CARDIORESPIRATORY FITNESS OF SCHOOLCHILDREN IN ELEMENTARY SCHOOLS IN BELGRADE

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ABSTRACT

Cardiorespiratory fitness is one of the most important components of health-related fitness. High cardiorespiratory fitness during childhood and adolescence has been associated with a healthier cardiovascular profile during these years (Mesa et al. 2006 a, b) and later in life (Ruiz et al. 2006a, b). One of the most widely used tests to assess cardio respiratory fitness among children and adolescents is the 20-m shuttle run test (Léger et Lambert, 1982). In the pilot study on the representative sample of schoolchildren of Belgrade (5692 boys and 5358 girls) we examined potential differences in the 20-m shuttle run test between boys and girls, among consecutive grades (from 3rd to 8th grade /9-14 years/). Two-way ANOVA (2x6) were performed (factors: gender and grade). When the significant main effects were found, Bonferroni post-hoc test was performed. The significant main effect of gender ($F_{1,11150}$ = 872.8; p<.01), grade ($F_{5, 11150}$ = 246.0; p<.01), and their interaction ($F_{5, 11150}$ = 26.6; p>.01) was found when the 20-m shuttle run test between boys and girls and among consecutive grades were compared. Post hoc analysis revealed higher run times in boys than in girls within all grades. When differences in the 20-m shuttle run test were observed within boys (between all consecutive grades), while girls stopped achieving better results after grades six. These findings are in line with the number of previous studies were performance on the 20-m shuttle run test improved linearly until the age 12 years in girls, without the reached plateau in boys. Further research relating other physical fitness components to cardio respiratory fitness should be additionally performed to establish more complex picture about the overall Serbian elementary schoolchildren fitness.

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Key words: cardiorespiratory fitness, schoolchildren, elementary school, physical education

INTRODUCTION

Tracking of the health-related physical fitness tests provides a better overall understanding of the stability of various fitnes components over the time. Over the past several decades, health-related physical fitness test batteries have been developed and used in the schools. The usage of fitness testing in physical education classes (Baumgartner, Jackson, Mahar, & Rowe, 2003) has emerged as an important component in efforts to assess and address health concerns related to children's physical inactivity. Research suggests that testing programs increase children's motivation to participate in regular physical activity (Harris and Cale, 2006), and that physical fitness is affected by participation in physical activities, while also playing a significant role in individuals' health in general (Bouchard, Shephard & Stephens, 1994). Cardiorespiratory fitness is one of the most important components of health-related fitness. High cardiorespiratory fitness during childhood and adolescence has been associated with a healthier cardiovascular profile during these years (Mesa et al., 2006 a, b) and later in life (Ruiz et al., 2006a, b). Cardiorespiratory fitness is partly influenced by genetic factors (Bouchard & Rankinen, 2001) and by byregular exercise. One of the tests most widely used to assess cardiorespiratory fitness among children and adolescents is the 20-m shuttle run test (Léger et Lambert, 1982). This test, as a fitness test, has many advantages, such as the possibility to test large number of subjects at the same time which enhances participant motivation, and objectivity, standardization, reliability, validity and availability of reference data. The 20-m shuttle run test has been included in several fitness batteries, such as the EUROFIT (Committee of Experts on Sports Research EUROFIT, 1993), FITNESSGRAM (Cooper Institute for Aerobics Research, 1999), among others.

As a part of a wider National project directed to follow-up student's physical fitness during the elementary school time, the purpose of this pilot study was to examine the potential differences in the 20-m shuttle run test between boys and girls among the consecutive grades (from 3rd to 8th grade /9-14 years/).

METHOD

Sample

The study sample consisted of 11050 schoolchildren (5692 boys and 5358 girls) from 3rd to 8th grade (9-14 years). The sample was selected by means of proportionate stratified random sampling, taking into account the location and the number of students by age and gender in each school. Schools were randomly selected within the each City part until the established number of subjects was attained by each part. The selected schools agreed to participate in the study. The data were collected during 2011. The participants were evaluated during school physical education classes by physical education teachers specially trained for this data collection. The consent was obtained from the participating school boards, and the student participation was voluntary.

