

CHARACTERISTICS OF TESTS FOR MEASURING INDICATORS OF THE PHYSICAL PROPERTY FLEXIBILITY

Original scientific paper

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Abstract

In many aspects the indicators of flexibility reflect the overall health of man and his potential to master the technical elements of a certain sport. The aim of this research article is to compare the obtained average values of three tests measuring flexibility: V-Sit test, Sit and Reach test and Toe Touch Test (TTT), as well as to identify any significant differences in the results in order to draw a characteristic of the tests. The tests were applied to 82 male students at the Sofia University "St. Kliment Ohridski", Bulgaria. The average age of the students is 20.34, the ± 1.64 . The tests were conducted at the time of sport classes during the month of May of 2015/2016 academic year. The students are not active athletes and do not participate in competitions. They attend sport classes once a week for 90 minutes. The mean values of Toe Touch test are 7.22 ± 7.42 cm, $V = 55.06\%$; Sit and Reach test are 9.48 ± 8.30 cm, $V = 68.89\%$; V-Sit test are 8.46 ± 8.03 cm, $V = 64.55\%$. Despite the differences in the mean values, the comparative analysis showed no statistically significant differences between the tests: T-Stat = -1,834 between the first and second test, T-Stat = -1,029 between the first and the third test and T-Stat = 0,793 between the first and third test. However, it has been established that the lowest average value was measured with the Toe Touch test (7,22 cm), moreover, the test observes the highest number of negative results - seven. The results obtained with Sit and Reach test and V-Sit test were nearly identical. The highest score was obtained with V-Sit test (+28 cm), and the lowest with Toe Touch test (- 22 cm).

Keywords: flexibility, tests, characteristics, students, physical properties

INTRODUCTION

The main physical properties that determine the physical capability of humans are speed, strength, endurance, flexibility and agility. The targeted practice of flexibility development exercises contributes to the improvement of the speed results (Żukowska, Krygowski, Szark-Eckardt & Zajac, 2016). This is an indication of the importance of flexibility exercises in terms of speed and flexibility development. The findings of an experimental study conducted with students show an improvement in their motor skills, a decrease of the standard deviation of physical properties indicators, and furthermore, better physical fitness and health of the students.

In many aspects the indicators of flexibility reflect the overall health of man and his potential to master the technical elements of the sport practiced. The poor development of flexibility causes a number of health problems. For instance, reduced Achilles tendon flexibility is a common clinical finding in adolescents (Brodersen, Pedersen & Reimers, 1994; Harreby, Nygaard, Jessen, Larsen & Storr-Paulsen, 1999; Milne & Mierau, 1979). Other researchers (Brodersen, et al, 1994) observed that 75% of boys and 35% of girls aged 10 revealed reduced flexibility of hamstrings. The researchers of Harreby et al (1999) confirmed this observation in 15- to 17-year-old boys. Reduced flexibility of hamstrings was reported to be associated with increased low-back pain prevalence (Sjolie, 2004; Jozwiak, Pietrzak & Tobjasz, 1997; Feldman, Shrier, Rossignol & Abenhaim, 2001; Mierau, Cassidy & Young-Hing, 1989; Takata & Takahashy, 1994), herniated lumbar disc (Takata & Takahashy K, 1994; Zhu, Gu, Yang, Lin, & Ga, 2006), decreased lumbar lordosis (Jozwiak et al, 1997), decreased range of lumbar spine flexion and increased range of thoracic spine flexion (Gajdosik, Albert & Mitman, 1994), increased thoracic kyphosis angle in adolescents with Scheuermann disease (Fisk, Baigent & Hill, 1984) and a higher risk of muscle injury (Witvrouw, Daneels, Asselman, D'Have & Cambier, 2003).

Assessing the level of flexibility of students who take part in basketball and soccer educational-sport groups at universities is important for two main practical reasons - one is to prevent muscle injury during activities, and the other is more effective improvement

of technical skills.

