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METRIC CHARACTERISTICS OF THE STATIC BALANCE TEST BY HIGH SCHOOL STUDENTS

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Original research:

Abstract

The aim of this research to test the metric characteristics reliability and sensitivity of a modified flamingo test for balance evaluating. High school students from Konjic were included in this research. The total number of participants is 301. The participants were divided into six sub-samples according to the gender, namely: first (male students N = 60 and female student N = 62), second (male students N = 38 and female students N = 47) and third grade (male students N = 49 and female students N = 45). The test sensitivity was estimated by the shape of distribution (Skewness and Kurtosis) and the normality of distribution (Kolmogorov-Smirnov tests), but the test reliability was estimated by the interclass correlation coefficient (ICC) and Cronbach alpha (Crα). The results obtained for the sensitivity show that the asymmetry measures move in all particles within (+/- 1), deviations were found for second-grade students. The results form a platykurtic curve in all sub-samples. By using the Kolmogorov-Smirnov test was found, that the results in the particles did not deviate statistically significant from the normal distribution. Good reliability was found for male sub-samples (Crα = 0.87), the interclass correlation coefficient was the same as Cronbach alpha and inter-item correlation was between (r=0.76) and (r=0.78). The lower coefficient was estimated for female sub-samples, between (Crα=0.78) and (Crα=0.86) and inter-item correlation was between (r=0.64) and (r=0.76). The obtained results show that the test can be used to evaluate the balance for high school students of both genders and that in addition to confirmed metric characteristics of sensitivity and reliability, the test is characterized by economizing, which enables faster assessment of the balance.

Keywords: modified flamingo test, reliability and sensitivity

Introduction

Physical and health education teachers are obliged to periodically monitor the development of motor abilities. According to Hadžikadunić (2004), testing is made at the beginning and the end of the school year. Educators use different motor ability test batteries to monitor the development of motor abilities (Neljak, et al. 2011; Boes.et, al, 2009; Council of Europe Committee on Development of Sport, 1993; Cooper Institute, 2009). By analyzing different motor ability test batteries (EURO FIT,1993; CPAFLA, 2004; FITNESGRAM, 2009; ALPHA FIT, 2009; CRO FIT, 2011), that in some batteries, there are no tests for the balance, and more attention is paid to functional and other motor abilities. Euro fit testing battery use some European Union countries, our country, and some neighboring countries, (Council of Europe Committee for Development of Sport, 1993). The Euro fit test battery is set of nine tests and covers flexibility, speed, endurance, strength, and balance. The flamingo test is a part of Euro fit test battery and assesses balance, strength of the leg, pelvic, and trunk muscle (Committee for Development of Sport, 1993). However, it is important to emphasize that when conducting testing in the educational process, the flamingo test lasts longer than others, so data collection is slower. According to (Hadžikadunic, 2000) the test should be performed three times, however, but most educators perform the test twice. According to my experience so far, I have conducted the flamingo test twice and some researches show that it is most difficult to have motivated test subjects in school, especially when the test is repeated several times (Fetz & Kornexl, 1993). Such a procedure requires the modification of the test in two parts: to shorten the duration of the test and, instead of counting how many students lost their balance, to estimate the balancing time. Confirming the metric characteristics of a modified flamingo test would result, that the test can be used in physical and health education, and enables faster data collection.

Methods

Sample of participants

High school students from Konjic were included in this research. The total number of participants is 301. The participants were divided into six sub-samples according to the gender, namely: first (male students,

N = 60 and female student, N = 62), second (male students, N = 38 and female students, N = 47) and third grade (male students N = 49 and female students, N = 45). Students regularly attend physical education classes and have not visible posture deviation.

Procedure

The modified flamingo test was used to assess participants' static balance. The original flamingo test is included in the Eurofit test battery, along with nine other motor tests.

The purpose of the modified test is to balance on one leg on a predefined dimension beam (50 cm long, 4 cm high, and 3 cm wide) for 40 seconds while holding the foot of the other leg.

In the modified flamingo test, the examinee steps on the beam with the preferred leg. The free leg bends backward and is gripped by the back of the foot with the hand on the same side. The examinee may place his or her arm on the examiner's shoulder to take the correct starting position. The test begins, and the stopwatch starts as soon as the participant releases his or her supporting arm from the examiner's shoulder. The examinee is allowed to use his or her free arm to keep his or her balance. The test should be repeated twice.

The test is interrupted, and the stopwatch stops every time when the participant touches the floor with any part of the body or when the gripped leg is released.

The score is the longest balance time, which participant keeps on the beam for 40 seconds.

