lives have a modifying effect on his motor development before he starts attending school?

It could be assumed that it is during preschool years when gender differences in the level of physical fitness are shaped, and that the place where children live is one of the important factors influencing both the level of physical fitness and of motor skills. In urban environment, children tend to be better at co-ordination, speed, and motor skills. In contrast, rural environment is conducive to the development of strength and endurance in children.

Materials and methodology

In 2006, there was a nationwide research project carried out in Poland entitled, “Dziecko sześciioletnie u progu nauki szkolnej” (~“A 6-year-old child on the brink of school education”), co-financed by the European Union and the State Budget under the European Social Fund. The project involved approx. 65 thousand 6-year olds born in 1999 and 2000 who were starting or finishing their one-year kindergarten preparation for school. The studies focused on children graduating from pre-school were conducted in April and May. In the Małopolska Province, the research project encompassed 6,409 children, including 3,117 girls and 3,292 boys from both urban and rural areas. A representative sample was taken (it included the division into country regions (provinces), the type of facility a six-year old was attending, and the environment in which he/she lived: a village or a town/city, grouped into villages, towns/cities in urban-and-rural communes, and rural areas in urban-and-rural communes). Therefore, the stratified and cluster sampling method without replacement was used, using the database provided by the Polish Education Information System (SIO) and updated by the Central Statistical Office (GUS) [16]. 10% of facilities of any type (preschools and schools) were taken from each strata, specifying their environment.

As was highlighted in the initial phase of the project, when choosing trials and tests to assess children’s physical fitness, varied available space resources of preschools and schools in Poland were taken into account.
Due to the limited time and the expected cost of the project, two tests were excluded: a static hand strength test and a cardiorespiratory endurance test. Therefore, the research program aimed to evaluate general balance, speed of hand movements, flexibility, running speed, strength of abdominal muscles, explosive strength of lower limbs, and the strength of arms and shoulders, using the Eurofit tests. To check the strength of arms and shoulders, a simplified version of the trial was applied: the straight-arm hang time trial. This modification was triggered by the results obtained in the pilot sample. Throughout the study, a proper order of trials was applied, in line with test rules. The results were recorded so as to also gather the data on the percentage of children who were not able to perform various motor tests. In addition, using the categories of 1 – very good, 2 – good, 3 – satisfactory, and 4 – not able to perform, children were tested on simple motor tasks: throwing a PE bean bag with left and right hand, catching a PE bean bag with left and right hand, throwing and catching a ball with both hands, kicking a ball with right and left leg, hopping on the right leg and left foot, and hopping on both feet. Physical fitness and motor skills were assessed by Physical Education teachers. Each group was evaluated by two teachers. During the evaluation, the inter-rater reliability method was used. In order to simplify the analysis of motor skills, they were divided into 4 groups: throws (throws with left and right hand and with both hands), catches (catches with left and right hand and with both hands), kicks (kicks with right and left foot) and hops (hops on left and right foot and with both feet). For this purpose, the totals of points awarded individually for each skill group and also for the performance of all motor skills were calculated. The latter was an overall assessment of all motor tasks during the diagnosis of each child’s physical fitness.

Having verified the distributions for each variable that was analyzed, the material was grouped by gender and place of residence. Basic statistical characteristics were calculated for each group, which was the basis for further statistical analyses (arithmetic mean, standard deviation). In both gender groups, the results were standardized to get the mean and standard deviation. A Student’s t-test was used to examine the differences in average values for motor skills depending on the environment. Three levels of statistical significance were adopted: \( p \leq 0.05, p \leq 0.01, \) and \( p \leq 0.00. \) In the case of running speed, balance, and motor skills, a lower score means that they are more developed.

**Research results**

There were statistically significant differences between the level of physical fitness in boys and girls. The differences were found in general balance \( (p = 0.006) \), explosive strength of lower limbs \( (p = 0.000) \), abdominal muscle strength \( (p = 0.004) \), the strength of arms and shoulders \( (p = 0.004) \), and running speed \( (p = 0.000) \). Boys outperformed girls in all analyzed skills. Girls were only slightly better at flexibility (the difference in the obtained results \( -0.286 \) cm) – Table 1.

