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The vertical and standing long-jump test as a determinant of sprinting abilities in young football players (13 - 14 years old).

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ABSTRACT

The aim of this study was to assess the correlation between the sprinting abilities with the results of the vertical jump-test and the standing long jump-test, in young football players (13-14 years). The study is based on the descriptive method. Thirty (30) young football players participated in this study. In each test, the player is allowed three repetitions. Statistical analysis of the data, using the Spearman test, showed a strong correlation between the results of the sprinting-test (10 meters sprint), and those of the standing long jump-test and vertical jump-test.

Keywordsstanding - long-jump test - determinant – sprinting- abilities - young football players-

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1-INTRODUCTION

In recent years, Various scientific studies, based on the analysis of the types of effort carried out by the players during the competition, have shown that modern football is characterized, on the one hand, by intermittent efforts (succession of intense, short and repeated efforts, interspersed with more or less passive recovery periods), and on the other hand, by an increase in the frequency of intense and short-term efforts (number of sprints, sudden acceleration, blockages and change of direction, struggles with and without the ball, jumps followed by acceleration etc.) (Ancian, J.P., 2008.; Bangsbo, J. and al.,1991). Based on this observation and, taking into account the current modeling of the activity, the physical preparation of the football player must, according to Turpin (2002), be oriented in two directions: the first one concerns the improvement of speed and strength training, which constitute determining qualities that would make it possible to destabilize the opposing team's defense system (Haceini, A., 2020, p.02; Hamouani, K. & Kasmi, A., 2020, p.122); the second one is the endurance training (Turpin, B., 2002, p.15).

Nowadays, strength training in its various forms constitutes, thanks to its direct or indirect impact on all sports’ performance factors, the most effective training mean, to optimize the athletes’ physical qualities in general, and those of football players in particular. indeed, in order to be effective and efficient on the technical and tactical level, players must not only, be enduring, but also present qualities of strength, power, speed and explosiveness (Haceini, 2020; Cazorla et Farhi, 1998 ; Montbaerts, 1991). The importance of strength training in football is therefore justified, as explained by Verheijen (1991, p.91.) by the fact that "competition requires a great deal of effort, not least because the tactical developments of modern football reduce the playing space to its simplest expression, and, as a result, players have less time to act, they are frequently in contact with their opponents and therefore have to distance themselves from them more often, play the ball harder, be faster and jump higher compared to what the football player did in the past". The footballer must be both fast and powerful in order to be able to produce short and decisive actions (Turpin, 2002, p.10).

Concerning the contribution of the development of muscular strength in sports training, many studies have noted, on this subject, the increase in motor performance in various sports disciplines thanks to muscular strengthening work; this increase is noted in both young people and adults(Sales,1988; Kraemer, and al.,1988).

With regard to the relationship between strength training and other forms of motor solicitation, scientific studies have noted on this subject that this type of work is accompanied, in addition to the improvement of muscular strength, by the development of speed qualities, the ability to jump, coordination, flexibility and balance(Adams, and al.,1992; Hoffman &Almasbakk, 1995). In children and teenagers, strength training aims to optimize performance capacity, the prophylaxis of attitude defects and the risk of injury (Weineck, 1997, p.277). The timely development of this physical performance factor, depending on age, is of crucial importance for the further development of athletic performance (Gropler and Thieb, in weineck, 1997, p.277).

On his part, weinek (1997, p.276.) argues that, a large number of children and teenagers, fail to achieve their maximum potential performance in sport simply, because, the stimuli applied, during the growth phase, to promote the development of the locomotor system, were insufficient. In this regard scientific studies show that, the phase of greatest improvement in muscle strength training capacity, occurs around puberty (Komadel, in weineck, 1997, p.289). In the same order of thought, American studies have shown that the period (12-14 years) has a particularity insofar as it is the moment when the proportion of intermediate fibers - they cannot be clearly classified as either slow twitch fibers (st = type I), nor in fast twitch fibers (FT = type II) - amounts to 14 ٪ in boys and about 10٪ in girls and therefore, appropriate training can transform them into ST or FT muscle fiber types , and this opportunity should be taken into account in strength-speed training (weineck, 1997, p.185).

