Evaluation of some physical fitness characteristics at age 11 to 13

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Abstract

Many studies indicate that an adequate physical fitness is an important marker for a healthy body and a healthy mind. The aim of the study was investigate the level of physical fitness of students aged 11-13. Depending on the results, we will determine the type of measures to propose in order to improve the obtained data.

251 volunteer students participated in this research, including 95 boys and 156 girls aged 11 to 13, who participated in the physical education class two times a week. Subjects underwent six anthropometric characteristics and five physical tests. For the statistical analysis the mean, standard deviation, and multiple comparisons were used in order to find the differences between genders, using Anova and Bonferoni Test for differences between certain age groups. Anthropometric measurements included height, weight, arm span, waist, hip, body mass index and physical testing as agility, balance and strength.

The findings suggest some differences between male and female subjects, as well as between age groups, namely boys obtained higher mean results compared to girls.

Key words: *Anthropometrics, agility, balance, strength, students*

Rezumat

Studiile ştiinţifice relevă faptul că o condiţie fizică bună este un factor important pentru un corp sănătos şi o minte sănătoasă. Scopul acestui studiu este de a investiga nivelul de aptitudini fizice la elevi de 11-13 ani. În conformitate cu rezultatele înregistrate, vom stabili ce fel de măsuri pot fi propuse pentru a îmbunătăţi bagajul motric şi implicit calităţile motrice.

În această cercetare au participat, în mod voluntar, 251 de elevi, dintre care 95 de băieţi şi 156 fete, cu vârsta cuprinsă între 11-13 şi care au participat la lecţia de educaţie fizică de două ori pe săptămână. Au fost realizate şase măsurători antropometrice şi cinci teste fizice. Pentru analiza statistică am utilizat media, deviaţia standard şi comparaţia multiplă, pentru a afla diferenţele între genuri, cu ajutorul Anova şi Bonferoni pentru diferenţele între vârste. Măsurătorile antropometrice au fost raportate ca: înălţime, greutate, anvergura, perimetrul abdomenului, perimetrul şoldului şi indicele de masa corporala, iar pentru testările fizice ca agilitate, echilibrul si forţă.

Constatările sugerează unele diferenţe intre fete şi băieţi , precum şi pe categorii de vârstă, iar băieţii au obţinut rezultate mai bune în comparaţie cu fetele.

Cuvinte cheie: *Antropometrie, agilitate, echilibru, forţă, elevi*

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Introduction

Regular physical activity plays a significant role in enhancing and maintaining human health [1], and is generally considered to be necessary for adequate growth and development [2]. At the same time, physical activity in children is a preventive and therapeutic measure to reduce the risk of future diseases such as obesity and cardiovascular diseases [3, 4].

Physical education in terms of an educational process consists of helping children and adolescents acquire skills, fitness, knowledge, and attitudes that contribute to their optimal development and wellbeing. Some physical fitness characteristics are taken into consideration for our paper: agility, balance and upper limb strength, lower limb and abdominal muscles. For many, balance is a complex part of the individual motor fitness and it is influenced by vision and the ability to maintain one's equilibrium in relation to the gravitational force and to make rapid body alternations when it is placed in various positions [5].

Balance is a mechanical condition, indispensable for the motor function, as it ensures the stability of positions (posture) and the orientation of movements in space; hence, it is required both in daily and professional, as well as in sports activities [6]. Agility is the ability to quickly change position or direction of the body and is also influenced by body balance, coordination, the position of the centre of gravity, as well as running speed and skill [7]. Power represents the ability to perform one maximum effort in as short time as possible, also known as explosive power. The combination of strength and speed is exhibited during jumping, striking, or distance throwing [5].

Methods and subjects

The study was carried out on 252 students within the "Mihai Eminescu" National College of Iasi, Romania (158 girls and 94 boys) aged between 11 and 13. We mention that for our research the purpose of the study was explained to all participants and the written consent from parents and students was obtained.

The anthropometric measurements included five evaluation criteria for the physical status: weight, height, arm span, waist and hip. Based on the first two measurements, we calculated the Body Mass Index (BMI).

Each subject was measured in accordance with the standard methods proposed by the International Society for the Advancement of Kinanthropometry [8] for:

- **Basic measurements** (height, weight). Equipment used included a stadiometer and a weighing scale. Height characteristics were measured to the nearest 0.1cm, and mass characteristic was measured in kg.
- **Girths** (waist and hip circumference). Both were measured with anthropometric tape and expressed in cm.
- **Arm span** was measured from one medium fingertip to another, while standing with the back to a flat wall and arms stretched with palms facing the investigator. The equipment required consisted of a tape measure on the wall, marked in cm.
- **The body mass index** (BMI) was calculated according to the formula weight (kg)/total height^2 (m^2), and it indicates the ratio between the weight and height of a person.