<table>
<thead>
<tr>
<th>Components of physical fitness</th>
<th>Boys</th>
<th>Girls</th>
<th>( t^* )</th>
<th>( p )</th>
</tr>
</thead>
<tbody>
<tr>
<td>General balance [n/60sec]</td>
<td>10.582</td>
<td>10.485</td>
<td>11.288</td>
<td>10.267</td>
</tr>
<tr>
<td>Speed of hand movements [sec]</td>
<td>27.000</td>
<td>6.711</td>
<td>27.312</td>
<td>6.739</td>
</tr>
<tr>
<td>Flexibility [cm]</td>
<td>16.473</td>
<td>4.963</td>
<td>16.759</td>
<td>4.641</td>
</tr>
<tr>
<td>Explosive strength of lower limbs [cm]</td>
<td>99.027</td>
<td>24.755</td>
<td>91.562</td>
<td>17.714</td>
</tr>
<tr>
<td>Strength of abdominal muscles [n/30sec]</td>
<td>7.105</td>
<td>5.171</td>
<td>6.743</td>
<td>4.943</td>
</tr>
<tr>
<td>Strength of arms and shoulders [sec]</td>
<td>26.052</td>
<td>7.665</td>
<td>24.183</td>
<td>4.302</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Motor skills</th>
<th>Boys</th>
<th>Girls</th>
<th>( t^* )</th>
<th>( p )</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total points for motor tests</td>
<td>23.680</td>
<td>5.988</td>
<td>23.848</td>
<td>5.704</td>
</tr>
<tr>
<td>Total points for throws</td>
<td>5.519</td>
<td>1.584</td>
<td>5.627</td>
<td>1.555</td>
</tr>
<tr>
<td>Total points for hops</td>
<td>6.051</td>
<td>1.910</td>
<td>6.618</td>
<td>1.765</td>
</tr>
<tr>
<td>Total points for catches</td>
<td>6.529</td>
<td>2.168</td>
<td>6.594</td>
<td>2.122</td>
</tr>
<tr>
<td>Total points for kicks</td>
<td>3.777</td>
<td>1.206</td>
<td>4.149</td>
<td>1.236</td>
</tr>
</tbody>
</table>

Table 1. The characteristics of physical fitness in 6- and 7-year-old children from the Małopolska Province.

Table 2. Assessment of motor skills in children from the Małopolska Province.
substantially better at hops, while boys are more skillful at kicks and throws.

Figures 1-2 and Tables 3-6 present different levels of physical fitness and motor skills, depending on where children live. It can be seen that in most cases rural children achieve a higher level of performance measured both in a quantitative (measurement of physical fitness components) and in a qualitative (evaluation of motor

Fig. 1. Normalized values for motor skills and tasks with regard to the growing-up environment – girls*. (From the top: total points given for motor skills, throws, catches, hops, kicks, running speed, strength of arms and shoulders, strength of abdominal muscles, explosive strength of lower limbs, flexibility, speed of hand movements, balance; red – urban areas, blue – rural areas)

Fig. 2. Normalized values for motor skills and tasks with regard to the growing-up environment – boys*. (From the top: total points given for motor skills, throws, catches, hops, kicks, running speed, strength of arms and shoulders, strength of abdominal muscles, explosive strength of lower limbs, flexibility, speed of hand movements, balance; red – urban areas, blue – rural areas)
Physical fitness and motor skills in 6-year-old children from the Małopolska Province

While assessing the various scores in physical fitness depending on the area of residence, both genders achieved significantly different results for balance (p < .001 girls, boys p < .000), arm and shoulder strength (girls p < .001, boys p < .000), and running speed (girls p < .050, boys p < .050) — (Tables 3-4, Figures 1-2). Urban children were characterized by higher levels of balance, while rural children scored better at arm and shoulder strength and running speed. In addition, rural girls showed greater speeds of hand movements (x_rural = 26.78 vs. x_urban = 28.00 — Table 3, Figure 1). Rural boys were more flexible (x_rural = 15.60 vs. x_urban = 15.18 — Table 4, Figure 2).

Also, the quality of motor tasks varied depending on where children live. Significant differences in favor of rural girls were obtained for the sum of points awarded for all motor tasks (x_rural = 23.33 vs. x_urban = 23.48 — Table 5, Fig.1) and the sum of points awarded for hops...
Compared with their peers from the city, rural boys performed significantly better at catches (urban: $\bar{x} = 6.40$; rural: $\bar{x} = 6.83$), (Table 5, Fig.1).