Statistical analysis

The data was processed by statistical software SPSS v.23. For each particle was calculated: the arithmetic mean, standard deviation, minimal and maximal score. The test of the sensitivity was estimated by the shape of distribution, skewness and kurtosis, and normality of distribution, Kolmogorov-Smirnov test. The test of the reliability was estimated by Cronbach alpha and interclass correlation coefficient.

Results

Looking at the results of the basic descriptive indicators in the flamingo test particles, the participants achieved a better second result in all sub-samples. However, the standard deviation results are extremely high and indicate large deviations of good and bad test results from the arithmetic mean. Observing the minimum and maximum score, all sub-samples have the participants who achieved the maximum results; however, the minimum results are almost the same.

Table 1: Results of the metric characteristic sensitivity

Gender	Class	Items	N	M	SD	MIN	MAX	SKEW	KURT	K_S
Male	1,0	Flamingo_1	60	14,87	11,58	3,09	40,00	0,93	-0,39	,20
		Flamingo_2	60	17,68	13,38	3,05	40,00	0,60	-1,15	,18
	2,0	Flamingo_1	38	12,25	10,95	3,12	40,00	1,57	1,53	,22
		Flamingo_2	38	13,19	10,81	3,19	40,00	1,58	1,79	,19
	3,0	Flamingo_1	49	16,38	13,52	3,18	40,00	0,90	-0,79	,21
		Flamingo_2	49	19,50	13,55	3,53	40,00	0,51	-1,32	,16
Female	1,0	Flamingo_1	62	15,16	11,21	3,24	40,00	1,03	0,10	,14
		Flamingo_2	62	16,89	12,72	3,03	40,00	0,78	-0,74	,15
	2,0	Flamingo_1	47	19,70	15,10	3,07	40,00	0,36	-1,65	,21
		Flamingo_2	47	22,35	15,42	3,43	40,00	0,10	-1,89	,22
	3,0	Flamingo_1	45	20,88	13,94	3,38	40,00	0,31	-1,56	,17
		Flamingo_2	45	21,65	15,23	3,32	40,00	0,15	-1,81	,20

Flamingo_1- first item of flamingo test, Flamingo_2 – second item of flamingo test; N – number of students; M-mean; SD – standard deviation; MIN- minimum; MAX – maximum, SKEW- skewness; KURT- kurtosis and K_S-Kolmogorov-Smirnov test

The sensitivity of the measuring instrument was checked by analyzing the results of the distribution shape and the normality of data distribution. The results show, that the asymmetry measures (skewness) have positive values in all the sub-samples, indicating that a greater number of subjects achieved bad results. Asymmetry coefficients range in the acceptable range from +1 to -1 in almost all sub-samples, except for second grade, male students. However, it is important to emphasize that some authors, (George &Mallery, 2010; Trochim & Donnelly, 2006; Field, 2009; Gravetter & Wallnau, 2014), consider the acceptable coefficient of asymmetry measures ranges from +2 to -2. According to these authors, the asymmetry coefficient in second grade by male students can be also accepted. The measure of roundness (kurtosis) in the sub-samples ranges below 2 what indicates that the data form a platikurtic, flattened curve, tend to disperse.

The Kolmogorov-Smirnov test evaluated the normality of data distribution. The obtained values were not statistically significant at a more stringent significance level ($p < 0.01$) for the sub-sample sizes; therefore, the results have a normal distribution. In some sub-samples, distortion of the distribution normality occurred in the first particle, but in the second repetition, the distribution normalized.

Table 2: Results of the metric characteristic reliability

Gender	Grade		Flamingo_2	Cronbach's Alpha	ICC	CI95%	
M	1,0	Flamingo_1	0,78	0,87	0,87	0,79[a]	0,92[b]
	2,0	Flamingo_1	0,78	0,88	0,88	0,76[a]	0,94[b]
	3,0	Flamingo_1	0,77	0,87	0,87	0,77[a]	0,93[b]
F	1,0	Flamingo_1	0,76	0,86	0,86	0,76[a]	0,91[b]
	2,0	Flamingo_1	0,72	0,84	0,84	0,70[a]	0,91[b]
	3,0	Flamingo_1	0,64	0,78	0,78	0,60[a]	0,88[b]

Flamingo_1- first item of flamingo test, Flamingo_2 – second item of flamingo test; a-lower bound of CI95%, b-higher bound of CI95%; M-males, F- females; ICC – interclass

Reliability was determined by Cronbach alpha coefficients and interclass correlation coefficients (ICC) while completing the analysis was made with the inter-item correlation. According to Field (2017), inter-item correlations should not be less than 0.3. In this case, a high correlation was found between the two particles, and in most of the subsamples is above ($r = 0.7$), an exception was found in the correlation of particles by third grade ($r=0.64$).