Studying and analysing the sports literature we found that in practice several basic fitness test to establish flexibility are being used. This led us pick out the three most commonly used international tests measuring the physical quality flexibility and compare them.

Based on this, the purpose of the research article is to compare the resulting average values of the three tests measuring flexibility - V-Sit test, Sit and Reach test and Toe Touch Test (TTT), to identify any significant differences in the results obtained and to characterize the tests.

METHODS

The current study was conducted at the time of sport classes during the month of May of 2015/2016 academic year.

The subjects of the study are students at Sofia University "St. Kliment Ohridski", Bulgaria.

The object of study is the flexibility of students from Sofia University.

The study sample includes 82 male students at Sofia University "St. Kliment Ohridski", Bulgaria. The students are not active athletes and do not participate in competitions. However, they have chosen to attend sport classes once a week for 90 minutes. The academic calendar provides 60 hours per year of sport classes (practical exercises). The purpose of the study and the procedures of measuring the necessary indicators were clarified to the students when they were invited to take part of the research. All tested students have joined voluntarily. They belong to two basketball profiled groups and three soccer profiled groups.

The measurement was performed during one ordinary class for each group. The indicators were measured by the research staff. An in-depth analysis of specialized and public literature on the importance of flexibility and the methods of analyzing results was completed before proceeding to the practical implementation of the study.

Statistical analyses

The results were processed through statistical analysis – SPSS version 19.0 software was used and the results were analyzed adopt-

ing a 5% significance and confidence interval (CI) of 95%. Data relative to age, height, weight and angular measures were presented in relation to the mean, standard deviation and correlation analysis. To compare the significance of the differences between the arithmetic average of the studied sample with different indicators a (T-Test: Two-Sample Assuming Equal Variances) was used. The calculations were performed in EXCEL. The research tests are: Toe Touch Test (TTT) – Test_1, Sit and Reach test – Test_2 and V-Sit test – Test_3.

Brief presentation of the tests and the equipment required

The sport literature of different countries makes use of variants of naming for the same tests. An example of this are the names of Fingertip-to-floor test (FTF), Modified Fingertip-to-Floor (MFTF) and Toe Touch test (TTT), which use identical procedure of measuring the flexibility indicators and thus, represent a single test. In this paper we prefer using the term Toe Touch test (TTT) because of the greater popularity in sport literature in comparison with the other two tests. For clarity, we present images of the studied tests (<http://antranik.org/toe...>; <http://www.bodytrainer.tv...>; <http://www.golfband.co.uk...>; <http://journals.plos.org...>; <http://www.scielo.br...>; <https://www.youtube.com...>).

When registering the results the following rules for measurement were applied: Negative values (marked with a minus) denote that the student was unable to reach the top of the measuring box, “zero” denotes the student was able to touch the box, positive values (no mark) denote the student was able to touch the box below its top. The results were given in centimetres (cm). It is essential before for students to warm up very well before the measurement takes place.

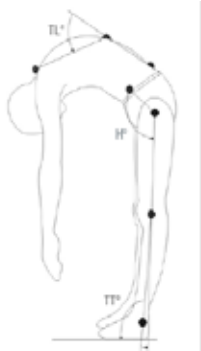


Fig. 1. Toe Touch Test (TTT) – Test_1

Fig. 2. TTT – equipment required

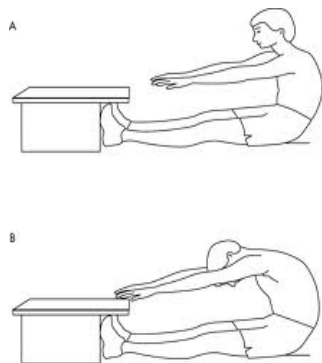


Fig. 3. Sit and Reach test (SRT) – Test_2

Fig. 4. SRT – equipment required



Fig. 5. V-Sit test (VST) – Test_3

Fig. 6. VST – equipment required

Figure 1 shows the measured joint angles which are significant for the results obtained (H0: Hip angle, K0: Knee angle, TL0: Thoracic-lumbar angle, TT0: Tibio-tarsal angle). Figure 2 shows the necessary equipment – a 30-cm-high measuring box and a ruler.