Before puberty, the increase in strength is achieved much more by improving intermuscular and intramuscular coordination than by increasing muscle cross-section (hypertrophy); it reaches its maximum development at 18 years of age in boys, both in the legs and arms. In terms of muscle power, the fastest increase in jumping strength occurs during childhood and adolescence, and further progress can be significantly improved by corresponding strength-speed training (Letzelter, 1990, p.169).

According to Turpin (1998, p.71), Dornhoff (1993, p.86),Calvin and Waty (2006, p.37) the development of "explosive strength" or even "jumping strength", should start at an early age, and the most favorable phase for training of this quality is between 13 and 16 years of age and therefore, measuring the power of anaerobic metabolism becomes important in children, because this is the ideal time, to detect young talents and guide them towards explosive sports (Sadouki, K., 2020, p.16).

Physiologically, the level of muscle power is conditioned by the structure of the muscle, intramuscular and intermuscular coordination, motor speed, working angle, types of motor solicitations and the corresponding nervous control mode, namely the type of motor control program (short or long innervation program). On this subject, Bauersfeld (1997, pp.178-181) asserts that movements with similar structures are executed with the same type of programming. Regarding energy supply, muscle power is largely dependent on ATP derived from the breakdown of phosphocreatine (PCr). From a practical point of view, this energetic process and muscle quality are evaluated by several tests such as: force-velocity tests on the cycle ergometer (Khiat, 2010), vertical jump test (Koutchouk, 2011; Chenouf and Nacer, A.K.,2017). Deradji and Mazari, 2020), the RAST test (Hallouz and Hannat, 2019) squat jump and countermovement jump (Sayeh et al., 2020), And others use the sprint running tests, like 30 meters (Bensalem et al., 2020; Ghidi and Sedira, 2019) and 40 meters (Mokkedes, 2013).

The biomechanical approach shows that the muscle contraction strength depends on the muscle-joint couple, that is the distance where the stressed muscles are inserted from the center of the joint; the articular angle formed by the bone segments involved in the movement; the possibilities of transmitting the force to the individual bone levers; the direction of the strength towards the external environment (1999, pp.302-307). On this subject, Hettinger (in weineck, 1997, p.230.) explained, with regard to the working angle (flexion) between the arm and forearm, that the maximum force developed by the muscles connecting the two levers is between 80 and 100 degrees. The physiological explanation for the variation in the level of force lies in the sarcomere, where there is, in fact, a fundamental pattern which indicates that the force developed is a function of the actin filaments sliding position. The closer the actin and myosin filaments get to the intermediate position, the number of bridges between these two types of filament is then maximum and therefore, there is more production of strength by the contractile unit (sarcomere). If, on the contrary, the sarcomere is lengthened, the number of contact zones between actin and myosin is reduced and consequently, the force produced decreases (Marieb,1999, p.285).

From a methodological and pedagogical point of view, the assessment of one or more of the determinants of sports performance, as is the case in our study, is of particular interest in the process of designing and planning sports training. Indeed, it will be used to determine the athlete's strengths and weaknesses and, consequently, to readjust the training process. from a practical perspective, the assessment of muscular power through appropriate tests such as, the vertical jump-test, standing long jump-test and the 10-meter sprint-test, could be justified, firstly, by the fact that these tests are reliable and practical; secondly, the results of these tests could, moreover, contribute to better structuring and adapting the training process in young people (detection, selection, orientation and design of training strategies and programs). Considering the fact that the age of the study group subjects, coincides with the rapid growth phase which is characterized, by a very marked imbalances between the different body dimensions and, also, on the basis of the various data on which we based our reflection, we conceived the problematic of this study on the following questioning : Are the vertical jump-test and standing long jump-test reliable for measuring the sprinting abilities of young football players (13-14 years old); in other words, do the results of the sprint-test significantly correlate with those of the standing long jump-test and the vertical jump-test?

1. Method and Materials

The aim of this study was to verify whether there is a relationship or correlation between the performances of the sprint-test (10 metres) and those of the vertical jump-test and the standing long jump-test. To achieve this objective, we used the descriptive method based on the correlative study.

2.1.Identification and definition of research variables

-Sprinting abilities

The ability of the physical qualities to perform motor actions with high or maximum intensity in the shortest time (Schnabel, in weineck, 1997, p.293).

- The vertical-jump

It is an athlete's vertical jump power; in other words, an index of lower limb power (Broussal, A., Bolliet, O., 2012, p.38).

