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ASSESSMENT OF THE LEVEL OF PREPARATION OF STUDENTS THROUGH THE RUFFIER AND DICKSON TESTS

Original scientific paper

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Abstract

The safe physical workload during sports activities in basketball requires a careful approach that is consistent with the health and efficiency of the heart of every student who participates in the training. In the interest of teaching basketball and the health of the students, the efficiency of the heart and the physical work load abilities of students have been examined using the Ruffier-Dickson test. Establishing in advance the physical preparation of students allows the teacher to determine the optimal level of workload during the educational-training activities in basketball. The purpose of this study is to identify the performance and the adaptation abilities of the cardio-vascular system of students to physical exercise. The study was conducted with 30 first-year students enrolled in basketball for the academic year 2015/2016 at Sofia University "St. Kliment Ohridski". The report reveals the level of physical preparation of students and makes specific proposals for the improvement of the collection of indicators of field conditions at the beginning of each academic year. Women and men have almost identical values of P1, but show much greater differences in physical effort (30 squats for 45 s). Among women P2 = (M = 132,53), while for men P2 (M = 120,27). We note a difference of 12,26 heart beats more of women than men. It is recommended that physical activity is consistent with the gender differences.

Keywords: *basketball, physical preparation, heart rate and pulse, Ruffier-Dickson index, physical work, educational-training activities, Kolmogorov-Smirnov and the Shapiro-Wilk tests, One-Way ANOVA, Ruffier's test*

INTRODUCTION

As is well known, one of the primary objectives of sport in universities is to preserve, strengthen and improve the health and the physical preparation of students, in order for them to be able to successfully fulfil the educational, social and professional activities. Inadequate physical exercise in educational-sports activities could lead to a distortion of the balance between the training impact, recovery and adaptation of the human body, as well as to injuries, which will adversely affect the students.

The regularly implemented physical exercises are very powerful tool for achieving a change in the physical and mental state of man. They have a significant impact on the organs and systems of man as cardiovascular, respiratory, muscular-skeletal, central-nervous, digestive and on the metabolism. For the exercises to be beneficial and not harmful it is necessary people to perform a regular self-control. It must be systematic and complete, giving a clear picture of the functional and physical condition of the body (Kokolova & Nikolaeva (Коколова & Николаева, (2009).

The changes in the cardiovascular function depend largely on the type of physical exercise, age, gender and the level of physical preparation of the individual (Popova, et al.,) (Попова, et al.,) (2015). The characteristics of the arterial pulse can greatly assist the diagnosis of cardio-vascular diseases. The frequency - the number of pulses for 1 minute, of healthy men, corresponds to the heart rate. Usually, the heart rate is 60-90 beats/min in rest conditions; we speak about sinus tachycardia when the rate exceeds 100 beats/min and about bradycardia when it falls below 60 beats/min. The young and well-trained individuals are characterized by a slow heartbeat, even around 55 beats/min (Belova (Белова, et al.,) (2015). Basketball as a sport is characterized by its dynamic nature where there is intermittent and discontinuous workload change during the game - from sprinting in offense and intensive defence, to slow running, walking and standing at one place during the free throws and the timeouts.

All this shows that the functional workload occurs in aerobic-anaerobic mode, where the frequency of cardiac contraction during the game can exceed 180 beats / min.

The concept of the whole training process should be based on real game conditions. Ultimately, it is one of the main aspects leading to success. From this point of view, it is necessary to have knowledge of physical and physic-ological demands of competitive games (Hoffman R., 2014). Hence, the analysis of internal and external indicators of the physical load emerges as an important prerequisite to increase the efficiency of the training process. The internal indicators of the physical load are most frequently expressed by the heart rate (HR) and the blood lactate concentration. We understand the external load as distance and speed characteristics (time-motion analysis) of the physical activity. The HR is a noninvasive and the most accessible indicator for evaluation of the physical load of the cardiovascular system, it reacts very sensitively to the increase of the intensity of load, moreover, HR may be monitored repeatedly, without any great financial expenses - (Achten & Jeukendrup, 2003; Gocentas, Landõr, & Kriščiūnas, 2011; Pettitt, Pettitt , Carbera, & Murray, 2007).

Regarding what stated, it is necessary to establish the current physical and health condition of students in the first few classes in basketball. It is very important for sports pedagogues to have an idea of the physical and health condition of the firstyear students who have enrolled in the educational-basketball class. The clarification of these issues could help to optimize the management of the training effect that is tailored to the individual health and physical condition of the students. This is a major pre-requisite for a quality sports preparation of the students.

The *purpose* of this study is to identify the performance and the adaptation abilities of the cardio-vascular system of students to physical exercise.

