

# Assessment of specific agility in volleyball: reliability and validity of modified X running test

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**Abstract** - It is very important to develop, as a part of training technologies, appropriate tools, or tests to validly and objectively control the level of specific skills development. This study aims to determine reliability and validity of the test for evaluation of specific running agility development level of young volleyball players. Male subsample consisted of 63 boys and 146 girls. Total subject sample was also divided into age categories, where boys consisted of: 29, 21 and 13, and girls: 65, 37 and 44 – U15, U17, and U19 respectively. All subjects were tested using modified X test. Differences were determined with ANOVA, while reliability evaluation was performed using Reliability analysis and Alpha and ICC criteria, as well as Linear Regression Analysis. Results showed that there were significant differences between age groups for both male and female subject ( $p = 0.002$  and  $p = 0.000$ , respectively). Test showed high reliability ( $>0.82$ ) for both day-by-day and trial-by-trial models. In general, applied modified X test, proved to be statistically reliable and sensitive to observed age groups of subjects, and therefore it can be recommended for use in volleyball training technology.

**Keywords**—testing, movement, youth, fast, volleyball

## I. INTRODUCTION

Volleyball is a game with predominantly very fast and explosive movements players perform in all directions. Specific skills shaped into volleyball technique with or without the ball are the main components making a successful volleyball player. Game is composed of short periods of very intensive activities followed by short periods of relative passiveness. According to structure of playing and energetics, during the active periods of the game players are predominantly in the anaerobic-alactic intensity zone. In relation to the other physical properties, volleyball players are required to have a high level of all strength and power characteristics, speed and high level of general and especially specific motor skills, i.e. specific quickness and agility. These properties transform into defence, spiking, serving, blocking and other actions whose efficiencies decide the winners of the volleyball matches [1].

Regarding the young athletes in volleyball, training should be aimed at their long term development, it should be prospective, meaning that the outcome of that training will be a successful and healthy adult athlete. Throughout youth categories, training develops their general as well as specific motor abilities, which combined with a set of good

technical skills will eventually lead to a good volleyball player. Quality training program needs to have periodical monitoring of sport specific motor abilities in order to follow programs effects. Therefore it is very important to develop, as a part of training technologies, appropriate tools, or tests to validly and objectively control the level of specific skills development. These tests must be in accordance with the demands of the game, meaning that its characteristics should imitate the volleyball situations [2]. This primarily refers to youth categories, where control of applied training process efficiency is still predominantly performed by means of laboratory or field conditions testing [3, 4, 5]. Furthermore, testing should be periodically repeated in order to have a comprehensive and continuous notion about development of young athlete. This study aims to determine reliability and validity of the test for evaluation of specific running agility development level of young volleyball players.

## II. MATERIALS AND METHODS

This study is conducted through field testing method using direct time measurement, needed to perform this test.

### A. Subject Sample

Subject sample for this study consisted of selected volleyball players from youth categories who trained in national level systematic sport training environments in Serbia. Male subsample consisted of 63 boys (Ages=16.2±1.6 yrs., BH=182.7±8.0 cm, BM=73.6±13.4 kg, BMI=21.99±3.17 kg•m<sup>-2</sup>, training experience = 5.8±1.6 yrs.), and 146 girls (Ages=15.5±2.1 yrs., BH=78.1±6.0 cm, BM=63.8±10.2 kg, BMI=20.96±2.50 kg•m<sup>-2</sup>, training experience = 5.5±2.6 yrs.). Total subject sample was also divided into age categories, where boys consisted of: 29, 21 and 13, and girls: 65, 37 and 44 – U15, U17, and U19 respectively.

B. Testing Procedures

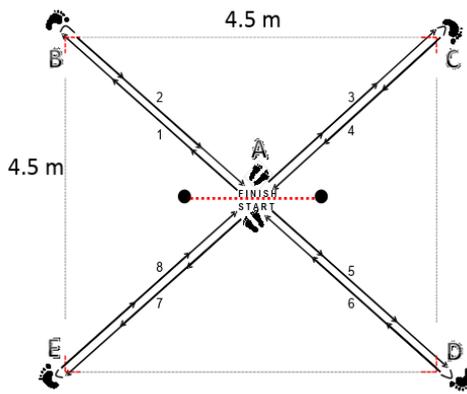


Fig. 1. Modified X test – scheme of performance

For the purpose of specific running agility development level of young volleyball players, all subjects were tested using modified X test (Figure 1). Compared to standardized running agility tests [6], volleyball related modifications are accomplished by correcting the running area dimensions, with original areas of 10m•10m (T test), and 15m (505 test) being replaced by area which resembles volleyball players coverage during the actual game [7].

