Original Article

Self-assessment of physical fitness in adolescents

LUKÁŠ RUBÍN[1] , ALEŠ SUCHOMEL[2], ROMAN CUBEREK[1], LADA DUŠKOVÁ[1], MARCELA TLÁSKALOVÁ[1]

[1] *Institute of Active Lifestyle, Palacký University Olomouc, Czech Republic*

[2] *Department of Physical Education, Technical University of Liberec, Czech Republic*

ABSTRACT

Background: Physical fitness is an important indicator of the current and future health condition in adolescents. In comparison with institutional testing, self-assessment of physical fitness offers a number of benefits, including minimization or elimination of possible negative experience with inter-individual comparison in the context of motor diagnostics. The main objective of this paper is to determine the distribution normality of the resulting data and the intersexual differences in self-assessment of physical fitness using selected test items of the INDARES battery in adolescents. Methods: The study involved a total of 626 adolescents (345 boys and 281 girls) aged 11 to 19 years (14.56 ± 1.95 years) from selected cities in the Czech Republic. The participants performed self-testing of physical fitness by means of selected motor tests (push-ups, modified curl-ups, V-sit and reach and shoulder stretch) from the INDARES test battery. The Shapiro-Wilk test was used to determine the distribution normality of the self-testing data; the Mann-Whitney U test was used to compare the significance of inter-sexual differences in the average self-testing results. Results: The results showed normal data distribution in most motor tests except the push-up motor test (in boys older than 15 years normality was confirmed). The analysis confirmed the published findings concerning significantly better outcomes of flexibility in girls compared with boys. Conclusion: The present study suggests that the results of self-testing roughly correspond with the published findings based on institutional physical fitness assessment. **Key words:** PHYSICAL FITNESS, ADOLESCENT, MUSCLE STRENGTH, FLEXIBILITY

Cite this article as:
Rubín, L., Suchomel, A., Cuberek, R., Dušková, L., & Tláskalová, M. (2017). Self-assessment of physical fitness in adolescents. *Journal of Human Sport and Exercise, 12*(1), 219-235. doi:10.14198/jhse.2017.121.18

Corresponding author. *Faculty of Physical Culture, Palacký University, třída Míru 117, 771 11 Olomouc, Czech Republic*.
E-mail: lukas.rubin@upol.cz
Submitted for publication July 2016
Accepted for publication May 2017
JOURNAL OF HUMAN SPORT & EXERCISE ISSN 1988-5202

doi:10.14198/jhse.2017.121.18

INTRODUCTION

Physical fitness is a state of the human organism that allows daily activities without inadequate fatigue and with a sufficient reserve for pleasant leisure time (Malina et al., 2004). Being physically fit means to be able to perform daily activities with due vitality. In their study, Zaharia and Raţă (2014) suggest that an increase in the level of physical fitness clearly contributes to better quality of life. A sufficient level of physical fitness reduces health risks associated with hypokinesia and is a prerequisite for participation in physically demanding activities that enrich humans physically and mentally (Blair et al., 2001; Corbin, 2004; Ortega et al., 2008).

Despite all positive facts mentioned above, there is a worldwide negative secular trend in the level of physical fitness (e.g. Ekblom et al., 2007; Craig et al., 2012). This applies not only to adults but also children and youth (Tomkinson et al., 2003; Tomkinson and Olds, 2007). A physically unfit adolescent need not necessarily show a worse health condition, but in the future such individual might be affected by various lifestyle diseases (Froberg, 2014). In addition, individuals in this age group form physical habits for adulthood (Telama, 2009; Biddle et al., 2010). For these reasons, testing of physical fitness should be an integral part of school-based physical education (Whitehead et al., 1990; Silverman et al.; 2008; Cooper Institute, 2010; Prusak III et al., 2013).

From an educational point of view, pupils should be explained significant facts relating to health-oriented fitness, at the same time, its level should be regularly diagnosed (Whitehead et al., 1990; Corbin, 2004). An emphasis should not be placed on the results achieved; after their enrolment in school pupils should become aware why physical fitness is important (especially in relation to health), what its components are, and how they should be tested and analysed. For this purpose, Corbin (2004) suggests teaching self-assessment of physical fitness as the most appropriate technique. The principal idea of self-assessment is that pupils themselves should learn to identify whether they have a sufficient level of physical fitness determining their health. This in turn leads to increased motivation of children to achieve the desired level through individually planned regular physical activity (Whitehead et al., 1990; Cooper Institute, 2010). Even the leading world test batteries such as the FITNESSGRAM are primarily designed for training of self-assessment and monitoring of the personal level of physical fitness (Cooper Institute, 2010).

In terms of achieving educational objectives the best self-assessment tool is self-testing (Corbin, 2004). According to Pangrazi (2001), this is an approach that teaches children to independently test their personal level of physical fitness. Pupils learn to carry out the testing (motor tests and somatic measurements) not only on themselves but also on peers. Through self-assessment, the results are then interpreted. Self-assessment through self-testing is thus one of the significant objectives of education of a physically educated person, being the utmost objective of physical education. That is an individual who understands the benefits of physical activity and physical fitness and knows how to be physically active to increase or maintain physical fitness in life (MacAllister, 2013).

Currently, there are not many studies addressing self-assessment of physical fitness in children and youth. So far, we have not come across any results of adolescent self-testing. From a health perspective, it is important to provide scientific information on this issue. The main objective of this paper is to determine the distribution normality of the resulting data and the intersexual differences in self-assessment of physical fitness using selected test items of the INDARES battery in adolescents. The paper should increase the awareness about the importance of self-assessment of physical fitness in adolescents and present research-based results on a representative sample of adolescents from the Czech Republic.

MATERIALS AND METHODS

Participants

The research included a total of 626 adolescents aged 11 to 19 years (14.56 ± 1.95 years). Of which 345 were boys (14.44 ± 1.91 years) and 281 were girls (14.70 ± 1.97 years). The representative samples consisted of pupils from 14 elementary and secondary schools from Holice, Lanškroun, Lázně Bělohrad, Letohrad, Litomyšl, Olomouc, Polička, Prostějov and Štěpánov nad Svratkou. These municipalities are located in the following regions: Hradec Králové, Olomouc, Pardubice and Vysočina, all in the Czech Republic. The research was approved under reference number 60/2012 on 31. 12. 2012 by the Ethics Committee of the Faculty of Physical Culture, Palacký University in Olomouc (chairperson dr. Štěrbová), which is governed by the ethical standards set out in the World Medical Association Declaration of Helsinki.