The subjects performed three physical fitness tests in order to assess agility, balance and strength of abdominal, lower limb and lower limb muscles [7].

- **Standing Long Jump** (SLJ) was used to assess explosive power and strength. The test performed from static position behind a line and jumping as far as possible by swinging arms foreword. Subjects performed two jumps and the best result (cm) was recorded.
- **Sit Ups Test.** From lying on the floor with knees bent, feet flat on the floor and arms folded across the chest, subjects were asked to rise to the 90^0 degree position and return to the floor. The number of executions in 30 seconds was registered.
- **10x5m shuttle test**. The subject runs to the opposite marker at 5-m distance from starting line, turns and returns to the starting line. This is repeated five times without stopping (covering 50 m in total). The total time in seconds is recorded.
- **Flamingo Test**. The subjects completed the test on the dominant foot; the test included a wood beam stabilized by two supports at each end. From standing on one leg on the beam with shoes removed, the free leg is flexed at the knee and the foot of this leg held close to the buttocks. The number of falls in 60 seconds of balancing is counted. In case of more than 15 falls in the first 30 seconds, the test is finished and score is zero.
- **Overhead Medicine Ball Throw**. The ball is brought back behind the head, and then thrown vigorously forward as far as possible. The subject is permitted to step forward over the line after the ball is released, and is in fact encouraged to do so, thus maximizing the distance of the throw. Three attempts are allowed and the best result is recorded.

For data evaluation, descriptive statistics including the mean (*X*) and standard deviation (SD) were calculated. Differences of means were analysed with

Anova and multiple comparisons with Bonferoni using the SPSS version 17.0 for Windows. The differences were considered significant if *p* value was less than 0.05.

Results

Anthropometric characteristics of the male participants are presented in Table I. Groups were divided by ages of subjects (group 1 = 11 years old; group 2 = 12 years old; group 3 = 13 years old).
We observed that results are similar between the first two groups for all measurement and higher scores were recorded for the group of the 13 year-olds.

Table I. Anthropometric measurements by age (boys)

	Weight	Height	Arm span	BMI	Waist	Hip
Gr. 1 (N=9)	39.00 ±11.21	1.46 ±0.08	146.33 ±7.50	1.33 ±0.50	71.22 ±8.85	80.55 ±8.00
Gr. 2 (N=43)	41.48 ±9.80	1.49 ±0.08	148.93 ±7.51	1.46 ±0.54	71.53 ±5.54	80.07 ±5.42
Gr. 3 (N=42)	49.44 ±10.91	1.58 ±0.08	159.71 ±9.29	1.74 ±0.58	76.41 ±7.20	83.02 ±7.54
Total (N=94)	44.80 ±11.17	1.52 ±0.09	153.50 ±10.02	1.57 ±0.57	73.68 ±7.04	81.43 ±6.78

Characteristics of girls are presented in Table II. Similar results were found between the first two groups and the third.

Table II. Anthropometric measurements by age (girls)

	Weight	Height	Arm span	BMI	Waist	Hip
Gr. 1 (N=15)	42.26 ±4.59	1.47 ±7.71	146.00 ±10.65	1.66 ±0.72	72.73 ±10.28	82.80 ±10.33
Gr. 2 (N=89)	42.42 ±11.03	1.50 ±0.07	149.62 ±7.37	1.47 ±0.64	73.09 ±8.98	82.25 ±10.53
Gr. 3 (N=54)	50.63 ±10.92	1.57 ±0.06	1.56 ±6.70	1.74 ±0.67	76.68 ±7.44	85.57 ±8.58
Total (N=158)	45.21 ±11.95	1.51 ±2.37	151.77 ±8.33	1.62 ±0.66	74.28 ±8.74	83.44 ±9.95

In Table III we presented the results of physical fitness measurements and observed that in all tests, group 2 (12 years old) obtained the lower performance. Among the girls group (Table IV) we observed that the lower performances were obtained by the first group in standing long jump, balance and medicine ball throw, second group for 10x5 m shuttle run and group 3 in sit-up.