After 10 minutes of standard volleyball warm-up all subjects received a verbal explanation and demonstration of the test performance, followed by one familiarization attempt for each subject. Testing was performed using two different procedures. First procedure referred to Trial-to-Trial model, where the rest period between trails was 5 minutes. Second procedure referred to Day-by-Day model, where the rest period between trials was at least 7 days, minimizing the factor of learning on tests results. Time measurement was performed using the optical foto-sensitive system PAT 01 (Uno lux, NS, Serbia).

C. Variables

Following variables were used for the assessment of applied running agility test considering male (boys) and female (girls) subsample:

- Results obtained at modified X running agility test at male sample (All Male) and subsamples (U15 M, U17 M and U19 M, expressed in seconds;
- Results obtained at modified X running agility test at female sample (All Feale) and subsamples (U15 F, U17 F and U19 F, expressed in seconds.

D. Statistics

Raw data was processed using descirptive statistical analysis for calculating average values (MEAN), standard deviations (SD), variabiliti coefficients (cV%), apsolute standard error of measurement (SE<sub>aps</sub>) as well as relative (SE<sub>rel</sub>) and minimal and maximal values of variables (Min and Max). Range of results reliability was calculated using 95% reliability interval of confidence. Differences between same age groups, but different gender, as well as different age groups and same gender were determined with ANOVA, while the differences between specific pairs were determined with Bonferoni Post Hock tests. This way test’s sensitivity regarding gender and age was determined. Reliability evaluation was performed with trial to trial and day by day testing models, using Reliability analysis and Alpha and ICC criteria, as well as Linear Regression Analysis of the tests level of confidence. Level of determination was set at p value of 95% level of statistical probability, with all of the statistical procedures being performed using SPSS 17.00 [8].

III. RESULTS AND DISCUSSION

TABLE I. DESCRIPTIVE STATISTICS FOR MODIFIED X SPECIFIC VOLLEYBALL AGILITY RUNNING TEST

Group	MEAN (s)	SD (s)	cV% (%)	SE <sub>aps</sub> (s)	SE <sub>rel</sub> (%)	95% Conf. Int.		Min (s)	Max (s)
						Low. Bound	Up. Bound		
Male - Boys									
<b>All Male</b>	<b>8.04</b>	<b>0.72</b>	<b>8.96</b>	<b>0.09</b>	<b>1.13</b>	<b>7.86</b>	<b>8.22</b>	<b>6.41</b>	<b>10.06</b>
U15 M	8.37	0.69	8.24	0.13	1.54	8.10	8.63	7.32	10.06
U17 M	7.83	0.76	9.71	0.17	2.11	7.49	8.18	6.41	9.62
U19 M	7.64	0.36	4.71	0.10	1.30	7.43	7.86	6.85	8.27
Female - Girls									
<b>All Female</b>	<b>9.16</b>	<b>0.83</b>	<b>9.06</b>	<b>0.07</b>	<b>0.75</b>	<b>9.03</b>	<b>9.30</b>	<b>7.15</b>	<b>11.54</b>
U15 F	9.56	0.77	8.05	0.10	1.00	9.37	9.75	7.91	11.54
U17 F	9.10	0.86	9.45	0.14	1.55	8.81	9.39	7.35	11.16
U19 F	8.64	0.54	6.25	0.08	0.95	8.47	8.80	7.15	10.03

Based on obtained results (Table 1) average time achieved on modified X test can be determined, for male subjects time was 8.04±0.72 seconds, or 8.37±0.69, 7.83±0.76 i 7.64±0.36 seconds respectively for U15, U17 and U19 age categories. Based on level of coefficient of variation and relative values of standard error of measurement, it can be determined that the subject sample was very homogenous (cV% in the range of 4.71 to 9.71%), and that the results of measurement were very precise (SE<sub>rel</sub> in the range of 1.13 to 2.11%, Table 1). Average time on modified X test achieved by females was 9.16±0.83 seconds, or 9.56±0.77, 9.10±0.86 i 8.64±0.54 seconds respectively for

U15, U17 and U19 age categories. Female subsample of subjects was also very homogenous for the estimated abilities (cV% in the range of 6.25 to 9.45%), and the results were also very precise (SE<sub>rel</sub> in the range of 0.75 to 1.14%, Table 1).

