METRIC CHARACTERISTICS OF TESTS BEAR WALK FORWARD AND BACKWARD FOR ASSESSING COORDINATION AND SPEED IN 12-14 YEARS-OLD CHILDREN

Zerin Emić[1], Adis Bekrić [2], Benjamin Alić[3], Almir Atiković[1], Muhamed Tabaković[4]
[1] *Faculty of Physical Education and Sport, University of Tuzla, Bosnia and Herzegovina*
[2] *Elementary School Kulin ban Tešanjka, Bosnia and Herzegovina*
[3] *Elementary School Džemal Bijedić Miljanovci, Bosnia and Herzegovina*
[4] *Faculty of Sport and Physical Education, University of Sarajevo, Bosnia and Herzegovina*

Original scientific paper

Abstract
The aim of this pilot study was to determine the metric characteristics of tests in 12-14 Years-Old Children. For the purpose of this study, a sample of 117 boys was measured. The respondents were selected from two schools in the city of Jelah and Tešanj, Bosnia and Herzegovina. The variables were composed of two motor tests of which two test were for assessing coordination and speed. In accordance with the aforementioned findings, the newly constructed tests can be characterized as a reliable and valid measuring instrument for motor skills assessment of 12-14 year-old children. Also, the test is easy to apply and easy to explain. The body evaluates the motor dimensions, defined as the specific frequency of the upper and lower extremities.
Key words: *motor abilities; school children; test; metric characteristics.*

INTRODUCTION

Searching for better, or, more appropriately, more specific diagnosis, there is a necessity for creating new and more specific tests for evaluation of how successful the performance of each activity was. Those tests should help when predicting the latent structure in a certain sport discipline. Motor abilities are responsible for the effectiveness of human movement (Malina, 2004). They are the basis for the development and improvement of certain types of movement and motor skills (Petz, 1992). Motor abilities are one of the main factors that largely define the level of success when performing movement structures (Popeska, Georgiev and Mitevski, 2009). In addition, the level of development of motor abilities is important for a child's overall development, both in the physical sense, but also in the cognitive, emotional and social aspect (Pišot and Planinšec, 2010).
In recent times, motor development tests and so-called health-oriented fitness tests that involve different tasks and can identify a greater or lesser health risk. This test has been excluded for this and other ages of children because it does not require any additional moves through obstructions, jumps, climbs, roll etc.
Coordination is the most complex motor skills it is her research is very demanding. Difficulties in trying to define the very concept coordination, and especially difficulties in trying to determine its latent structure, are mainly the result of disagreements in the operational determination of this area motor skills (Hošek, 1976). Coordination significantly correlates with large by the number of other motor skills that are often limited. Coordination is not determined by just one factor. It consists of a large number of manifestations (Sekulić, 2007). Coordination as a motor ability is certainly one of the indispensable ones must find in each equation and every sport. Coordination can be defined as the ability of the central nervous system to control the locomotive system or its individual parts. Within the same capability, there are also further possibilities so that different types of authors can be found in appearing forms like speed coordination, rhythmic coordination, fast learning of motor tasks, spatial time orientation, timeliness or timing. Defining the coordination structure has started in the 1970s (Hošek, 1976) and has so far had a lot of work on it this topic, but any new knowledge can contribute a lot to one of the most complex ones motor skills. Many researches have been conducted relating to the metric characteristics of motoric and physical tests (Abernethy, Wilson and Logan, 1995.; Begatović, Čuk and Atiković, 2010.; Veličković and Petković, 2005., Delaš-Kalinski, Miletić and Miletić, 2008.; Delaš-Kalinski, Mandić-Jelaska and Atiković, 2011.; Begatović et al., 2012.; Stanišić, 2012.; Hraski, Horvat and Bokor, 2015; Živčić Marković, Krističević and Aleksić Veljković, 2016).