Discussion

The main aim of the research was to determine the differences in physical fitness and motor skills in 6-year olds from the Małopolska Province based on the type of environment they live in. Additionally, gender differences were found in physical fitness and motor skill levels. As expected, boys significantly outperformed girls at most H-RF components. They were also much better at catches, throws, and kicks. Differences between the two sexes in the level of physical fitness and motor skills have already been researched and are nothing new [17]. What is more, they are a major source of individual variability and are shaped differently at each stage of ontogeny. A slightly smaller gender variation was found in younger children, with boys being substantially better than girls in almost all components of physical fitness and motor agility. A significant edge that preschool boys have over preschool girls usually stems from diverse forms of physical activity that children are engaged in from an early age. This, in turn, is often associated with the fact that children repeat adults’ patterns of physical activity, as well as with the process of socialization occurring from the earliest days of life, because boys and girls interact with others in different ways. In their relationships with other people, girls tend to care more about doing things together; boys, on the other hand, are focused on competition, individualism, and self-centeredness [19].

It seems that in order to discuss this, what needs to be taken into account is the susceptibility of functional characteristics, including the elements of physical fitness, to any changes in the external environment. It is particularly important to acknowledge the fact that the dichotomous urban-rural division of the growing-up environment is marked by various levels of parents’ education and their different career choices, as well as by diverse cultural patterns and different sports habits of the closest family members. In addition, these two environments differ in the availability of preschool educational institutions [19,20]. In rural areas, there are more schools with preschool units, whereas towns and cities usually offer independents preschool facilities with a greater range of paid extracurricular activities, including PE classes. Also, it turns out that in villages, children more often attend preschool for only one year, while urban children usually finish the full 3 years of preschool care and education [21]. Such differentiation in the social functioning in different living environments also implies unequal access to preschool education from an early age, which means that rural children have smaller educational opportunities as early as the outset of their school careers.

The research shows that out of the 14 components of physical fitness (7 for boys and 7 for girls), differences which depend on the growing-up environment were found for only half of them (4 for girls and 3 for boys). Moreover, there are environmental differences in the scores in simple motor tasks most frequently performed during games and play. Here, the number of significant findings is concerned with the group of girls rather than boys (three skills for girls and one skill for boys). It was also shown that the rural environment provides better conditions for the unhindered development of most of the physical fitness and motor skill components in preschool children. This is evidenced by significantly better arm and shoulder strength scores and running speed scores observed in both sexes, and also by scores for ball catches and total scores given for all motor tasks during the diagnosis. In addition, such differences were also found in rural girls for the speed of hand movements and in rural boys for flexibility. The urban environment is only conducive to the development of balance in both sexes, which was checked with the Flamingo Balance test.

When comparing these results to the earlier observations by other authors, it is easy to notice a certain discrepancy. Therefore, such differences are not universal. The study by Momola and also the one by Zaradkiewicz show that 6-year-old children from cities and other environments of high socioeconomic status achieved significantly better results in running speed than their rural peers [23,24]. In addition, various research done on children from Croatia [25], Mexico, and Spain [11,26] proved similar differences in running speed as well as in other trials with the speed component, such as explosive strength of lower limbs, both directly and after eliminating age and body size variables. Additionally, what was observed in children from Cyprus was a significant advantage of urban 9-year olds in the hand movement speed test (plate tapping) [27]. However, different conclusions were drawn after the analysis of the Polish nationwide research material, which say that the running speed of urban children is substantially better than in rural children [14].

It is probably impossible to conclude that one specific growing-up milieu has an unambiguous influence on children’s strength. The importance of rural environment and its indirect impact on static hand and shoulder girdle strength are shown in the study of children from southern Europe and Mexico [11, 26-28]. However, for the
same research populations, the direction of differences is quite the opposite with respect to arm strength measured by the distance of basketball chest pass done from a sitting position [28] and to abdominal muscle strength [11, 26]. On the other hand, the Croatian and Spanish studies indicate that there are no significant differences in abdominal muscle strength between children from the two types of environment [25, 26]. Similar observations apply to another component of physical fitness: flexibility. High flexibility scores were usually observed in children from rural areas [27, 29, 30]. Nevertheless, the most comprehensive Polish research on the biological shape of Polish children and adolescents did not show a significant impact of the living environment on the development of flexibility, particularly when it comes to girls. Such results, however, are partly confirmed by the Greek and Croatian studies [14, 25, 28].