TABLE II. RELIABILITY STATISTICS – TRIAL TO TRIAL TESTING PROTOCOL

Trial-by-Trial protocol	Cronbach's Alpha	95% Confidence Interval		F ANOVA	p
		Low. Bound	Up. Bound		
<b>All Male</b>	<b>0.827</b>	<b>0.708</b>	<b>0.898</b>	<b>5.794</b>	<b>0.000</b>
U15 M	0.777	0.657	0.977	4.943	0.037
U17 M	0.873	0.8701	0.946	7.877	0.000
U19 M	0.785	0.468	0.978	4.643	0.038
<b>All Female</b>	<b>0.830</b>	<b>0.707</b>	<b>0.901</b>	<b>5.889</b>	<b>0.000</b>
U15 F	0.851	0.656	0.936	6.723	0.000
U17 F	0.799	0.573	0.906	4.986	0.000
U19 F	0.743	0.427	0.885	3.894	0.001

ANOVA results showed that there were statistically significant differences between age groups for both male and female subject sample regarding the time needed to perform the modified X test at the level of  $F = 6.899$ ,  $p = 0.002$ , and  $F = 20.814$ ,  $p = 0.000$ , for male and female subjects, respectively.

Observing the male sample for different age groups, Bonferoni Post Hoc Test showed statistically significant differences between U15 vs U17 groups ( $p = 0.019$ ), as well as U15 vs U19 ( $p = 0.005$ ), while there was no statistically significant difference in modified X test results between U17 vs U19 groups of male subjects. Observing the female subjects sample statistically significant differences were observed for all pairs of different age groups: U15 vs U17 ( $p = 0.009$ ), U15 vs U19 ( $p = 0.000$ ), as well as U17 vs U19 ( $p = 0.015$ ).

Between different age groups, in the function of gender, it was determined that male subjects performed the task of modified X test statistically significantly faster compared to female subjects: U15 M vs U15 F (Table 1, 8.37 vs 9.56,  $F = 50.67$ ,  $p = 0.000$ ); U17 M vs U17 F (Table 1, 7.83 vs 9.10,  $F = 31.85$ ,  $p = 0.000$ ); and U19 M vs U19 F (Table 1, 7.64 vs 8.64,  $F = 38.11$ ,  $p = 0.000$ ).

TABLE III. RELIABILITY STATISTICS – TRIAL TO TRIAL TESTING PROTOCOL

Day-by-Day protocol	Cronbach's Alpha	95% Conf. Int.		F ANOVA	p
		Low. Bound	Up. Bound		
<b>Male</b>	<b>0.894</b>	<b>0.821</b>	<b>0.937</b>	<b>35.59</b>	<b>0.000</b>
U15 M	0.782	0.322	0.930	7.46	0.017
U17 M	0.866	0.677	0.944	29.20	0.000
U19 M	0.881	0.713	0.951	5.42	0.030
<b>Female</b>	<b>0.835</b>	<b>0.785</b>	<b>0.872</b>	<b>54.47</b>	<b>0.000</b>
U15 F	0.803	0.663	0.885	21.81	0.000
U17 F	0.792	0.710	0.850	31.56	0.000
U19 F	0.796	0.583	0.901	2.71	0.110

Results of Trial-by-Trial protocol showed (Table 2) that, on the general level values of Cronbach's Alpha coefficient for male subjects 0.827 (from 0.708 to 0.898), and for female subjects 0.830 (from 0.707 to 0.901), and that in both cases it is highly statistically significant ( $p = 0.000$ ). For all age groups statistically significant partial reliability was determined (Table 2, from  $p = 0.000$ ,  $F = 7.88$  for U15 M to  $p = 0.038$ ,  $F = 4.64$  for U19 M).

