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Differences between boys and girls in applied variables to assess motor skills

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Abstract

Introduction. Physical fitness is the capacity to perform different activities involved in everyday life. Aim of Study. The main goal of this study was to investigate gender differences among second graders in the physical activity level, physical fitness and fundamental movement skills. Material and Methods. In doing so, a sample of 78 children (35 girls, 43 boys, overall mean 7.34 ± ± 0.53 years) was measured using NPAQ (Netherland Physical Activity Questionnaire), FMS-Polygon, BOT-2 (Bruininks–Oseretsky Test of Motor Proficiency), F3 test and BMI. Results. The between-subject t-test was applied to determine whether a significant difference exists between the genders. Differences were found between boys and girls in applied physical fitness tests in two tests: F3 (t = 3.05; p = 0.003) and FMS-Polygon (t = –2.7; p = 0.007), while no significant differences were observed for BOT-2, physical activity (KA), sedentary activity (SA) and BMI. Conclusions. The applied between-subject t-test showed significant differences between the genders. Such differences were found between boys and girls in applied physical fitness tests in two tests F3 (t = 3.05; p = 0.003) and FMS-Polygon (t = –2.7; p = 0.007), while no significant differences were observed for BOT-2, physical activity (KA), sedentary activity (SA) and BMI.

KEYWORDS: children, physical activity, motor skills, sedentary activity, fundamental movement skills.

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Introduction

Physical fitness, defined as the capacity to perform physical activity, includes integrated measures of most body functions (skeletomuscular, cardiorespiratory, hematocirculatory, psychoneurological and endocrine-metabolic) involved in everyday physical life activity and physical exercise [24]. Therefore, physical fitness includes two categories: skill-related fitness described based on agility, speed, coordination, balance, power and reaction time, and health-related fitness such as cardiorespiratory fitness, muscular endurance, muscular strength and flexibility [21]. Studies report that a higher motor skill proficiency during childhood positively impacts physical activity among young people [6, 7]. Furthermore, increased physical activity is likely to have positive effects on preschool health and skill-related fitness qualities [14]. Moreover, a high level of physical fitness can also increase health outcomes and prevent chronic diseases, musculoskeletal problems and psychological health issues. It has been treated as a powerful marker of health [24]. Moreover, the acquisition of fundamental movement skills at preschool age is one of the most important predictors of physical fitness because of the natural form of movement in preschoolers, which is important in further specific sports skills [12]. Insufficiently stimulated and underdeveloped motor skills and knowledge at a young age may lead to decreased or delayed development of motor creativity [19].

Furthermore, previous studies had identified gender differences in physical fitness, which may to a greater extent affect adolescents [9]. Thus preschool-age boys have better results on some tests such as standing broad jump, shuttle run and arm hanging, while girls have better results in coordination and manual dexterity; nevertheless, the differences were small [18]. Researchers have reported that boys spend more time in various physical activities during the day than girls [14, 17]. Some studies have also reported a significant difference between genders in locomotor skills, where boys performed better in object control skills [5, 16]. In contrast, girls tend to have better locomotor skills [16]. Consequently, despite some gender differences some researchers state that there are no significant differences between genders in physical fitness [5]. Therefore, there is a lack of evidence in previous studies in identifying gender differences in this context. Therefore, this study aimed to investigate gender differences among second graders in their physical activity level, physical fitness and fundamental movement skills.

Material and Methods

Participants

The sample included 78 children (35 girls, 43 boys) with an average age of 7.34 ± 0.53 years. Participants for this study were recruited from two elementary schools attending the second grade according to the nine-year curriculum in Bosnia and Herzegovina. With the school principal's consent to conduct the research, a meeting was held with the parents of the respondents. Children with health problems and motor disorders were not included. All the participant's parents signed written consent forms and were fully informed of the purpose of the study. The research was conducted fully in accordance with the Declaration of Helsinki and approved by the institution's Ethics Committee.

Measures and procedures

Two experienced observers took all measurements at the beginning of June for five consecutive days before training at approximately the same time of the day between 9:00 a.m. and 10:30 a.m. during physical education classes. The FMS-Polygon test was taken three times and all the other tests were repeated once.

Gender was the independent variable analyzed in this study. Additional dependent tests included six quantitative variables. For the evaluation of physical activity and sedentary activity of children, parents were asked to complete the NPAQ [22] determining psychometric characteristics. The NPAQ consists of two sections: assessment of (1) physical activity, and assessment of (2) sedentary activities. The section that evaluates activity contains seven statements that parents must answer using a Likert scale (1-5) regarding how much they agree with the statement, with the total score being the mean value of all answers (KA). The part that evaluates the child's inactivity contains only two questions related to the average daily time spent doing sedentary activities (watching television and using a computer). The total is calculated by summing the two responses (SA). To assess fundamental movement skills an (3) obstacle polygon was used [29]. An obstacle polygon was designed with its reliability and validity proved [20]. More precisely, the polygon is based on the scientifically founded hierarchy of fundamental movement skills and includes the following tasks: passing and catching a volleyball against the wall as representing motor skills for object manipulation, jumping over sponge obstacles 50 cm high as representing motor skills to overcome obstacles, lifting and carrying 3 kg medicine balls as representing motor skills to overcome resistance and a 20-m run as representing motor skills to master space. The result required to overcome the polygon (FMS-Polygon) was recorded with a pair of photocells. In addition to the FMS-Polygon, a short form was used to assess the degree of motor skills acquisition, (4) Bruininks-Oseretsky Test of Motor Proficiency, second edition (BOT-2) [8]. The short version consists of 14 tests covering all 8 motor areas. The scoring system depends on the individual test (range of 2 to 13-point scales). The sum of all results gives the total motor quotient. Furthermore, children were tested in (5) F3 test (running distance in 3 minutes). Performance was determined from the running distance in meters covered in 3 full minutes in an track outdoor field. To gain a more detailed view of morphological features of the observed sample (6) the body mass index (BMI) was also calculated.