Only the environmental differences in balance consistently pointed to the fact that urban children score higher in balance, which is in line with the results obtained for 6- and 7-year-olds from the Malopolska Province [27, 30, 31].

The level of development of physical fitness is the outcome of multiple factors. A crucial role is also played by some basic parameters like height and weight, their mutual proportions, including longitudinal proportions, muscle mass, adipose tissue, and the center of mass [32, 33]. Hence, in the debate on the environmental differences in the physical fitness levels of 6- and 7-year-old children from the Malopolska Province, we should take into account the subjects’ basic somatic parameters [34]. Markowska observed that, on average, children from the rural areas of Malopolska are approximately 1 cm smaller and 1 kg heavier than their urban peers, and that the observed differences are statistically significant. Such children also have a thicker fat layer [34]. Therefore, the somatic factor in rural children might have contributed to achieving better average results in individual trials.

In the context of environmental variation, the comparative analysis of the scores obtained by Malopolska children for performing simple motor tasks is difficult for many reasons. First of all, there are no other publications on motor skills whose methodology and the research scope is similar to the methods and scope used herein. However, from the available results of different studies done on Fundamental Motor Skills (FMS) and presented primarily abroad, one could infer a conclusion that low FMS scores do not depend on the living environment. Nevertheless, they might be associated with a socioeconomic status (SES) as well as ethnic and cultural background of families in which children are raised [35], as it has been noticed that lower FMS levels co-occur with low family SES, particularly for the group of girls. What plays a key role for boys is the cultural and ethnic factor [35-36]. It should be noted, however, that there are significant regional differences between the two studies.

The analysis of the observed variation in how well the children from Malopolska perform particular motor skills was most likely motivated by several factors. One of them is the fact that local authorities pay special attention to preschool education in rural areas [37] due to the comprehensive program for equal preschool educational opportunities in urban and rural areas. As part of the program, the Ministry of Education announced the competition which inspired this research. In addition, for a number of years now it has been possible for various associations, communes, and educational institutions to apply for additional EU funds, which enable better learning facilities and preschool teacher trainings.

What also seems important in the case of rural environment is the lay of the land. The Malopolska Province is one of the regions with a lot of mountainous and upland terrains. Full access to its natural assets is possible mostly in rural areas. Close proximity to open spaces and forests is conducive to the organization of physical activities, during which children shape their motor potential. These observations are supported by the studies on children from Cyprus and USA [38, 39].

Furthermore, it could be concluded that there were many other indirect factors having a significant impact on the obtained scores in physical fitness and motor skills. For the proper development of children’s motor skills and fitness, it is important to select appropriate Health and Physical Education curriculums and to implement them in a responsible manner. Another key factor includes extracurricular physical activities offered by educational institutions and the immediate living environment, as well as proper sports equipment and access to playgrounds [40].

However, regardless of numerous external modifiers, what needs to be kept in mind is the undeniable direct impact of children’s physical activity on the process of learning motor tasks and its outcomes [41-44]. Even a small improvement in motor task scores may evoke positive emotions in children, thus making them more willing to take further steps to tackle more complex forms of physical movement. Hence, it seems important to make sure that the adequate process of motor learning starts in preschool and early school years and is supervised by well-trained teaching staff. Unlike older children, small children are not yet aware of their mistakes and do not get stressed when they fail at motor tasks. If children are taught to perform physical activities from the very beginning, they might be more willing to participate in the general physical education in the future.
Conclusions

The conducted analysis allows to draw the following conclusions:

1. 6-year-old children from the Małopolska Province demonstrated significant gender differences. Boys turned out to score significantly higher in all components of motor skills and physical fitness (except for flexibility).

2. The dichotomous division of the growing-up environment clearly shows different levels of physical fitness. This phenomenon was observed in both sexes and similar components.

3. Points given by PE teachers for particular motor tasks indicate that rural children slightly outperform urban children at simple motor tasks.

The results clearly indicate that the previously observed shortcomings in the functional development in rural areas have been made up for.

Bibliography

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