METHODS

Subjects Characteristics

The sample of the study is comprised of 30 students who have chosen the sport - basketball for the 2015/2016 academic year (n = 30). All participants are first-year students at Sofia University "St. Kliment Ohridski" from different majors and departments. 15 students are female aged 19,53 ± 1,30 years old. The average height of the female students is 169,53 ± 7,21 cm, and their average body mass is 60,87 ± 12,11 kg. The rest of the participants are 15 male students aged 20,20 ± 1.90 years old. The average height of male students is 178,20 ± 9,63 cm, and their average body mass is 77,27 ± 13,86 kg. All students stated that they were healthy and fully able to participate in the basketball activities.

Procedure

To interpret the obtained values the test of Ruffier and the modified test of Dickson were used to establish the change in the pulse frequency and to evaluate the adaptation capabilities and performance of the cardiovascular activity during the exercise.

The tests of Ruffier and Dickson present a method to evaluate the performance of the heart during the exercise. Through these basic medical-educational tests a conclusions about the performance of the cardiac system could be indirectly drawn, as well as conclusions about what level of physical workload can a person withstand, without risks for its health. In both tests the pulse frequency at rest, after workload and after recovery is measured and the difference between the obtained values is in the application of the formula for calculating the results.

The measurement of the arterial pulse is called palpation and it is committed at the base of the neck at the *Arteria carotis*. The middle and the ring fingers are used to feel the pulse. The fingers are placed at the back corner of the *Mandibula* and they go down into the notch on par with the *Trachea*. Each student itself counts the pulse strokes in 15 s. The first measurement is after 5 min rest and is registered as P1, then students do 30 squats for 45 s, and the pulse is measured again for 15 s, this result is registered as P2. After that a 1 min recovery is given and the pulse, measured again, is registered as P3.

The procedure of measuring the indicators is fast, cheap and it takes place before educational exercise in the sports gym. The only tools required are a stopwatch and a metronome that sets the pace of implementing the squats.

The Experts believe that the Dickson's index is more reliable because if a given subject is too emotional the pulse frequency measured at rest could be very high and thus, the results are unfavourable.

The obtained results were calculated electroni-cally using the following formulas:

- Ruffier's Index = (4 * (P1 + P2 + P3) - 200) / 10
- Dickson's Index = ((P2-70) + 2 (P3-P1)) / 10

(http://entrainement-sportif.fr/ird-ruffier-dickson.htm the last visit - 17/04/2016).

The resulting values are assimilated in a verbal grading scale as follows:

Table 1. Ruffier's (index) – results

Verbal evaluation	***Index - Ruffier***
Excellent performance of the heart in workload	Below 3
Very good performance	3,1 to 6
Good performance	6,1 to 10
Unsatisfactory performance	10,1 to 14,9
Bad performance	above 15

Table 2. Dickson's (index) – results

Verbal evaluation	***Index - Dickson***
Excellent adaptation of the heart to workload	Below 0
Very good adaptation	0,1 to 5
Good adaption adaptation	5,1 to 10
Unsatisfactory adaptation	10,1 to 15
Bad adaptation	15,1 to 20 and above

Statistical analysis

The results here are stated as mean ± standard deviation (SD) and analysis of variance . The normality distribution of data was verified by Shapiro-Wilk's test. We have used the Kolmogorov-Smirnov and the Shapiro-Wilk's tests to check the assumptions of normality required by other statistical tests to be used later in our analysis. The One-Way ANOVA analysis was used. It compares the variance (variability in scores) between different groups (women and men) with the variability within each of the groups.

RESULTS AND DISCUSSION

Table 3. and 4. show the mean and the variance of the observed indicators of female and male students from the basketball sports groups.

Based on the obtained results we can conclude that the studied sample of students from the educational-sports groups is strongly heterogeneous (V> 30%) in most of the indicators with variability greater than 40%. The variance (V) of P1 among women is 258, 78% and among men is 166, 55%. Considering the P2 women register (V=230, 55%), but the percentage among men is double (V=421, 64=). The pulse frequency P3 shows variability of (V=316, 50%) among women and of (V=304, 27%) among men.

As we know, if the results of either test are significant (e.g. $p<0.05$) rejecting the null hypothesis means rejecting the assumption of normality for the distribution. The results obtained from the two tests, both women and men, show that the p-value is greater than 0.05, therefore, we would accept the null hypothesis that the data come from a normally-distributed population (Tables 5. & 6.).