Prior to the implementation of the research the participants' parents or the participants themselves (older than 18 years of age) signed a written informed consent. The participants were informed about and consented to the objectives of the study and the test items. They were also informed about a possibility to terminate the testing procedure at any time. A more detailed description of physical parameters of the representative samples is shown in Tables 1 and 2.

Measurements

The participants underwent self-testing of physical fitness as a part of school-based physical education. The tests were adopted from the module "Physical fitness" of the INDARES system (International Database for Research and Educational Support), which is a comprehensive online system aimed at recording, analysis and comparison of physical activity and physical fitness of registered users (INDARES, 2015). The module "Physical Fitness" offers a battery of motor tests, which is designed for self-assessment of physical fitness. The research included a total of four motor tests: push-ups, modified curl-ups, V-sit and reach and shoulder stretch.

T1: Push-ups – testing of muscle strength and endurance of the upper body and upper limbs. For the purposes of self-testing, the test was modified by strict definition of the lower extreme position by a tennis ball or an object without sharp edges of the same size. The probands performed a maximum number of push-ups without interruption. Girls' push-ups were performed with their knees resting on the mat. The result is the number of repetitions. The basic version of the test was verified by Massicote (1990). The version with the knees resting on the mat was verified by Clarke and Clarke (1987), with reliability ranging from 0.83 to 0.97. Plowman and Meredith (2013) reported reliability coefficients among school-aged children ranging from 0.60 to 0.98.

T2: Modified curl-ups – testing of muscle strength in the area of the abdomen and torso. The testing requires a mat and a device with a minute timer. The task of the probands is to perform a maximum number of curl-ups per minute, the upper limbs are stretched all the time and the hands touch the thighs (in the extreme position the fingers touch the highest point of the knees). The result is the number of repetitions per minute. A synthesis of findings relating to the test reliability was published by Plowman and Meredith (2013). The identified reliability coefficients among school-aged children ranged from 0.64 to 0.94 and increased with their age.

T3: V-sit and reach – testing of joint mobility in the area of the lower back and hamstrings. The results of the test are measured using a measuring tape. The probands attempt a maximum bend in a sitting position with their legs split (distance between feet is 20 cm), the upper limbs are stretched, the fingers overlap and move

on a measuring tape. The test is repeated twice with a short break. The result is the better of the two attempts with an accuracy of centimetres, the level of the feet is considered 30 cm. In their study, Cuberek et al. (2013) showed that the test was useful for self-assessment of flexibility because it is not demanding in terms of personnel, materials or time, and has high intra-individual reliability (r = 0.98).

T4R and T4L Shoulder stretch – testing of joint mobility of the upper arm, especially in the shoulder joints. No equipment is needed for the test. The probands are in a standing position, move their right arm up and their left arm down and try to touch the tips of their fingers behind the back (T4R). Then the sides are reversed (T4L). The result of the test is either a successful "1" or unsuccessful "0" contact. According to Vanhelst et al. (2014) the test shows high reliability (r = 0.91) in children and youth.

Procedures

The data collection was performed between June 2013 and April 2014 in elementary and secondary schools in physical education lessons. All persons had appropriate sports shoes and clothing. At the beginning of the lesson the pupils were given basic information about the research. For motivation purposes, they were explained the importance of physical fitness in relation to health. The testing was preceded by a joint warm-up lasting 10 minutes. After that the pupils were explained correct execution of the motor tests (including one trial run) and recording of the results into the record sheet. The pupils filled out the headings of the record sheet, including their somatic parameters (body height and body weight). The back side of the record sheet had a brief explanation concerning the execution of the test items (see Figure 1).

The actual self-testing was carried out in a circular exercise as a supplement to regular PE activities. Each test item was carried out in a specific station. The pupils moved from one station to another in a recommended order. The pupils were instructed to perform testing in each station independently and conscientiously.

Statistical Analysis

For statistical data processing we used descriptive statistics: arithmetic mean (x) and standard deviation (s) for the description of the representative samples and the results of self-testing. The normal distribution of data from self-testing in the motor tests of press-ups, sit-ups and V-bend was verified by means of the Shapiro-Wilk normality test, which is according to a study by Razali and Wah (2011) the most powerful normality test. The difference in motor performance between boys and girls was assessed by means of the Mann-Whitney U nonparametric test. The representativeness was verified for standard use at a level of significance of 1 %. The statistical analysis was performed using the software STATISTICA, version 12 (StatSoft Inc., Tulsa, OK, USA).