Statistical analysis

All data were presented as means ± standard deviation, minimum and maximum results. Gender differences were evaluated using the t-test for independent samples. Statistical analyses were performed using the Statistica 13.2 data analysis software system (Dell Inc., Tulsa, OK, USA). The type one error was set at $\alpha = 5\%$.

Results

Means ± SD values, minimum and maximum values in both observed groups were presented (Table 1).

Table 1. Descriptive statistics for parameters between genders

Variables	Total	Male	Female	Min	Max	p
	M ± SD	M ± SD	M ± SD			
F3 (meters)	479.56 ± 38.87	491.1 ± 36.41	465.40 ± 37.55	396	568	<0.001
BOT-2 (sum of point scale)	63.69 ± 5.94	63.47 ± 6.59	4.10 ± 0.50	46	75	0.71
Physical activity (hours)	4.01 ± 0.63	4.10 ± 0.50	3.89 ± 0.74	1.57	5	0.16
Sedentary active (minutes)	147.44 ± 67.47	150.23 ± 65.88	144.00 ± 70.18	30	390	0.68
FMS-Polygon (seconds)	25.51 ± 2.81	24.75 ± 2.73	26.46 ± 2.65	20.89	33.66	<0.01
Body mass index (kg/m^2)	17.71 ± 2.68	17.55 ± 2.73	16.79 ± 2.59	12.95	28.21	0.22

The t-test was applied to determine whether a significant difference exists between the genders. As can be seen in Table 1, there were significant difference between male and female first graders in F3 ($t = 3.05$; $p = 0.003$) and PBMZ ($t = –2.7$; $p = 0.007$), while no significant differences were observed for BOT-2, KA, SA and BMI.

Discussion

This study confirmed that there are general gender differences in physical fitness. Differences between boys and girls in applied physical fitness tests were identified in two tests, F3 and FMS-Polygon, while BOT-2, NPAQ and BMI showed no significant differences in performance related to locomotor and manipulative motor skills in children aged 6-7 years [20]. These findings are in agreement with the frequently observed gender differences in aerobic performance [11, 27]. Previous research studying aerobic capacity assumed that body composition has an impact on gender differences [9]. In this case, the F3 test confirms the distance between boys and girls. Accordingly, Armstrong and Welsman [3] claimed that these differences are due to changes in lean-body weight, body fat, hemoglobin and hormonal changes, but increase during puberty. To put it differently, girls have a higher level of leptin, which is strongly related to adipose tissue [26]. Also, some authors compared heart size with an aerobic difference, because girls have smaller heart sizes, indicating a smaller stroke volume [20].

Additionally, in terms of muscle mass boys also have an advantage over girls, which leads to gender differences [2]. Furthermore, girls have more imbalances in the development of a high burst of power [4]. For the most part, these claims are not so readily apparent in preschoolers and first graders, as all explanations have been speculative and rejected [13, 25].

Not only the F3 test, but also the FMS-Polygon, which can be characterized as a test assessing locomotor and manipulative motor skills, had shown gender differences, because in most cases boys are better in fundamental movement skills, where they are superior in object manipulation [28]. More precisely, they have an advantage over girls in strength and endurance [30]. Although this may be true, researchers concluded that this polygon test is also age-sensitive [10].

Furthermore, the BOT-2 test in the paper contains all motor skills, the sum of which gives the result of the total motor space, showed no gender differences. On the other hand, the differences were confirmed in the FMS-Polygon, which can be characterized as a test assessing locomotor and manipulative motor skills. Therefore, the obtained results certainly open the space for additional research that would determine the background responsible for the skills that differentiate boys and girls in fundamental movement skills. Based on previous knowledge, it can be argued that gender differences in fundamental motor skills are primarily defined by sports activities that children practice [23]. Nevertheless, similarly as the NPAQ test, BMI does not significantly affect performance in locomotor and manipulative motor skills in children aged 6-7 years [20].

The presented results suggest a careful observation of gender as a predictor of physical activity in early elementary school age. Correspondingly, from the observed six areas of physical fitness, differences were found in some tests, while in others there were no differences. It is in line with findings from previous research [15]. Therefore, it is an indicator of the need for individual analyses of different areas of physical fitness in the context of gender differences. In this way it would be possible to find the most effective teaching models for physical education as sports training in elementary school pupils in relation to gender differences [1].

Conclusions

The present study results indicate that differences in boys and girls were identified mainly in aerobic performance due to body composition. Also, differences are observed in fundamental movement skills characterized by strength and endurance, where boys have an advantage. Although we can say that the results of this study are generally accepted facts, they are often neglected in practice. This is especially true for the implementation of teaching physical education in the lower grades of elementary school, through which due to organizational shortcomings gender differences can be neglected. Moreover, differences can also be observed in sports clubs of younger age groups, where girls and boys train together. This practice certainly has many advantages, but it is still necessary to consider gender as a crucial factor in specified areas of physical fitness.

Consequently, the practical value of this paper is to point out once again the complexity of the approach to the implementation of physical education programs in view of gender differences and various aspects of physical fitness.

Therefore, it is obvious that gender cannot be unambiguously viewed as a predictor of physical fitness, but it is necessary to take into account the specifics of individual factors of fitness and observe them individually. This approach will ensure the most complete development of all areas of physical fitness in boys and girls.

Conflict of Interest

The authors declare no conflict of interest.

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