MATERIALS AND METHODS

The examinees' sample

This research is carried out on the sample of N=117 examinees. They are healthy male pupils, aged from 12 – 14 who regularly attended their PE lessons and who do not have any physical disabilities or injuries that could affect the results of this research. All of the examinees are pupils

of the primary school in Jelah and Tešanj, Bosnia and Herzegovina.

The sample of variables

Two tests were applied with the examinees and each of them was repeated three times.

The measuring techniques

TEST (NAP9M and NAZ9M) bear walk forward (Fig. 1)and backward (Fig. 2) the average lap time.
Factor: the goal of this measuring is to calculate the speed of movement.
The time: the estimation of the entire duration of the test for one examinee is three minutes.
The number of examiners: one examiner.
The requisites: only for that purpose a special nine-meter long drilling area is arranged for measuring bear walk forward and backward hich is calibrated with yellow and red cones that are separated 50 cm from one another. Brower Timing System which consists of one pair of photocells which are placed along nine-meter length and they make contacts with one another. Namely, the apparatus consists of a mobile receiver which telemetrically makes the connection with the photocells. The photocells function in pairs and they are placed on a tripod which enables the position of photocells on different levels depending on the needs of the research. Each pair of photocells is placed near the runway so that when the examinee passes, the photocells transmit the signal to the transmitter which at the same time receives the data and memorizes it in internal memory, which can later be used for further analysis and research.
The venue description: 12 x 3 meters room, minimally

The task

Assuming the starting position: the examinee starts by assuming the sarting position on the start line where a takeoff mark is placed. He is facing the drilling area where the Brower Timing System is set and calibrated.
The performance of the task: the examinee's task is to cross the nine-meter distance as quickly as possible by properly performing bear walk. The task is performed three tiimes and it is finished after the distance of nine meters is crossed.
The examiner's position: the examiner is positioned so as not to disturb the camera angle, holding the Timing System receiver where all the data are collected upon the completion of the task. It is examiner's duty to make sure that all data are memorized in the receiver's software.
The assessing: the time of examinee's crossing the distance is registered.
The instructions to the examinee: the task is demonstrated and the examinee is instructed at the same time.

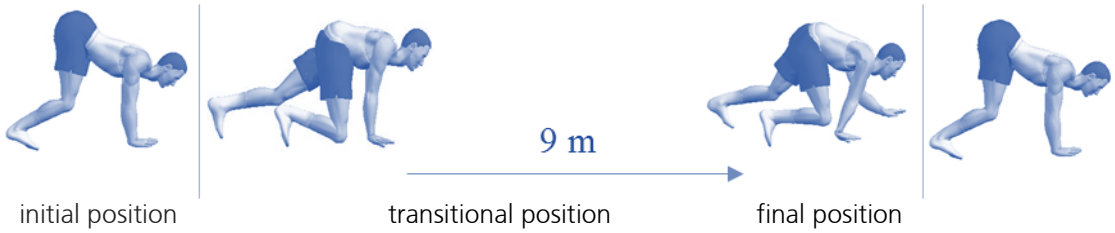

Figure 1. *Bear's walk forward 9 meters*

Figure 2. *Bear's walk backward 9 meters*

The collected data

Were analysed by statistical software SPSS 21.0. The basic descriptive parameters were calculated: arithmetic mean (M), standard deviation (SD), the asymmetry (SKEW) and degree of peakedness (KURT) of distribution for determining the sensitivity while the normality was tested by the Kolmogorov-Smirnov Test (K-S test). The reliability of the test was determined by calculating inter item correlation (IIr), and Cronbach alpha (Crα). The homogeneity was estimated by univariate analysis of variance (F test and the level of significance $p<0.05$). Factorial validity of tests was calculated by factor analysis. This is a pilot study and the results will

be helpful for future research related to motor abilities of school children. For measuring speed passage at 9 m we used Brower Timing Systems - Wireless Sprint System. Times accurate to 1/100th of a (seconds). The results of this research will provide the answer whether the selected tests can be used to assess motor abilities in 12-14 years-old children.