Figure 3 illustrates the first phase (A) initial position and the second phase (B) bending, retention and measurement. Fig. 4 shows the necessary equipment – a testing box and a mobile scale with units which ensures reliability in measurement.

Fig. 5 shows the first phase - initial position and the second phase - bending, retention and measurement. Fig. 6 displays the necessary equipment - a mat and two rulers. It is important to know that the distance between the heels is 30 cm.

RESULTS AND DISCUSSION

The variation analysis shows that the average age of students is $20,34 \pm 1,64$ years, the height is $180,54 \pm 3,34$ cm, the weight is $74,90 \pm 10,81$ kg.

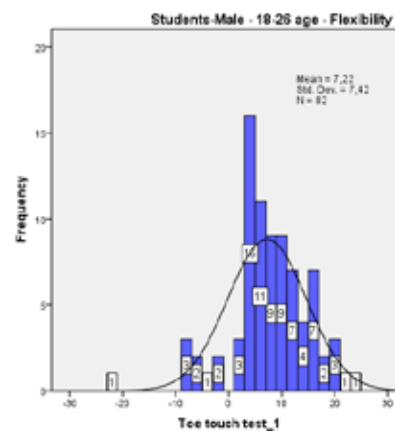


Figure 7. Histogram Test_1

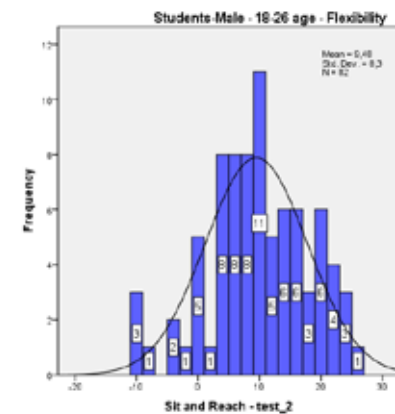


Figure 8 Histogram Test_2

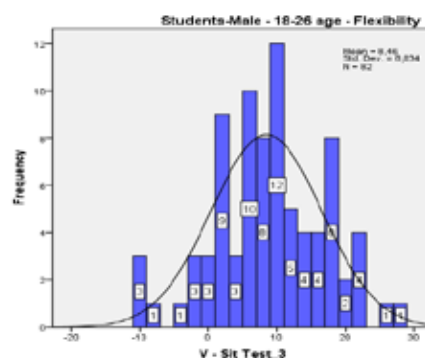


Figure 9. Histogram Test m_3

Table 1. Variation analysis results of respondents and indicators

	n	Xmin	Xmax	R	Mean	SD	V	As	Ex
Age	82	18	26	8	20,34	1,64	2,70	1,04	,98
Height	82	160	197	37	180,54	7,34	53,88	-,06	,11
Weight	82	54	109	55	74,90	10,81	116,85	,88	1,32
TT Test_1	82	-22	23	45	7,22	7,42	55,06	-,78	2,29
SR Test_2	82	-10	25	35	9,48	8,30	68,89	-,28	-,16
V-S Test_3	82	-10	28	38	8,46	8,03	64,55	-,09	,02

Note: When $n=80$ and $\alpha=0,05$ the critical values of skewness and kurtosis are $As_{0,05}= 0,538$ $Ex_{0,05}= 1,064$ respectively

Table 2. Results from the correlation analysis between the three test

	Toe Touch test_1	Sit and Reach test_2	V-Sit test_3
Toe touch test_1	Pearson Correlation 1		
Sit and Reach test_2	Pearson Correlation 0,854**	2	
V-Sit test_3	Pearson Correlation 0,831**	0,901**	3