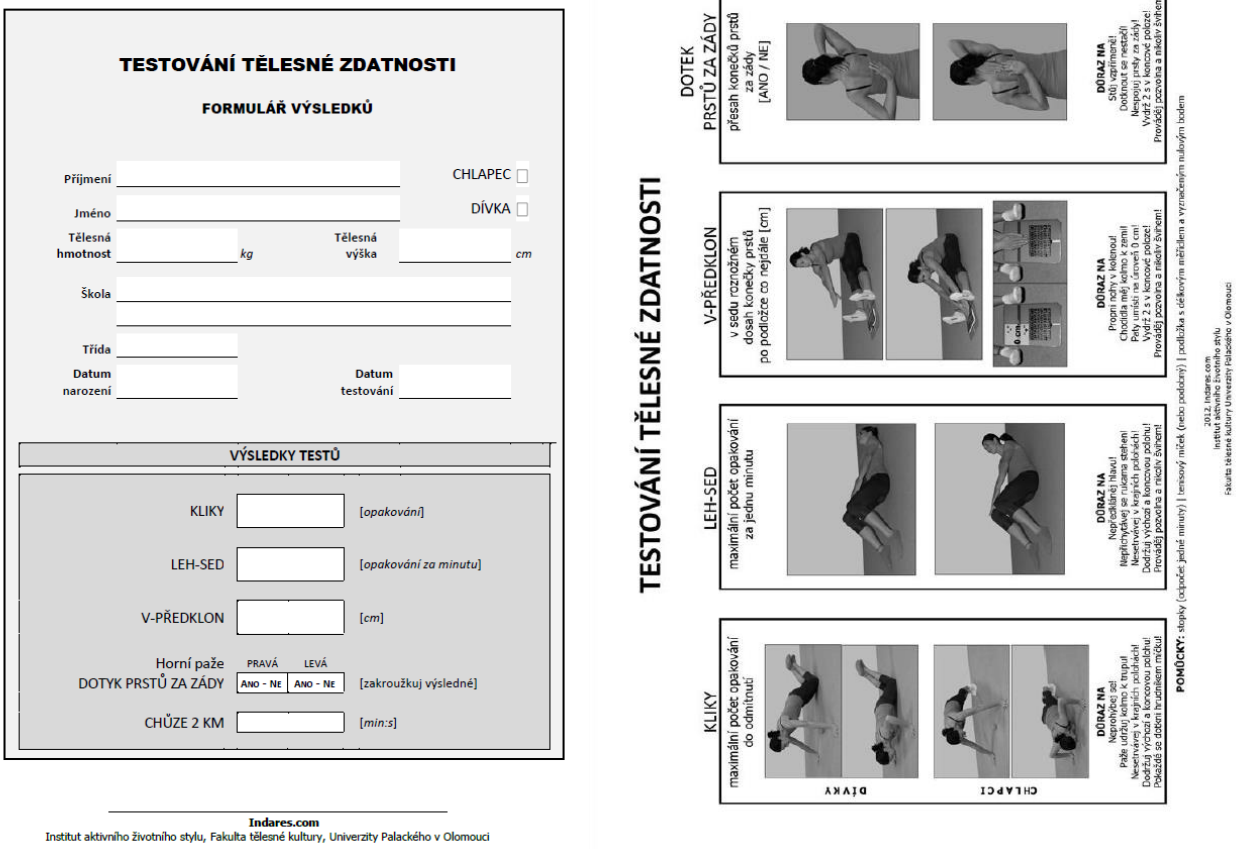

Figure 1. Record sheet – front and back page.

RESULTS

Somatic characteristics (body weight, body height and BMI) of the representative samples are described in Tables 1 and 2.

Motor characteristics of the representative samples are described in Tables 3 and 4.

The Mann-Whitney test confirmed significant intersexual differences between the average results. Girls achieved better results in motor tests focused on flexibility: V-sit and reach ($Z = 10.814$; $p < 0.001$), shoulder stretch right ($Z = 2.917$; $p = 0.004$), and shoulder stretch left ($Z = 3.890$; $p < 0.001$). On the other hand, girls achieved poorer results in the motor test focused on strength and endurance of the abdominal muscles: modified curl-ups ($Z = -4.970$; $p < 0.001$). The results of push-ups were not compared because of different execution by boys and girls.

The histograms (figures 2–7) show normal distribution of the self-testing data in both genders classified into groups by two years of age. Because of a smaller number of participants the group of 19-year olds was merged with 17 to 18-year olds.

The Shapiro-Wilk test confirmed normal distribution in the modified curl-up test (except boys' category of 13 to 14 years of age and girls' category of 15 to 16 years of age) and the V-sit and reach (except girls' category of 15 to 16 years of age). For the push-up test, normal distribution of the results was not confirmed except older boys' categories of 15 to 16 and 17 to 19 years of age.

Table 1. Basic somatic characteristics of boys' representative samples.

Age	N	Weight [kg]		Height [cm]		BMI [kg/m^2]	
		Mean	SD	Mean	SD	Mean	SD
11	17	42.29	5.23	153.88	7.99	17.82	1.25
12	68	46.03	10.13	154.81	7.64	19.05	2.83
13	78	50.86	10.24	164.49	8.68	18.70	2.95
14	67	60.09	12.48	172.04	8.27	20.16	3.14
15	44	64.07	10.12	175.43	7.73	20.80	2.95
16	31	69.29	13.16	179.03	7.28	21.51	3.44
17	14	75.36	9.38	180.29	5.60	23.14	2.25
18	17	73.88	10.10	183.35	6.87	22.03	3.19
19	9	76.22	7.47	182.00	7.99	23.10	2.68

Table 2. Basic somatic characteristics of girls' representative samples.

Age	N	Weight [kg]		Height [cm]		BMI [kg/m^2]	
		Mean	SD	Mean	SD	Mean	SD
11	19	46.32	6.75	154.16	6.79	17.71	1.93
12	34	46.71	8.84	157.38	7.21	18.78	2.88
13	55	51.27	9.81	161.60	8.33	19.56	2.82
14	54	53.98	8.62	164.81	6.82	19.88	3.00
15	58	56.98	6.85	164.98	6.26	21.01	2.89
16	25	60.60	7.76	169.00	5.28	21.20	2.44
17	11	57.91	7.70	166.09	4.27	21.09	3.49
18	15	59.60	5.55	168.20	4.42	21.04	1.51
19	10	57.70	5.33	165.80	6.49	20.99	1.53

Table 3. Results of self-testing of boys' representative samples.

Age	N	T1 [reps]		T2 [reps]		T3 [cm]		T4R [pass/fail]		T4L [pass/fail]	
		Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD
11	17	17.18	11.39	39.06	7.88	0.18	10.05	0.88	0.32	0.59	0.49
12	68	15.66	27.39	40.94	13.85	-0.15	8.15	0.91	0.28	0.82	0.38
13	78	15.35	10.94	44.69	15.64	0.72	7.85	0.91	0.29	0.76	0.43
14	67	18.49	12.29	45.07	14.53	2.18	7.59	0.91	0.29	0.76	0.43
15	44	19.18	11.37	47.61	15.58	0.11	10.03	0.84	0.37	0.68	0.47
16	31	20.35	11.94	45.71	12.82	1.35	10.09	0.87	0.34	0.71	0.45
17	14	24.36	12.15	59.21	11.99	1.43	10.24	0.79	0.41	0.57	0.49
18	17	26.59	11.93	58.47	9.58	2.53	6.68	0.82	0.38	0.65	0.48
19	9	28.33	10.30	61.22	14.70	1.44	12.02	0.78	0.42	0.67	0.47

T1 = Push-ups; T2 = Modified curl-ups; T3 = V-sit and reach; T4R = Shoulder stretch right; T4L = Shoulder stretch left

Table 4. Results of self-testing of girls' representative samples.