Results of Day-by-Day protocol showed (Table 3) that, on the general level values of Cronbach's Alpha coefficient for male subjects 0.894 (from 0.821 to 0.937), and for female subjects 0.835 (from 0.785 to 0.872), and that in both

cases it is highly statistically significant ( $p = 0.000$ ). For all age groups statistically significant partial reliability was determined (Table 3, from  $p = 0.000$ ,  $F = 31.56$  for U17 F to  $p = 0.030$ ,  $F = 5.42$  for U19 M), except for U19 F ( $p = 0.110$ ,  $F = 2.71$ ).

On the Graphs 1 and 2 Linear Regression Analyses was shown for overall male and female Trial-to-Trial and Day-by-Day protocol test samples aggrement between Modified X test trials. Based on obtained results it can be observed that both male and female subjects at the general level there is a statistically significant ( $p = 0.000$ ) common variability of 62.2 and 61.6 i.e. 69.4 and 51.3% for applied protocols in relation to measured motor ability, respectively.

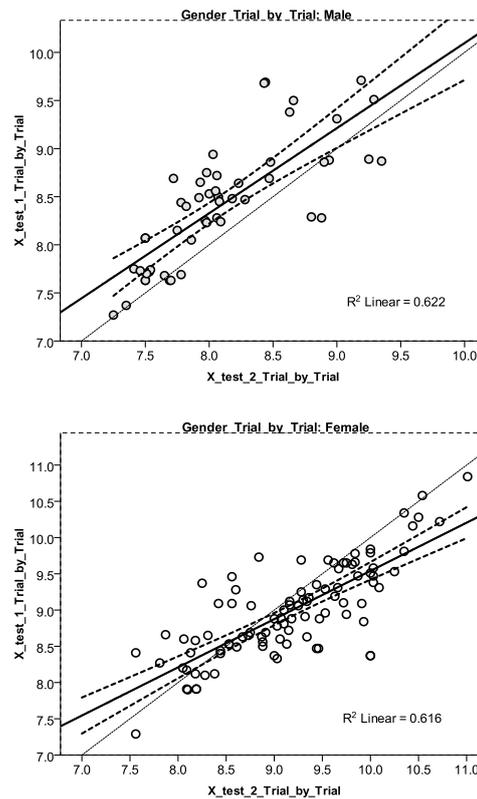


Fig. 2. Linear Regression analyses results of overall male and female sample: Trial-to-Trial protocol

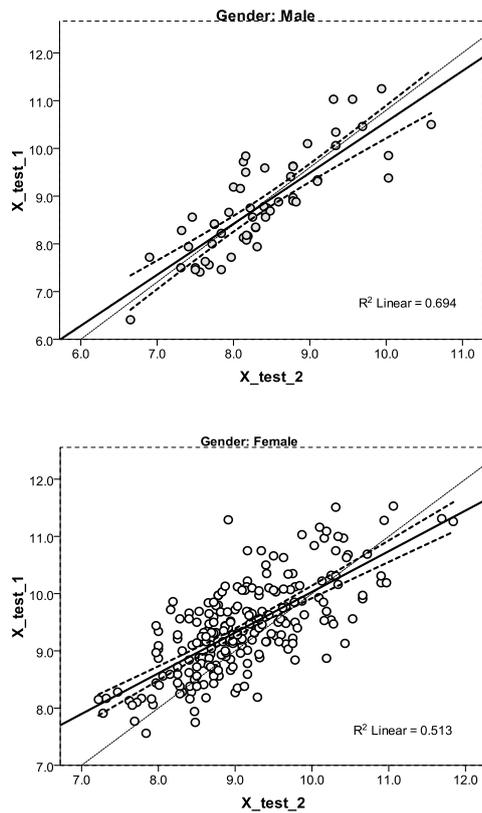


Fig. 3. Linear Regression analyses results of overall male and female sample: Day-to-Day protocol

#### IV. CONCLUSION

In general, based on the obtained results it can be concluded that the applied modified X test, for specific volleyball running agility with changes of directions, is statistically reliable (Trial-to-Trial protocol at 0.827 and 0.830, Day-to-Day protocol at 0.894 and 0.835 for boys and girls, respectively) and sensitive to observed age groups of subjects (U15, U17 and U19 players), and therefore it can be recommended for use in volleyball training technology according to presented test protocol with youth age categories, as well as, for both genders.

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Conflict of interest: not declared.

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