The values of the Cronbach alpha coefficient are highest for the second grade, male students ($cr\alpha = 0.88$), while similar values were found for other male sub-samples. By the female students, the highest Cronbach alpha values were found in first grade ($cr\alpha = 0.86$) and the lowest in the third one, female students ($cr\alpha = 0.78$). According to Field (2017), Cronbach alpha values are considered to be good if they exceed over 0.8 when determining the reliability of the questionnaires, while in the ability test, values greater than 0.7 are considered as good. The Interclass coefficients (ICC) values are the same as the Cronbach alpha, while the confidence interval values (CI95%) are above (CI95%> 0.70), an exception was found in the results of third-grade students, where the lower bound is below the acceptable limit. The coefficients found show that the modified flamingo test has good reliability.

Discussion

Checking the metric characteristics of the motor abilities tests is necessary to have practical applicability. This is especially obvious in education, because the groups, who attend classes are heterogeneous in their ability level, which also requires the use of other measuring instruments or modification of those used in the testing of persons involved in the training process. Continuous verification of the metric characteristics of Euro fit battery tests is also recommended by Kemper and van Mechelen (1996).

Equilibrium belongs to the coordination capacity and represents the ability of the whole body, to maintain equilibrium position or to maintain and reestablish it, when the part or whole body is moved in the space (Meinel & Schnabel, 2004). In addition to dividing equilibrium into static and dynamic (Lacy, 2010), equilibrium must be observed through two segments: open and closed eye balance (Sekulić, et.al. 2007). The ability to balance depends on several mechanisms. In the first place, the function of balance depends on the mechanisms of the inner ear (Lacy, 2011), it is easier to maintain the balance with open eyes, what shows that it also depends on visual receptors to correct the position of the body (Sekulic, et.all 2007). In addition to the above mechanisms, the influence of kinesthetic proprioceptors in muscles, joints, and tendons that sends information to the brain in body position and contributes to maintaining balance should not be overlooked (Meinel, et.al, 2004).

The results of the study showed that the modified test had acceptable sensitivity. However, in some other studies (Tsigilis, et.al, 2002; Sarabon, et.al, 2007) the existence of poor test sensitivity has been found. In the Tsigilis (2002) research, the original flamingo test, in a university population, found poor test sensitivity, with extremely high standard deviation values, while the opposite in the Sarabon (2007) research found the test too easy for the school population.

The obtained negative values of the asymmetry measures show poorer results in the sub-samples. The appearance of poorer results in the balance test is certainly compounded by the fact that motor skills are highly variable and can also be significantly affected by fatigue (Schmid & Schieppati, 2005), a low motivation of the student to perform the test, especially when repeating the test (Fetz & Kornexl, 1993). standing on one leg also requires the strength of a knee extender (Mikic, 2000). Some authors (Mohammadi, et.al, 2012) have confirmed that strength training can improve balance. The above facts show an extremely wide range of factors that can affect the performance of the test itself or obtained results.

The analysis of test reliability measures revealed the existence of good reliability in all sub-samples. The Cronbach alpha and interclass correlation coefficients are higher than in the research of other authors (Tsigilis, et.al, 2002; Sarabon, et.al, 2007).

However, it is important to emphasize that the basis of good test reliability is to have a larger number of measurement particles (Herbert et.all, 1998; Emons, et, al, 2007). By this research and by checking the metric reliability characteristic with a minimum number of particles, we tried to determine the justification itself conducting testing in such a way. The results show that the modified two-particle test has acceptable reliability and can be used. According to Eising et al. (2013), two-particle test reliability is possible but the use of the Pearson correlation is not recommended,

while the use of Cronbach alpha and Spearman-Brown procedure is acceptable.

Conclusions

By checking the metric characteristic of reliability and sensitivity on the modified flamingo test, we came to the conclusion that metric characteristics were confirmed and that it can be used when testing the balance in the school population. In many balance abilities tests, the procedure requires that the test should be repeated up to six times (Kurelic et. al, 1975, according to Šose & Rađo, 1998). However, the teaching process, the students' low motivation to repeat the tests, the defined time period in the curriculum for which the test of motor skills should be completed requires the search for better solutions. The obtained results also confirmed that the test satisfies the metric characteristic of the test economic, which will certainly contribute to faster data collection, and due to the shorter duration, the higher motivation of the respondents can be expected as well.

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Submitted: 16.04.2020.
Accepted: 25.05.2020.