Age	N	T1 [reps]		T2 [reps]		T3 [cm]		T4R [pass/fail]		T4L [pass/fail]	
		Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD
11	19	26.74	14.34	41.84	11.18	13.42	6.39	0.95	0.22	0.79	0.41
12	34	17.88	10.53	39.38	11.71	7.62	8.50	0.97	0.17	0.82	0.38
13	55	20.85	12.10	38.20	12.49	7.96	7.54	0.96	0.19	0.89	0.31
14	54	17.91	10.56	40.20	13.57	7.46	9.93	0.94	0.23	0.87	0.34
15	58	20.46	13.04	37.62	12.76	7.95	8.63	0.93	0.25	0.83	0.38
16	25	16.64	7.69	35.40	12.07	9.68	7.01	0.96	0.20	0.88	0.32
17	11	19.80	16.58	51.91	13.56	12.09	7.76	1.00	0.00	1.00	0.00
18	15	12.40	6.39	53.20	12.80	13.00	7.23	1.00	0.00	0.93	0.25
19	10	14.10	12.70	45.60	11.54	11.50	7.77	0.80	0.40	0.80	0.40

T1 = Push-ups; T2 = Modified curl-ups; T3 = V-sit and reach; T4R = Shoulder stretch right; T4L = Shoulder stretch left

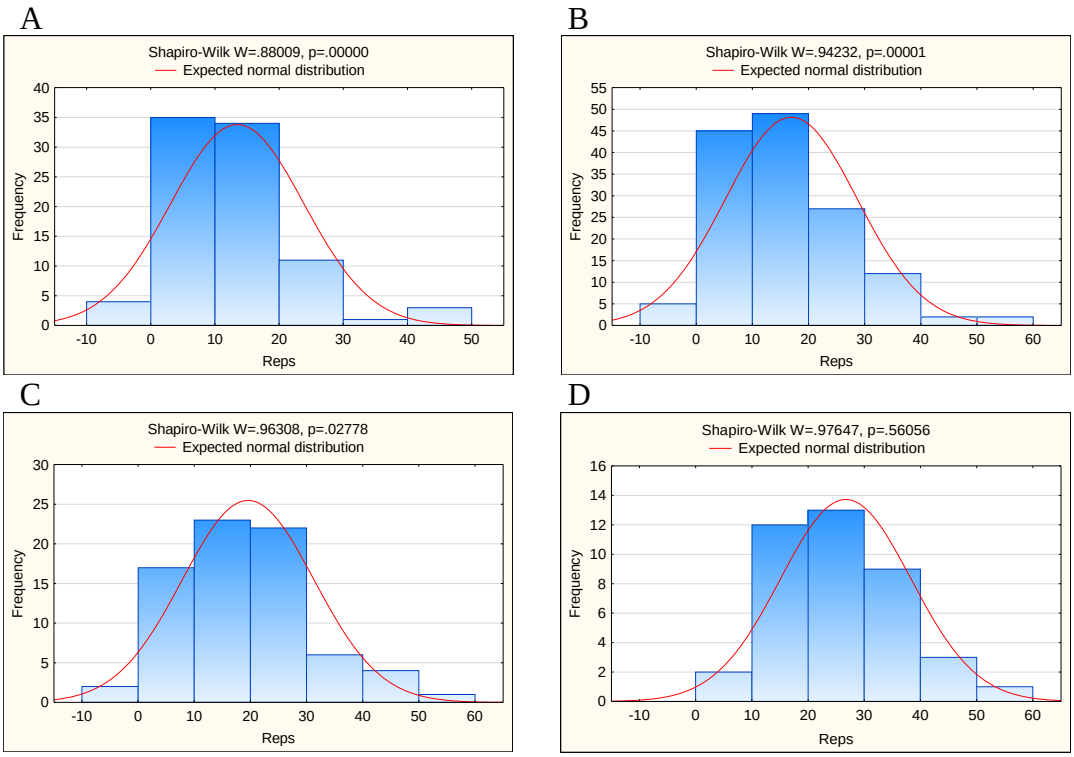

Figure 2. Distribution of results of push-up motor test in boys.
A: 11–12 years; B: 13–14 years; C: 15–16 years; D: 17–19 years

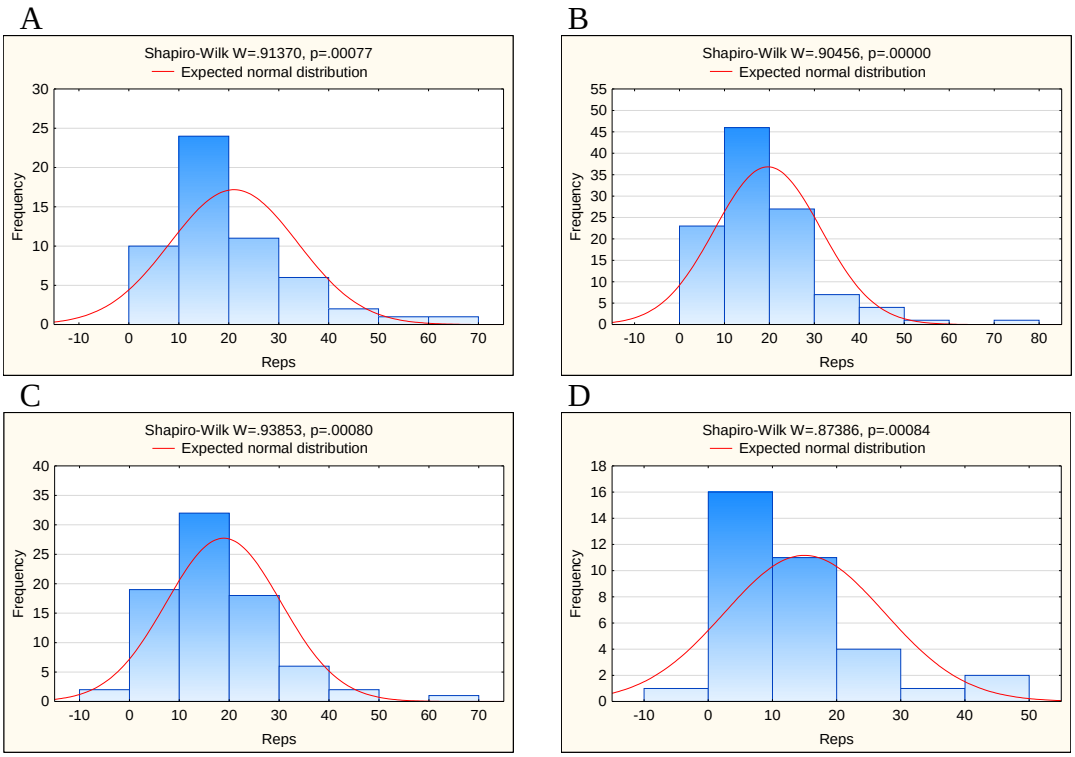

Figure 3. Distribution of results of push-up motor test in girls.
A: 11–12 years; B: 13–14 years; C: 15–16 years; D: 17–19 years