For his part, Badin (1991) defines vertical jump power as "the ability of the neuromuscular system to overcome resistance with the greatest speed contraction possible". While, LE GUYADER (1987), specifies that it is "the physical quality which makes it possible to suddenly contract part or all of the muscles". It results from the contraction-relaxation cycle of muscle groups.

- **The standing long-jump**

This is horizontal jumping power (an index of power and plyometric coordination of the lower limbs (Broussal, A., Bolliet, O., 2012, p.34).

2.2.Participants

Thirty (30) young footballers (13-14 years old, height: 163 / + - 2.5 cm, weight: 51 / + - 1.5 kg), took part in this study. all the players play in the wilya championship of tizi ouzou. Regarding the sampling technique, the subjects were selected on the basis of the convenience sampling technique.

2.1. Materials

To measure the performances related to the vertical jump-test, we used the following equipment: Plane and rigid jumping surface - a measuring tape, a ruler or a measuring stick - chalk of a color other than that of the wall. However, to carry out the standing long jump-Test, we used the following equipment: Plane jumping surface measuring 6 meters in length - A sufficiently long measuring tape - Adhesive tape or chalk. The 10-meter sprint-test requires the following elements: Reliable and consistent test facility of at least 20 m in length; Test timekeepers (minimum of 2); stopwatch; Marker Cones; Performance recording sheet.

2.2. Design and Procedure

The players were evaluated in 3 different periods by three timekeeper. The time between one period and the other is 3 weeks. Before the tests were carried out, the players warmed up for 15 to 30 minutes. Each participant had to perform 3 trials in each test (vertical jump-test, standing long jump-test and sprint-test). The recovery time between trials is 2-3 minutes, and between one test and other is 5-7 minutes. The study took place between February and April 2019, that is to say (i.e.) during the 2018/2019 sports season.

2.2.1. vertical jump-test

Purpose

Evaluate the vertical jump power of an athlete - establish a power index of the lower limbs **(**Derval, A-B, &Bollet O., 2012, p.38).

Test procedure

The athlete smears his fingers with chalk - standing upright, shoulder about 15 cm from the wall, feet flat on the ground, the athlete raises his dominant arm as high as possible and makes a first mark of chalk on the wall - Then, without changing position, the athlete immediately makes a counter-movement and jumps as high as possible. At the peak of the jump, the athlete touch the wall again with the same hand - The strength of the jump is then the gap between the two marks - 3 tests are allowed, the best result of the 3 tests is recorded.

2.2.2. The standing long-jump-test

Purpose.

Evaluate the horizontal jump power; establish a power index of the lower limbs; evaluate plyometric coordination (Derval, A-B, &Bollet O., 2012, p.34).

Test procedure.

Establish a line of one meter wide with chalk or tape to mark the starting point - The athlete stands straight, feet side by side, toes behind the starting line - With the help of a against movement, the athlete tries to jump as far as possible, then starts again 2 or 3 times - the athlete must land balanced on both feet to validate the test during each jump - a mark with the chalk or the elastic band is established behind the farthest heel - set the distance from start to finish using the measuring tape and the distance of each jump - Record the best result on 3 runs.

2.2.3. Sprint-test (10-meters).

This is a simple test used to measure an athlete's ability to accelerate as quickly as possible (weineck, 1997, p.342). It is a test protocol that measures the acceleration capacity in sports disciplines that often involve short sprints, as is the case in football. Sports that include any form of short distance acceleration should often include 10, 20 and 30 meters sprint tests in their performance test battery (Turpin, 2002b, p.55).

Test procedure

- Participants must warm up before the start of the test; Warm-ups should correspond to the biomechanical and physiological nature of the test.

- In addition, sufficient recovery (eg 3-5 minutes) should be given to athletes after the warm-up and before the start of the test.

- The participants prepare on the start line.

- The timekeeper must stand on the finish line to record sprint time.

- Each participant has to perform a minimum of three sprints, a rest of 2-3 minutes is granted after each sprint.

- At the signal "GO", the participant has to accelerate as fast as possible towards the finish line.

Rating system

The average of the three repetitions provides a total sprint time of 10m. This is done using the following equation: The average time (seconds) over 10m = (sprint time1 + sprint time2 + sprint time3) / total number of sprints.