Table 1. Measuring procedures for data collection using the sports - educational chart, their abbreviations and the dimensions they represent

Abbreviation	Motor Dimension and Variable	Hypothetical dimension measured
PT R-right, L-left	Plate tapping in 20 seconds (frequency)	Speed and the coordination of limb movement
LT R-right, L-left	Leg tapping in 15 seconds (frequency)	Speed of alternate movements with the leg
R20	Speed Test on 20 meters (seconds)	Speed of whole-body movements
SR	Sit and reach (mm)	Flexibility of the lower back and hamstring muscles
SF	Shoulder flexibility (mm)	Flexibility of the shoulder zone
TMB	Medicine ball throwing from siting position 2 kg (cm)	Muscular strenght of arms and shoulders
PU	Push-up maximum repetation (frequency)	Muscular strenght of arms and shoulders
SUP	Sit-ups in 60 seconds (frequency)	Strength of abdominal muscles
LT	Lifting a torso from lying postion maximum repetation (frequency)	Strenght of the trunk muscules
SBJ	Standing broad jump (cm)	Muscular strenght of the legs
BJ	Bunny jump 9 meters (seconds)	Co-ordination of whole-body movements
PF	Polygon forwards (seconds)	Co-ordination of whole-body movements
PB	Polygon backwards (seconds)	Co-ordination of whole-body movements

Analyzing the central tendency parameters (Table 1), the arithmetic mean, the standard deviation, variance, kurtosis show the balance of the results distribution on the sample N of 117 examinees. In accordance with the aim of the research, (Tables 2 to 6) present the results of metric characteristics of tests constructed for the assessment of coordination and speed. After the insight into the applied univalent analysis of the variance on the sample N of 117 examinees (Table 2) (ANOVA), we ascertained that the value of the univalent test NAP9M (F-test) is .008 and NAZ9M .422 so that the contribution of the applied variables is of great significance. However, some important differences between the items were noticed, namely the arithmetic mean and variability. Also, there are no significance relations on the statistically important level of the treated variable (NAP9M $r = .992$; $p<0.01$) and (NAZ9M $r = .928$; $p<0.01$).

Cronbach's α coefficient of generalizability, which is estimated from the particles' projections on the first main component on the particles' intercorrelation, proves a very high reliability level of the applied test NAP9M and NAZ9M. Cronbach Alpha (α) in this research is (α: .928-.974) reliability and standardized Cronbach is which is very high reliability level. A coefficient data without participation of the certain particle in the analysis show that three repetitions of the test are sufficient.

Table 2. Metric characteristics of the test for assessing coordination – bear walk forward and backward (N=117)

Variable	N	M	SD	Skew	Kurt	K-S	F	p	Ilr	Crα
NAP1	117	4.767	1.331	1.061	.962	.19				
NAP2	117	4.892	1.471	.938	.530	.18	.008	.992	.974	.974
NAP3	117	5.073	1.580	.929	.528	.16				
NAZ1	117	9.042	2.514	.601	-.493	.22				
NAZ2	117	9.728	2.938	.726	-.088	.32	.422	.656	.928	.928
NAZ3	117	10.357	3.246	.673	.064	.19				

Legend: N – no. of performances; M – mean; SD – standard deviation; Skew., Kurt. – coefficients of skewness and kurtosis; K-S – Kolmogorov Smirnov test normality of the distribution; F - The homogeneity of tests was calculated by analysis of variance; p - significance at the p<0.05 level (2-tailed); parameters of reliability Ilr- Inter-item correlations and Crα- Cronbach's alpha coefficients.

Having inspected and analyzed Pearson's matrix of intercorrelation which is applied on measuring of motor variables NAP9M and NAZ9M (Table 3), it can be observed that the matrix includes coefficients of correlation which have statistically high values on the statistically significant level of $p<0.01$. High values can be observed in all inter-correlations of the results.

Table 3. The analysis of the matrix of motor variable intercorrelation NAP9M and NAZ9M

Variable	NAP1	NAP2	NAP3	NAZ1	NAZ2	NAZ3
1	1	.927*	.928*	1	.850*	.807*
2		1	.939*		1	.822*
3			1			1

*. Correlation is significant at the 0.01 level (2-tailed).