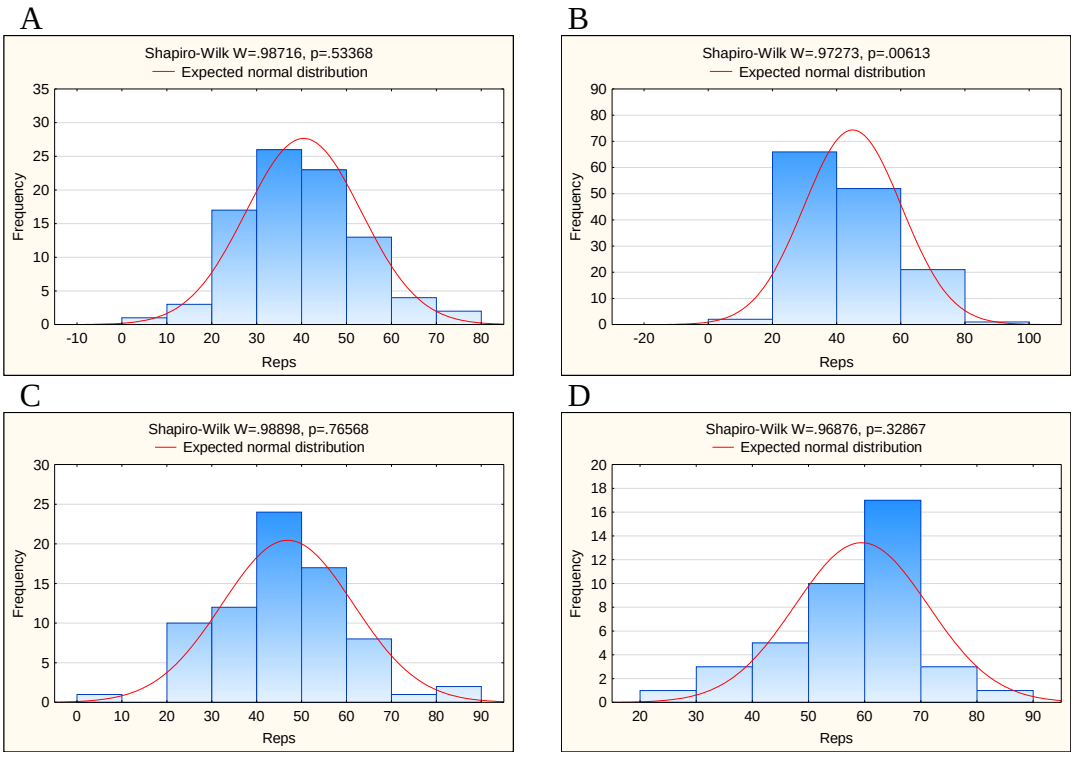

Figure 4. Distribution of results of modified curl-up motor test in boys. A: 11–12 years; B: 13–14 years; C: 15–16 years; D: 17–19 years

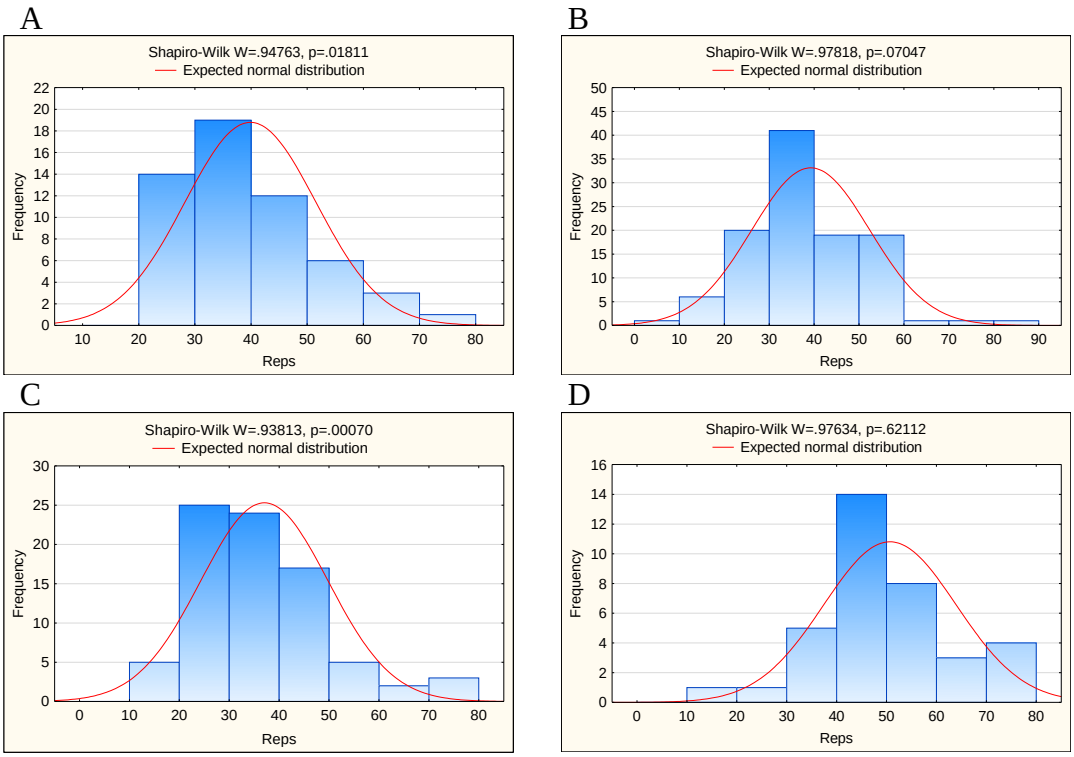

Figure 5. Distribution of results of modified curl-up motor test in girls.
A: 11–12 years; B: 13–14 years; C: 15–16 years; D: 17–19 years