	Statistical Analysis

2.2.4. validity and Fidelity

Validity means that the test measures what it is supposed to measure and nothing more. Regarding this criterion, we believe that the tests chosen in this study (10-meter sprint-test; vertical jump-test; The standing long-jump) are validated by several sports science specialists (Derval, A-B, & Bollet O .; 2012; Turpin, 2002b; Le Gall, 2002; Weineck, 1997; Vrilac & Serini, 1997; Brikci and al., 1990).

Fidelity-test is an estimate of the degree to which the test provides consistent results. It assesses whether the test measures the expected dimension with little error in measurement, that is to say the test should give similar results regardless of the day and circumstances of its taking. To estimate this aspect, we subjected the tests to a so-called “test-retest” procedure. A sample of 10 subjects outside the study group was evaluated on two occasions spaced 2 weeks apart. The fidelity coefficients of the tests (table N°01) vary between 0.84 and 0.90.

Tests	A coefficient of fidelity
vertical jump-test.	0,84
The standing long jump-test.	0,90
Sprint-test (10-meters).	0,90

Table (N°01): statistical data related to the fidelity test

2.3. Statistical Analysis

	means (m)	(SD)	Sample (n)	coefficient (R),	significance level
The vertical jump-test.	34,05	(+/-) 2,92	30	0,93	0,02
Sprint-test (10-meters).	2,25	(+/-) 0,07	30		
The standing long jump-test (cm)	165.5	(+/-) 4,04	30	0,88	0,03
Sprint-test (10-meters).	2,25	0,07	30		

Statistical analysis is performed using SPSS software; it includes descriptive statistics, the Shapiro-Wilk (SW) test to check whether the sample is from a normally distributed population, and a Spearman correlation test.

Results

Table N°02: Results of the Shapiro-Wilk test (normality test)

Tests/ statistical parameters	mean (cm)	Shapiro-Wilk test (SW)	degrees of freedom.	significance level
The standing long jump-test	185.5	0.228	30	0.00
The vertical jump-test.	35,05	0.231	30	0.01
Sprint-test (10-meters).	2.20	0.226	30	0.02

The statistical data in table (N°02) shows that, the shapiro-wilk test results related to the standing long jump-test (0.228), Vertical Jump-test (0.231) and the Sprint-test (0. 226) are significant at $\alpha \leq 0{,}05$ and therefore, they confirm that the statistical data related to these three tests, do not follow the normal law, in other words, they do not follow the curve of the normal distribution and consequently, the assessment of the correlation coefficient (R), between the results of these different tests, must be done using the Spearman test, and, not on the basis of the Pearson correlation test.

Table N°03: Spearman's correlation coefficient (r) of the first assessment

The results of the table (N°03) show that there is a strong correlation between the Sprint-test and the Vertical Jump test (0,93), and also between the Sprint-test and the standing long jump-test (0,88). Indeed, the values of the spearman correlation coefficient (r) are significant, respectively, at the significance level of (0.02) and (0.04).

Table N°04: Spearman's correlation coefficient (r) of the second assessment

Type of test	Statistical Analysis				
	means (m)	(SD)	Sample (n)	coefficient (R),	significance level
The vertical jump-test.	35,95	(+/-) 1,67	30	0,91	0,04
Sprint-test (10-meters).	2,27	(+/-) 0,04	30		
The standing long jump-test (cm)	169.5	(+/-) 3,09	30	0,90	0,05
Sprint-test (10-meters).	2,27	0,04	30		

The results of the table (N°04) show that there is a strong correlation between the Sprint-test and the Vertical Jump test (0,91), and also between the Sprint-test and the standing long jump-test (0,90). Indeed, the values of the spearman correlation coefficient (r) are significant, respectively, at the significance level of (0.04) and (0.05).

Table N°05: Spearman's correlation coefficient (r) of the third assessment

Type of test	Statistical Analysis				
	means (m)	(SD)	Sample (n)	coefficient (R),	significance level
The vertical jump-test. (cm)	33,95	(+/-) 2,67	30	0,89	0,05
Sprint-test (10-meters).	2,28	(+/-) 0,05	30		
The standing long jump-test (cm)	168	(+/-) 5,09	30	0,87	0,03
Sprint-test (10-meters).	2,28	0,04	30		

The results of the table (N°05) show that there is a strong correlation between the Sprint-test and the Vertical Jump test (0,89), and also between the Sprint-test and the standing long jump-test (0,87). Indeed, the values of the spearman correlation coefficient (r) are significant, respectively, at the significance level of (0.05) and (0.03).