In the matrix of characteristic roots and explained parts of the common variance (Table 4), NAP9M having solved the characteristic equation of intercorrelation matrix, the first main component is isolated (Total) which is 2,863 as well as the characteristic vectors of that matrix, the explained parts of the common variance, which explain the common variance of the isolated main component. In the column marked (% of Variance) the relative cumulative contribution of the first main component is stated which comes to 95,426% and it is very high. NAZ9M having solved the characteristic equation of intercorrelation matrix, the first main component is isolated (Total) which is 2,653 as well as the characteristic vectors of that matrix, the explained parts of the common variance, which explain the common variance of the isolated main component. In the column marked (% of Variance) the relative cumulative contribution of the first main component is stated which comes to 88,431% and it is very high.

In (Table 4) the values are presented and they show the acquaintance with the variables' vectors in the vectors' space (as a percentage of the valid variance), actually the part of the variance of each variable which can be explained by the isolated first main component. These values present vector lengths of the manifested variables (NAP9M and NAZ9M) which are projected on the first main component. The presented communalities' values are high enough, so that the acquaintance with variables' vectors in the analyzed vectors space is satisfactory. The percentage of valid variance is high and even, which will contribute a great deal with defining the first main component.

Table 4. Factorial validity of constructed tests

Component	Initial Eigenvalues			Communalities
	Total	% of Variance	Cumulative %	Extraction
NAP1	2.863	95.426	95.426	.949
NAP2	.076	2.537	97.963	.957
NAP3	.061	2.037	100.000	.957
NAZ1	2.653	88.431	88.431	.888
NAZ2	.198	6.614	95.045	.898
NAZ3	.149	4.955	100.000	.867

Legend: Lambda - value characteristic; Variance% - percentage of variance explained by latent dimension

Results of regression analysis of the criterion variable NAP9M and NAZ9M (Table 5), provide enough information about the effects of the appropriateness of the variables on the success of the performance bear walk 9 m (sec.). Common of variance is (NAZ9M .596 and NAP9M: .761) with the criterion is explained with the predictor system of variables, while the correlation of the entire system, the predictor variables with the criterion, coefficient of multiple correlation is between (Ro^2: NAZ9M .485 and NAP9M .579). The analysis of individual variables impact in (Table 5) showed that the highest and statistically most important influence of the criteria variables following individual variables: bunny jump forward (β *beta*: 0.337-.454), run 20 meters (sec) (β *beta:* ,224-.229). The following group of motor variables were chosen to assess the basic motor abilities identified in previous studies as relevant for the successful performance of motor skills among 12-14 years old children (Delaš Kalinski et al., 2011) psychomotorhythmic coordination, strength (explosive, repetitive and static), and flexibility.

Table 5. Multiple linear regression analysis for the dependent variable between bear walk forward and backward with individual variables

Variables	Forward		Backward	
(Constant)	β	p	β	p
		.382		.332
PTR	-.012	.927	-.026	.855
PTL	.064	.583	-.240	.067
LTR	.005	.985	.301	.327
LTL	-.050	.851	-.267	.370
R20	.229	.023*	.224	.044*
SR	-.007	.927	.000	.996
SF	-.031	.640	.040	.587
TMB	.075	.397	.076	.439
PU	-.134	.139	-.173	.085
SUP	-.188	.050	-.071	.499
LT	.034	.687	.056	.555
SBJ	-.020	.845	.056	.612
BJ	.454	.000*	.337	.000*
R	.761		.696	
R Square	.579		.485	
F	10.886		7.447	
p	.000		.000	

Legend: a Predictors: (Constant), PTR, PTL, LTR, LTL, R20, SR, SF, TMB, PU, SUP, LT, SBJ;
b Dependent Variable: bear walk forward and backward.