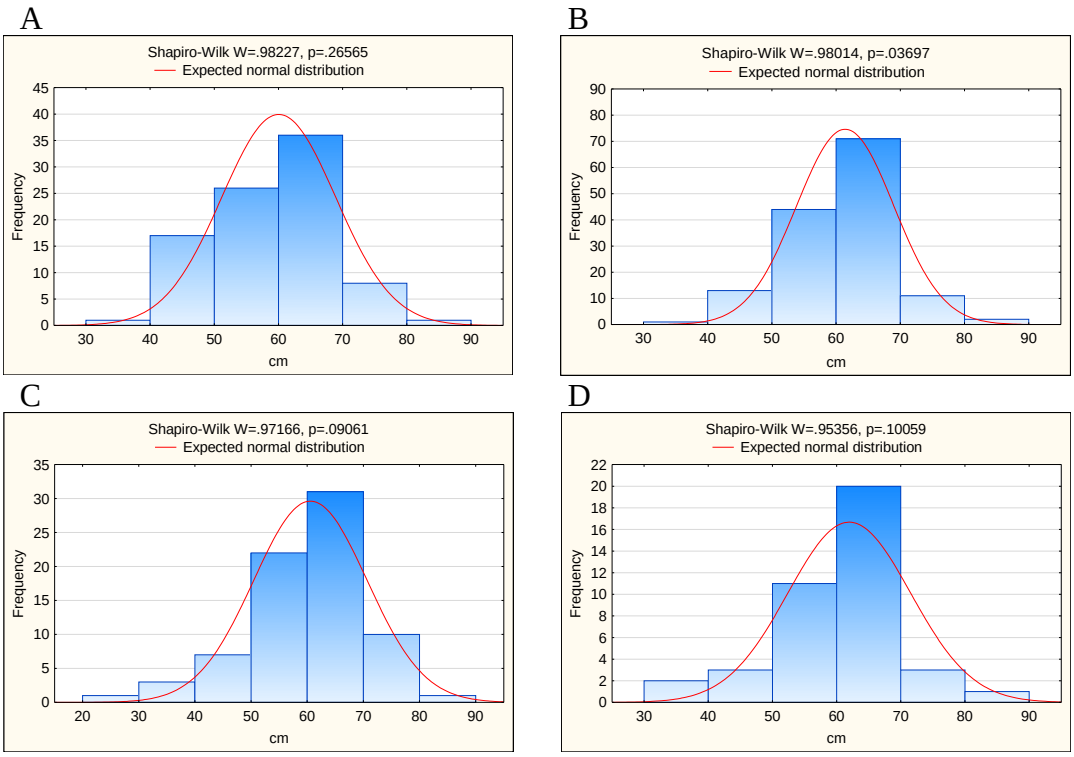

Figure 6. Distribution of results of V-sit and reach motor test in boys.
A: 11–12 years; B: 13–14 years; C: 15–16 years; D: 17–19 years

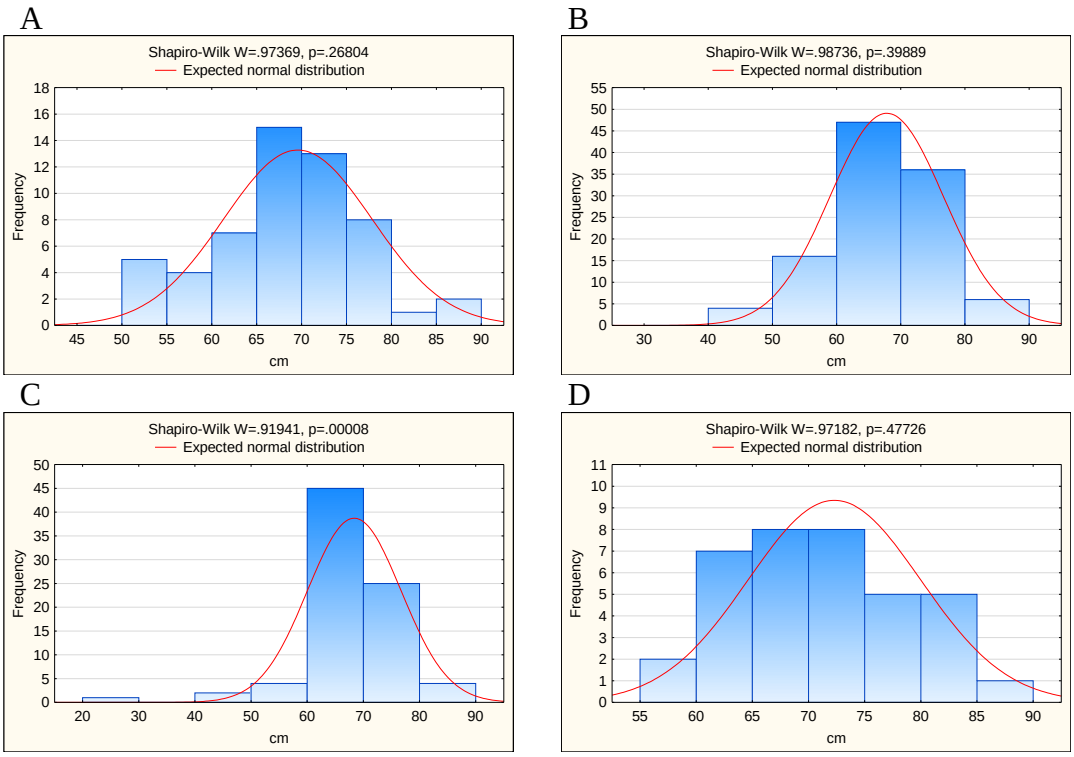

Figure 7. Distribution of results of V-sit and reach motor test in girls.
A: 11–12 years; B: 13–14 years; C: 15–16 years; D: 17–19 years

DISCUSSION

A comparison of the average results of somatic characteristics with the Czech national standards confirmed the current trend of moderate increase in the values of body height, body weight and BMI as a result of improving living conditions, while no significant differences were identified between the observed values and the national standards (Vignerová et al., 2006). The results of self-testing of physical fitness confirm existing results in professional literature (e.g. Marta et al., 2012; Rubín et al., 2012) on better flexibility of girls as opposed to boys, who in turn achieve better performance in the modified curl-up motor test. The results of the push-up test were not compared due to the different execution between girls and boys.