Measurement of Cardiorespiratory Fitness

The Maximal multistage 20-m shuttle running test was used to assess cardiorespiratory fitness (Leger et al., 1988). Running pace was determined by audio signals emitted from CD- player, the initial velocity was 8.5 km/h, which was increased by 0.5 km/h per minute (i.e., per stage). Subjects were instructed to run in the straight line, to pivot on completing the shuttle, and to pace themselves in accordance with the audio signals. The test was finished when the subject failed to reach the end lines concurrent with the audio signals on two consecutive occasions. Otherwise, the test was finished when the child stops because of fatigue. This test was done once.

Statistical analysis

Means and standard deviations were calculated for shuttle run times. Two-way ANOVA (2x6) was used to test gender and grade differences on the shuttle run times.

When the significant main effects were found, Bonferroni post-hoc test was performed. The level of statistical significance was set to p<.01. Data were analyzed using SPSS 17.0 software (SPSS Inc. Chicago, IL, USA).

RESULTS

Table 1 represents the means and standard deviations of the shuttle run times based on gender and grade of the participants.

Table 1 Descriptive statistics of shuttle run times (mean ± SD), for boys and girls (from 3rd to 8th grade)

school grade/age	boys	girls
3	180 ± 81	155 ± 61 ¥
4	208 ± 103*	162 ± 72* ¥
5	229 ± 101*	188 ± 84*
6	269 ± 118*	213 ± 87* ¥
7	286 ± 114*	212 ± 95 ¥
8	304 ± 137*	212 ± 96 ¥

*p<0.01 with respect to the previous age group (within the same gender group); ¥p<0.01 between boys and girls (within the same age group);

The significant main effect of gender (F1,11150 = 872.8; p< .01), grade (F5, 11150 = 246.0; p< .01), and their interaction (F5, 11150 = 26.6; p< .01) was found when the 20-m shuttle run test between boys and girls and among consecutive grades were compared. Post-hoc analysis revealed higher run times within boys than within girls group within all grades. In addition, the differences in the 20-m shuttle run test were observed within boys, between all consecutive grades, while the girls stopped achieving better results after 6th grade (Table 1).

DISCUSSION

The aim of this research was to examine the potential differences in the 20-m shuttle run test between boys and girls, among consecutive grades (from 3rd to 8th grade /9-14 years/). The results revealed higher run times within boys than within girls, within all grades. The analysis of 109 studies from 37 countries revealed that boys easily outperformed girls. The differences were significant in every age group (Olds et al., 2006). The results presented in the current studies, obtained on the representative sample, are in line with the results of Olds and coworkers (Olds et al., 2006). Because differences between the sexes are consistent across a wide range of countries with different social, political, and economic systems, these differences are probably biological rather than social in their origin (Olds et al., 2006).

Regarding the particular trends across the age, the results of this research indicated that differences in the 20-m shuttle run test were observed within boys (between all consecutive grades), while girls stopped achieving better results after 6th grade. These findings are in line with the number of previous studies where performance on the 20-m shuttle run test improved linearly until the age 12 years in girls, without the reached plateau in boys. This is in line with results of Olds and coworkers, which indicates that performance on the 20-m SRT improves linearly until the early post-pubertal years (about age 12 years in girls and 16 years in boys) and then plateaus. The results reported for girls could be potentially explained by the reduced physical activity within the observed age of children in Serbia, particularly within girls (Radisavljević, Janić et al., 2012). Higher levels of physical activity within boys than within girls (Caspersen et al., 2000 Telama & Yang, 2000; Riddoch et al., 2004), and also generally slightly lower percentage of girls involved in sports activities then boys in the early post-pubertal years (Klomsten et al., 2005, Milanovic & Radisavljević Janic, 2011) could possibly be one of the reasons for the results on the test for cardiorespiratory fitness at this age.

CONCLUSION

In the conclusion, the present study indicated that the differences in the 20-m shuttle run test were observed within boys (between all consecutive grades), while girls stopped achieving better results after 6th grade.

To establish a more complex picture of the overall Serbian elementary schoolchildren fitness, further research relating other physical fitness components to cardiorespiratory fitness should be performed additionally.

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