Table 3. Studied group: Women - mean and variance of results

Variables	Mean	SD	R	Min	Max	V
Height (cm)	169,53	7,21	25	160	185	51,98
Weight (kg)	60,87	12,11	41	47	88	146,55
Age (years)	19,53	1,30	5	19	24	1,70
P1 (HR)	79	16,09	44	60	104	258,78
P2 (HR)	133	15,18	60	112	172	230,55
P3 (HR)	87	17,79	68	52	120	316,50
Ruffier's (index)	9,8	3,78	14,4	5,2	19,6	14,30
Dickson's (index)	8,0	3,08	12,4	1,0	13,4	9,51

Table 4. Studied group: Men - mean and variance of results

Variables	Mean	SD	R	Min	Max	V
Height (cm)	178,20	9,62	34	160	194	92,60
Weight (kg)	77,27	13,86	50	60	110	192,07
Age (years)	20,20	1,90	7	18	25	3,60
P1 (HR)	78	12,91	40	60	100	166,55
P2 (HR)	120	20,53	68	92	160	421,64
P3 (HR)	80	17,44	64	56	120	304,27
Ruffier's (index)	7,8	4,25	15,6	2,40	18,00	18,06
Dickson's (index)	5,5	3,94	12,8	,20	13,00	15,52

Table 5. SPSS output of the Kolmogorov-Smirnov and the Shapiro - Wilk tests – Women

Var.	Kolmogorov-Smirnova			Shapiro-Wilk		
	Statistic	df	Sig.	Statistic	df	Sig.
P1	,154	15	,200	,891	15	,069
P2	,178	15	,200	,909	15	,131
P3	,184	15	,184	,915	15	,163

Table 6. SPSS output of the Kolmogorov-Smirnov and the Shapiro - Wilk tests – Men

Var.	Kolmogorov-Smirnova			Shapiro-Wilk		
	Statistic	df	Sig.	Statistic	df	Sig.
P1	,125	15	,200	,936	15	,334
P2	,186	15	,173	,943	15	,418
P3	,173	15	,200	,932	15	,293

To implement the One-Way ANOVA analysis, the respondents were divided into two groups for comparison: women and men. The results indicate that there are no statistically significant differences between the two groups in measuring the pulse frequency P1, where F=,051 and p <0.823; the pulse frequency P2, where F=3,461 and p <,073; and the pulse frequency P3, where F=1,207 and p <0.281.

Although the analysis of the results showed no statistically significant difference between the two groups, it is important to note that the women's average heart rate is higher in all three measurements in comparison to that of men. The highest score of P2 =172 HRmax was registered among women, while men scored P2 = 160 HRmax in the same measurement.

The comparison between the ranges among which the measured pulse rates occur and the evaluation of adaptation of the heart in implementing the physical exercise show that male's cardiovascular functions adapt better to the physical effort, therefore men can work with greater workloads.

The analysis of the changes in the pulse rate after physical effort, according to Ruffier and Dickson's tests, (Table 7.) has shown that the largest number of students fall within the range of "good performance and adaptation". Respectively, 8 out of 15 female students surveyed and 6 of 15 male students surveyed, according to the test of Ruffier.

According to the same test, among the men there are 3 students with "very good" and 2 students with "excellent adaptation and performance" to physical effort; while among women there are no scores in the "excellent" range and only one female student has scored a "very good" result. In both male and women groups there is one case where the test has to be repeated in order to confirm or exclude "bad results". Those cases require recommending students a medical examination to check the presence of a cardiovascular disease.

Table 7., shows the students' distribution according to the Dickson's test. Among the women, 9 students have a "good adaptation", while among the men in the same range there are 4 students. Many more men than the women score "very good adaptation" (8 men and 2 women). Compared to the Ruffier's test, there are not reported students scoring "bad adaptation and performance" of the cardiovascular system during physical effort.

Table 7. Distribution of students according to their results achieved in the Ruffier's and Dickson's tests

Evaluation	Tests			
	Ruffier		Dickson	
	Men	Women	Men	Women
Bad	1	1	0	0
Unsatisfactory	3	5	2	4
Good	6	8	4	9
Very good	3	1	8	2
Excellent	2	0	1	0

CONCLUSIONS

Based on the analysis and guided by the fact that students attend basketball classes approximately once a week, we can deduce the following conclusions and recommendations

- The average pulse frequency measured among women (M = 79,07) and among men (M = 77,87) is within the norm, but it shows that young people (average age (M = 19.87) have not been practising sport and do not have sufficient level of physical preparation. It is advisable to for the students to work individualy in aerobic mode to reduce the pulse in rest conditions.

- Women and men have almost identical values of P1, but show much greater differences in physical effort (30 squats for 45 s). Among women P2 = (M = 132,53), while for men P2 (M = 120,27). We note a difference of 12,26 heart beats more of women than men. It is recommended that physical activity is consistent with the gender differences.

- Men recover their pulse more quickly. P3 among women (M = 86,93), and among men (M = 79,87), but for both genders the values are in the range of expected and normal recovery for 1 minute. It is required for the pulse frequency after recovery not to be greater than 10 beats with respect to the pulse frequency in rest conditions.

- When comparing the results between the two tests we observe differences in reporting the number of "bad" results. In the Ruffier's test there are 2 “bad” cases recorded, while in Dickson’s such cases are not registered. When there are indicators that deviate from the average, we recommend investigating using both tests, repeating the tests in field conditions, and if necessary, directing these students to a medical personnel for further cardiovascular tests.

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