DISCUSSION

In this paper we designed a new composite test which is a situational test. We named it "bear walk" forward and backward decided to check the metric characteristic of the test. The test proved high values of metric characteristics so that further analyses of the test can be carried out. Since it is a composite test, it is important to establish which motor skills and morphological characteristics lead to the more successful performance of the test. The coaches and teachers will benefit from this test while teaching pupils how to properly perform a walk. Having analyzed the received results, we came to the conclusion that only two repetitions of the test are sufficient. Therefore we suggest that the better result is used while measuring.

Based on the results we received for the applied composite test, used for the performance evaluation of the coordination and speed "bear walk forward and backward", with the purpose of ascertaining its reliability as a metric characteristic, we can put forward the following conclusions:

- a satisfactory metric characteristic is ascertained for the applied test,
- the applied test is recommended to the researchers in their further analyses, with the note that, while performing, the test should be repeated at least twice and the better result should be taken into consideration,
- in further studies, the authors also suggest implementation on a larger sample and other ages,
- there is a relatively strong relationship between two motoric variables and performance in a sample bear walk.

Conflict of interest

The authors declare no conflict of interest.

Acknowledgements

We thank all subjects who helped us in this study.

References

1. Abernethy, P., Wilson, G., & Logan, P. Strength and power assessment. Sports Medicine, 1995, 19: 401-417.
2. Begatović, E., Čuk, I., & Atiković, A. The reliability of the test "bunny jumps forward". Sport scientific and practical aspects, 2010, 7(2): 29-36.
3. Begatović, E., Čuk, I., Atiković, A., & Bučar Pajek, M. Influence of some basic motor abilities on the performance of bunny hop movement. Acta Kinesiologica, 2012, 6(2): 20-26.
4. Delaš-Kalinski, S., Mandić-Jelaska, P., & Atiković, A. Influence of some motor abilities on the basicgymnastics skills performance through the learning process. In: Milanović, D. (Eds). 6th International Conference on Kinesiology, Opatija, Croatia, Zagreb: University, Faculty of Kinesiology, 2011, pp. 219.

5. Delaš-Kalinski, S., Miletić, A., & Miletić, Đ. The influence of motor factors on performing fundamental movement skills – the differences between boys and girls. Facta universitatis - series: Physical Education and Sport, 2008, 6(1): 31-39.
6. Hošek, A. Struktura koordinacije, Kineziologija 1976, 1-2(6), pp. 158.
7. Hraski, M., Horvat, V., & Bokor, I. Metric Characteristics of Tests for Assessing Coordination, Speed and Balance in Four-Year-Old Children. Croatian Journal of Education, 2016, 18(SE1): 61-70.
8. Malina, R.M. Motor Development during Infancy and Early Childhood: Overview and Suggested Directions for Research. International Journal for Sport and Health Science, 2004, 2: 50-66. http://dx.doi.org/10.5432/ijshs.2.50
9. Petz, B. Psihologijski rječnik. Zagreb: Prosvjeta, 1992.
10. Pišot, R., & Planinšec, J. Motor structure and basic movement competences in early child development. Annales Kinesiologiae, 2010, 1(2): 145-165.
11. Popeska, B., Georgiev, G., & Mitevski, O. Structure of motor space in children at 7 year age. Physical Education and Sport, 2009, 48(8): 19-24.
12. Sekulić, D., &Metikoš D. Osnove transformacijskih postupaka u kineziologiji – udžbenik, 2007, pp. 162.
13. Stanišić, I. Metric characteristics of speed frequency jumping tests for preschool children. APES 2012, 2(2): 167-172.
14. Veličković, S., & Petković, E. The objectivity of situational-motor coordination measuring instruments in gymnastics. Facta Universitatis, Series Physical Education and Sport, 2005, 3(1): 69-80.
15. Živčić Marković, K., Krističević, T., & Aleksić-Veljković, A. Metric characteristics of a new test for the evaluation of dynamic balance. Kinesiology, 2016, 48(2): 267-273. Retrieved from http://hrcak.srce.hr/170505