Table 3. Results of the comparative analysis of statistical significance between the three tests

	n	Pooled Variance	H.Mean Diff	df	t Stat	P(T<=t) one-tail	t Critical one-tail	P(T<=t) two-tail	t Critical two-tail
TT test_1	82	61,98	0	162	-1,834	0,03	1,65	0,06	1,974
SR test_2	82								
TT test_1	82	59,81	0	162	-1,029	0,15	1,65	0,3	1,974
V-Sit test_3	82								
SR test_2	82	66,72	0	162	0,793	0,21	1,65	0,43	1,974
V-Sit test_3	82								

The results indicate that the flexibility results of test_1 - Toe Touch Test range from -22 cm to +23 cm. The average value is $7,22 \pm 7,42$ cm, the coefficient of variation demonstrates that the variance of the values is large ($V = 55,06\%$). The empirical values of the coefficient $As_{0,05} = -0,78$ and $Ex_{0,05} = 2,29$ exceed the critical, indicating a positive asymmetry with increased kurtosis (Table 1). The highest frequency is represented by 16 results (11 are +4 cm and 5 are +3 cm) (Fig. 7).

There are eight scores of +6 cm, and two groups of six scores of +9 cm and a +15 cm respectively.

The results indicate that the flexibility results of test_2 - Sit and Reach Test range from -10 cm to +25 cm. The average value is $8,46 \pm 8,03$ cm, the coefficient of variation demonstrates that the variance of the values is large ($V = 64,55\%$). The empirical values of the coefficient $As_{0,05} = -0,28$ and $Ex_{0,05} = -0,16$ do not exceed the critical, indicating a normal distribution. The highest frequency is represented by 11 results (9 are +10 cm and 2 are +11 cm). Six of the results are +4 cm and five are +5 cm (Fig. 8).

The results indicate that the flexibility results of test_3 - V-Sit Test range from -10 cm to +28 cm. The average value is $9,48 \pm 8,30$ cm, the coefficient of variation demonstrates that variance of the values is large ($V = 68,89\%$). The empirical values of the coefficient $As_{0,05} = -0,09$ and $Ex_{0,05} = 0,02$ do not exceed the critical, indicating a normal distribution. The highest frequency is 12 achievement (6 are +10 cm and 6 are +9 cm). There are also two six achievement with the result +6 cm and a +2 cm (Fig. 9).

Comparing the most common results measured with the three tests we may say that the most frequent high result achieved with test_2 was +10 cm - nine students reached it, with test_3 six students reached it and with test_1 only three.

By comparing the negative sign results it was found that test_1 registered seven such results, test_2 registered six, while test_3, five.

The greater similarity between the results of test_2 and test_3 is evidenced by the data obtained in the correlation analysis, where the strength of the relationship is 0,901 (Table 2).

The results of the comparative analysis indicate that among the

indicators establishing the flexibility to students with three different tests there were no significant differences. This is evident from Table 3, wherein the established significance t-Stat ($t \text{ Stat} = -1,834$; $t \text{ Stat} = 1,029$; $t \text{ Stat} = 0,793$) is less than the critical values t Critical two-tail = 1,974.

CONCLUSIONS

There are no statistically significant differences in the results of the three tests. However, it has been established that the lowest average value was measured with the Toe Touch test (7,22 cm), moreover, the test observes the highest number of negative results - seven. The results obtained with Sit and Reach test and V-Sit test were nearly identical. The highest score was obtained with V-Sit test (+28 cm), and the lowest with Toe Touch test (-22 cm).

The results obtained indicate that the average values of the three tests used to measure flexibility in the current research are relatively close. Based on this, we can recommend the use of the three tests, depending on the available equipment for measuring flexibility, which would help to optimize the training process and the special impact of exercises in developing flexibility as well as other physical properties.

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