Table III. Physical fitness measurements by age (boys)

	SLJ	Sit-up	10x5m	Flamingo	Ball throw
Gr. 1 (N=9)	1.49 ±0.17	21.89 ±2.89	23.21 ±4.01	14.89 ±3.98	4.35 ±0.86
Gr. 2 (N=43)	1.45 ±0.16	20.14 ±4.34	23.74 ±2.65	16.28 ±6.25	4.06 ±0.66
Gr. 3 (N=42)	1.61 ±0.24	21.57 ±3.31	21.13 ±2.31	15.69 ±6.30	5.40 ±0.90
Total (N=94)	1.53 ±0.21	20.95 ±3.82	22.52 ±2.92	15.88 ±6.06	4.68 ±1.02

Table IV. Physical fitness measurements by age (girls)

	SLJ	Sit-up	10x5m	Flamingo	Ball throw
Gr. 1 (N=15)	1.32 ±0.19	18.07 ±3.41	23.96 ±1.55	17.07 ±7.67	3.87 ±0.99
Gr. 2 (N=89)	1.41 ±0.18	18.30 ±3.59	24.91 ±2.53	13.71 ±7.79	4.10 ±0.70
Gr. 3 (N=54)	1.45 ±0.88	16.85 ±3.98	21.88 ±1.94	15.50 ±7.96	4.43 ±0.93
Total (N=158)	1.42 ±0.19	17.78 ±3.75	23.78 ±2.66	14.64 ±7.87	4.10 ±0.83

As for differences between genders, boys have proven more strength in the lower and upper limbs, as well as more developed abdominal muscles, and girls have a better balance compared to boys.
Statistical differences were obtained with Bonferoni test for multiple comparisons between groups. In the male group (Table V), significant differences (p<0.05) were obtained between group 2 and 3 for standing long jump, agility test 10x5m and medicine ball throw. The mean difference is also significant between groups 1 and 3.

Table V. Physical fitness measurements by age – Multiple comparisons with Bonferoni (boys)

	SLJ	Sit-up	10x5m	Flamingo	Ball throw
Mean differences (Gr 1 – Gr 2)	0.044	1.749	-0.53	-1.390	0.289
Mean differences (Gr 1 – Gr 3)	-0.118	0.317	2.081	-0.802	-1.050*
Mean differences (Gr 2 – Gr 3)	-0.163*	-1.432	2.61*	0.589	-1.339*

Discussions

These differences are predicted by the puberty period for both genders [9]. Previous studies reported 1.55 cm height and 50 kg weight in 12 years old; 1.53 cm [10] and 47.74 kg in 13 years old [11]; 1.57 m and 48.29 kg for 12.51 years old non-athletes female [12]. The anthropometric characteristics increased with age, as expected for all measurements.
We also observed that the BMI increased for both groups of genders. Our results concur with those reported by Castro-Pinero et al (2010), whereas Caswell et al (2016) suggested a normal weight after two years of experience in American football [13, 14]. Waist and hip circumference showed an increasing trend with age among both girls and boys, similar with the Greek population [15].
This is an expected finding during puberty, as it represents a critical period for the development and distribution of body fat [16]. The effects of physical education during this phase of life are difficult to distinguish from those of normal growth and

development [17]. Sauka et al. (2015) suggested that boys performed better than girls in muscular endurance, lower body muscular strength, upper body muscular strength and speed agility. Research results show that our data are consistent with the scientific literature in the field, for both girls and boys [18, 19, 20]. In a research published in Turkey, for subject aged 12, results were 23.8 times more for boys and 26.3 times more for girls in comparison to the subjects of the same age included in our study [21]. Standing long jump could be considered as a general index for muscular fitness in young subjects [13]. Previous studies reported two characteristics of strength: (1) a significant association between lower body muscular strength and upper body muscular strength [13], and (2) young adults performed best and children performed worst [22].

Sekeljig's study (2016) showed balance as the ability to maintain body equilibrium during different movements and in different positions.

Our investigation report showed that girls performed better in the Flamingo test. It depends on information, visual analyzers, and kinaesthetic analyzers as well as on the vestibular apparatus [23]. This is the reason why the best, but also the most stable results for this motor skill can be expected only after 12 years of age [24].

Conclusions

The literature indicates that physical fitness is an important health marker starting from young ages. Correct interpretation of physical fitness assessment requires comparing the score with normative values for the general population of the same age and gender.

The results of the present study showed that physical fitness performance was better in male students except from balance, where female students performed better.

Future research needs to examine methods for increasing physical fitness level among pupils and young student and identify cut-points related to health.

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