The biggest advantage of self-testing is that once pupils are able to successfully assess their level of physical fitness, they can repeat the testing procedure throughout life for regular assessment of their level of physical fitness. Other advantages include: minimization or elimination of negative experience with traditional institutional testing such as competitiveness of comparison, i.e. potentially unpleasant situations for physically unfit individuals; opportunities for mutual learning - pupils can work individually or in pairs; more significant role of the pupil in the process of education; understanding the significance of the physical fitness concept; opportunities for self-knowledge; learning in order to develop personal objectives in physical fitness or learning to integrate the knowledge from other subjects (Morgan et al., 2004; Huotari et al., 2009).

Additionally, the findings from questionnaires and follow-up interviews aimed at school-aged children revealed that children enjoyed the self-testing format, understood the purpose of fitness self-testing, and connected their results to their overall health lending support to the use of a fitness self-testing approach in PE (Graser et al., 2011).

On the other hand, to learn effective self-testing takes a lot of practice time. A significant issue of self-testing is decreased reliability of the results, especially for the initial attempts (Cooper Institute, 2010). However, the primary focus of the personalized self-testing approach is not the accuracy of testing or achieving excellent results; a much more important aspect is to develop a positive educational atmosphere based on children's needs and their motivation for physical activity in the future (Corbin, 2004). Welk and Wood (2000, 37) add the following: "*Rather than worrying about the precision of the evaluation, it is more important to ensure that children learn something in the process*".

The reliability of self-testing results may be affected by age. In their study aimed at a comparison of self-assessment and traditional assessment of aerobic fitness (specifically the YMCA 3-minute Step Test), Liguori and Mozumdar (2009) showed that self-assessment in the age group of university students was just as reliable as directly supervised assessment (Kolmogorov-Smirnov Z values 0.84 in males and 0.94 in females). This was also confirmed in a study by Knapik et al. (1992), in which US soldiers (aged 36 to 51 years) were able to give a reasonable estimate of aerobic capacity, muscle strength, and some types of flexibility by means of self-assessment. However, Schuler and Marzilli (2003) found that self-assessments of specific fitness components in older adults were not nearly as reliable. There appears to be an age related influence on the reliability of self-report or self-assessment of fitness variables, however, no data to our knowledge exists relative to school-children.

A limitation of the research study is the fact that the data on body height and body weight are subjectively reported by children. However, in their meta-analytical study, Knai et al. (2012) demonstrated a relatively high level of dependence expressed by a correlation coefficient of r = 0.70 between respondent-reported body weight and height and measured body weight and height. Another limitation of the study is the aspect of self-testing, which has lower values in terms of validity/reliability, according to the theory especially during the initial testing attempts (Cooper Institute, 2010). Some studies even analyse only subjective questionnaires for the assessment of physical fitness, yet they report relatively good correlations. For example, in the Self-Reported Fitness Survey (Keith et al., 2015), validity ranged from r = 0.40 to 0.77, or the test-retest reliability of the International Fitness Scale (Sánchez-López et al., 2015) was good with average weighted Kappa = 0.70. A strength of the study is the relatively large sample (n = 626) from 9 cities in various regions of the Czech Republic.

CONCLUSIONS

Effective assessment of physical fitness should ensure a need to be physically active throughout life; therefore, it should be included in the school-based PE curriculum. From the perspective of lifelong motivation and understanding the general concept of health-oriented fitness, the best way of performing self-testing of physical fitness with subsequent results interpretation is self-assessment, which leads to setting the objectives of the development of own physical fitness. This approach in pupils is based on a positive atmosphere and minimizes or eliminates negative experience with traditional institutional testing. For children and youth the initial objective is not to emphasise precise (valid and reliable) testing of physical fitness. Despite this fact, the present study suggests that the results of self-testing roughly correspond with normal data distribution (except the press-up motor test) and confirm the published findings, e.g. on better flexibility

in girls. Future research should verify an identical sample for agreement between self-testing results and institutional testing results.

ACKNOWLEDGMENTS

This paper was supported by the research grant of Czech Science Foundation (No. 13-32935S) "The objectification of comprehensive monitoring of school mental and physical strain in adolescents in the context of physical and mental condition" and by the research grant of Palacký University Olomouc, Internal university grant (No. FTK_2013_014) "Assessment of physical fitness in physical education: Suggestion and evaluation of a diagnostic lesson".

REFERENCES

1. Biddle, S.J.H., Pearson, N., Ross, G.M., Braithwaite, R. (2010). Tracking of sedentary behaviours of young people: A systematic review. *Prev Med.*, *51*(5), 345-351.
2. Blair, S.N., Cheng, Y., Holder, J.S. (2001). Is physical activity or physical fitness more important in defining health benefits? *Med Sci Sport Exer.*, 33 (suppl 6), S379-S399.
3. Clarke, H.H., Clarke, D.H. (1987). *Application of measurement to physical education*. 6th ed. Englewood Cliffs, NJ: Prentice Hall.
4. Craig, C.L., Shields, M., Leblanc, A.G., Tremblay, M.S. (2012). Trends in aerobic fitness among Canadians, 1981 to 2007–2009. *Applied Physiology, Nutrition, and Metabolism.*, 37(3), 511-519.
5. Cooper Institute. (2010). *Fitnessgram & Activitygram test administration manual*. Champaign, IL: Human Kinetics.
6. Corbin, C.B. (2004). What every physical educator should know about teaching physical activity and fitness. *Teaching Elementary Physical Education.*,15(1), 7-9.
7. Cuberek, R., Machová, I., Lipenská, M. (2013). Realiability of V sit-and-reach test used for flexibility self-assessment in females. *Acta Universitatis Palackianae Olomucensis. Gymnica,* 43(1), 35-39.
8. Ekblom, B., Engström, L.M., Ekblom, Ö. (2007). Secular trends of physical fitness in Swedish adults. *Scand J Med Sci Spor.*, 17(3), 267-273.
9. Froberg, K. (2014). Relations between physical activity, fitness, muscle strength and health: Findings from the European youth hearth study (EYHS). *Education. Physical Training. Sport,* 2, 10-20.
10. Graser, S.V., Sampson, B.B., Pennington, T.R., Prusak, K.A. (2011). Children's perceptions of fitness self-testing, the purpose of fitness testing, and personal health. *Physical Educator,* 68(4), 175-187.
11. Huotari, P., Sääkslahti, A., Watt, A. (2009). Associations between the self-estimated and actual physical fitness scores of Finnish grade 6 students. *Facta Universitatis, Series: Physical Education and Sport.*, 7(1), 27-36.
12. INDARES. (2015). *International Database for Research and Educational Support*. INDARES Web site. http://www.indares.com/public/default.asp. Accessed November 11.
13. Keith, N.R., Clark, D.O., Stump, T.E., Callahan, C.M. (2015). Validity of self-reported fitness across black and white race, gender, and health literacy subgroups. *Am J Health Promot.*, 29(4), 266-272.
14. Knai, C., Lobstein, T., Darmon, N., Rutter, H., McKee, M. (2012). Socioeconomic patterning of childhood overweight status in Europe. *International Journal of Environmental Research and Public Health,* 9(4), 1472-1489.
15. Knapik, J.J., Jones, B.H., Reynolds, K.L., Staab, J.S. (1992). Validity of self-assessed physical fitness. A*m J Prev Med.*, 8(6), 367-372.