2. Discussion

This study aims to assess the correlation between performance related to the sprint-test (10 meters) and those related to the vertical-jump test and the standing long jump-test in young footballers (13-14 years).Through the various statistical data mentioned in the tables N° 03, N°04 and N°05, we have found that the performances linked to the 10-meter sprint-test (2.25 – 2.27 and 2.28) are strongly and significantly correlated with those of the vertical jump-test (34,05- 35,95 and those of the standing long jump-test (165.5- 169.5and 168).These results corroborate the findings of various specialists who confirm, that rapid and sudden actions (jumping then accelerating, sprinting then changing direction etc.) are, directly, linked to the muscular contraction strength (Adams & al.,1992; Hoffman & Almasbakk,1995). On the basis of these data, we can, therefore, confirm that the performances related to the speed-test are, positively, correlated with those obtained during the vertical jump-test and the standing long jump-test.

This observation, also, leads to the conclusion that there is a concordance, between these findings and those of previous studies, that have examined the relationship between strength training and the physical factors of sports performance. In fact, several of these studies have confirmed that the level of muscular strength is positively correlated with other forms of motor solicitation or physical qualities such as: speed, balance, coordination, jumping ability and flexibility (Adams & al., 1992; Hoffman & Almasbakk, 1995; Cometti & Cometti, 2007).

Physiologically, the level of muscle power is conditioned by the structure of the muscle, intramuscular and intermuscular coordination, motor speed, working angle, types of motor solicitations and the corresponding nervous control mode, namely the type of motor control program (short or long innervation program). On this subject, Bauersfeld (1997, pp.178-181) asserts that movements with similar structures are executed with the same type of programming. Regarding energy supply, muscle power is largely dependent on ATP derived from the breakdown of phosphocreatine (PCr) (Dellal, 2008, p.174). The variation in performance in the three tests (standing long-jump, vertical-jump and sprint-test) can be explained, mainly, by : the intramuscular coordination (the number of motor units recruited, synchronization of the motor units work and the frequency of electrical discharge of these motor activities) ; intermuscular coordination (synchronization of the agonist and antagonist muscles) (Weineck, 1997, Letzelter 1990) ; myotatic reflex intervention (Schmidbleicher, 1985) ; the Golgi receptor threshold ; the coupling time (Bosco, 1985) ; the muscle stiffness (Pousson, 1984) ; growth and the effects of the usual training programs to which the players are subjected. This leads to the conclusion that the neuromuscular coordination is the basis of the performances specific to the standing long-jump test, vertical-jump test and sprint-test.

Also, through the results of this study, we have, also, found that the subjects do not respond in the same way to the proposed situations, this finding confirms the conclusions of several studies (Manno,1989; Hawleyand Burke, 1988; Weineck, 1997). This variation in motor performance can be explained by the fact that individual reactions to training stimuli are conditioned by personal factors (genetic, physiological, psychological, etc.)(Cometti, 1988). All these factors must, therefore, be at the basis of the design and modeling of any sports training project, whether in the short, medium and long term.

Conclusion

The aim of this study was to assess the correlation between the sprinting abilities with the results of the vertical jump-test and the standing long jump-test, in young football players (13-14 years). In order to achieve this goal, we used the descriptive method based on the correlative study. Statistical analysis includes descriptive statistics, the Shapiro-Wilk-test to check whether the sample is from a normally distributed population, and a Spearman correlation test. The statistical data confirm that the performances linked to the 10-meter sprint-test are strongly and significantly correlated with those of the vertical jump-test and those of the standing long jump-test. As pedagogical consequences, we can, therefore, conclude that the vertical jump-test and the standing long-jump-test can be used, as reliable teaching methods that would help, to better structure and guide the training process of young football players. The results of this study remain limited; indeed, due a lack of time and means, it was not possible to study and explore the variables on a large study sample and, also, to take into consideration the effect of variables related to the athletes' morphology. This is what we propose, as a problem for future studies.

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