16. Liguori, G., Mozumdar, A. (2009). Reliability of self assessments for a cardiovascular fitness assessment. *International Journal of Fitness,* 5(1):33-40.
17. MacAllister, J. (2013). The 'Physically Educated' Person: Physical education in the philosophy of Reid, Peters and Aristotle. *Educational Philosophy and Theory,* 45(9), 908-920.
18. Malina, R.M., Bouchard, C., Bar-Or, O. (2004). *Growth, maturation and physical activity*. Champaign, IL: Human Kinetics.
19. Marta, C.M., Marinho, D.A., Barbosa, T.M., Izquierdo, M., Marques, M.C. (2012). Physical fitness differences between prepubescent boys and girls. *J Strength Cond Res.*, 26(7), 1756-1766.
20. Massicote, D. (2012). *Partial curl-ups, push-ups, and multistage 20 meter shuttle run, national norms for 6 to 17 year old*. 1st ed. Montreal, Quebec: University of Quebec, CAHPER.
21. Morgan, C.F., Beighle, A., Pangrazi, R.P., Pangrazi, D. (2004). Using Self-Assessment for Personal Fitness Evaluation. *Teaching Elementary Physical Education,* 15(1), 19-22.
22. Ortega, F.B., Ruiz, J.R., Castillo, M.J., Sjöström, M. (2008). Physical fitness in childhood and adolescence: a powerful marker of health. *Int J Obesity,* 32(1), 1-11.
23. Pangrazi, R.P. (2001). *Dynamic physical education for elementary school children*. Boston, MA: Allyn and Bacon.
24. Plowman, S.A., Meredith, M.D. (Eds.). (2013). *Fitnessgram/Activitygram Reference Guide* (4th Edition). Dallas, TX: The Cooper Institute.
25. Prusak III, J.E., Whitehead, J.R., Brinkert, R.H., Eklund, R. (2013). The effects of fitness testing on social physique anxiety and physical self-perceptions. *Pamukkale Journal of Sport Sciences,* 4(2), 146-157.
26. Razali, N.M., Wah, Y.B. (2011). Power comparisons of Shapiro-Wilk, Kolmogorov-Smirnov, Lilliefors and Anserson-Darling tests. *Journal of Statistical Modeling and Analytics,* 2(1), 21-33.
27. Rubín, L., Suchomel, A., Kupr, J. (2012). The relationship between somatic parameters and motor performance in children aged 10–12 years. *Česká kinantropologie,* 16(2), 106-118. [In Czech, English abstract]
28. Sánchez-López, M., Martínez-Vizcaíno, V., García-Hermoso, A., Jiménez-Pavón, D., Ortega, F.B. (2015). Construct validity and test-retest reliability of the International Fitness Scale (IFIS) in Spanish children aged 9-12 years. *Scand J Med Sci Spor.*, 25(4), 543-551.
29. Schuler, P.B., Marzilli, T.S. (2003). Use of self-reports of physical fitness as substitutes for performance-based measures of physical fitness in older adults. *Percept Motor Skill.*, 96(2), 414-420.
30. Silverman, S., Keating, X.D., Phillips, S.R. (2008). A Lasting Impression: A pedagogical Perspective on Youth fitness Testing. *Measurement in Physical Education and Exercise Science.*, 12(3), 146-166.
31. Telama, R. (2009). Tracking of Physical Activity from Childhood to Adulthood: A Review. *Obesity Facts,* 2(3), 187-195.
32. Tomkinson, G.R., Léger, L.A., Olds, T.S., Cazorla, G. (2003). Secular trends in the performance of children and adolescents (1980–2000). *Sports Medicine,* 33(4), 285-300.
33. Tomkinson, G.R., Olds, T.S. (2007). Secular changes in pediatric aerobic fitness test performance: The global picture. *Medicine and Sport Science,* 50, 46-66.
34. Vanhelst, J., Béghin, L., Fardy, P.S., Ulmer, Z., Czaplicki, G. (2014). Reliability of health-related physical fitness tests in adolescents: the MOVE Program. *Clinical Physiology and Functional Imaging,* 36(2), 106-111.
35. Vignerová, J., Riedlová, J., Bláha, P., Kobzová, J., Krejčovský, L., Brabec, M., Hrušková, M. (2006). *6th Nation-wide Anthropological Survey of Children and Adolescents 2001 Czech Republic*. Praha: Univerzita Karlova v Praze a Státní zdravotní ústav.

36. Welk, G.J., Wood, K. (2000). Physical activity assessments in physical education: A practical review of instruments and their use in the curriculum. *Journal of Physical Education, Recreation, and Dance,* 71(1), 30-40.
37. Whitehead, J.R., Pemberton, C.L., Corbin, C.B. (1990). Perspectives on the physical fitness testing of children: The case for a realistic educational approach. *Pediatr Exerc Sci.*, 2(2), 111-123.
38. Zaharia, A.M., Raţă, G. (2014). Increasig the quality of life in female adolescents by improving their physical fitness. *Science, Movement and Health, 14*(2), 211-216.