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Anthropometry and biomotor contribution towards track and field with talent potential norms standardization for boys aged 11-14 years old

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Abstract

This study aims to develop a model of talent scouting athletic sports for boys with an age range of 11-14 years. The research method used is research and development. The data used is secondary data FROM Kemenpora TID Program. The results of validity test tell that the data obtained from the test and measurement results in two places, namely the State University of Solo (UNS), and the State University of Surabaya (UNESA), have good validity value on the anthropometry test items that are athlete height, Arm span and leg length. All test present that all of data is valid.

The data result and integration of reference of journal result of research got that is the percentage value of weight of athletic talent of children aged 11-14 years that is boys obtained values for height, arm, and leg length is 26.25%, while weight is 21.25%. Coefficient value for biomotor of male 14,29%.

The results of normality data test mention some data is distributed normal, spread value of data some test item also normal, also from result of reliability test obtained that component of test item is reliabel. Thus, the test component is considered reliable to be used as an identification item of athletic talent of children aged 11-14 years, it needs a review of the factors that affect the quality of data

From the results of this study obtained guidelines and identification norms of athletic talent of children aged 11-14 years. The norms and weight of this giftedness apply only to children of that age range, and can not be used for children over the age range, this is related to differences in development and growth of children before 14 years and after.

Keywords: Talen Identification; Athletics; Long Jump; 11-14 year old Boys

1. Introduction

There are several methods and factors involved in the process of improving performance. One of them is talent scouting. Talent scouting can be a bridge to accelerate performance improvement. The hope is that improving performance will no longer require a long time and require significant costs and materials. The talent scouting system in Indonesia currently still adopts the talent scouting system used by other countries. While this talent scouting system is certainly good, the problem arises from the disparity in conditions and situations in Indonesia and Australia. The physical condition of athletes in both countries differs, environmental conditions vary, and so on.

Richards Ralph (2016), in his research on Athlete Talent Identification and Talent Transfer, stated that there are two keys to talent identification: athletes identified through their chosen sport, which can be based on performance or on

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the athlete's physical, physiological, and psychological development. Furthermore, there are potential athletes identified outside of their chosen sport.

Referring to this, there are many ways to identify talented athletes, but these methods remain vague and uncertain. With Indonesia's abundant human resources, it's certainly not easy to find athletes with impressive abilities, although there are certainly some within them, genuinely gifted individuals who develop as talented individuals. These talents are sometimes channeled in inappropriate ways, and numerous factors influence this. Through talent identification, the development process, and the improvement of children's achievements can be easily directed, ensuring that no child's talents are neglected or misdirected. In the 2015 sports guidance and development manual, there are 15% of individuals who meet the criteria for being talented in sports and the rest are less talented.

Talent identification is a process of scouting students through various physical, physiological, psychological, and social tests and measurements. The stages, as outlined in the diagram above, demonstrate that these steps are not easily implemented. However, if implemented, it will be possible to identify and develop potential athletes capable of improving performance or regeneration, which takes considerable time.

Therefore, Indonesia, specifically in athletics, hopes to have a talent identification system capable of addressing performance improvement issues and helping accelerate national achievement. Athletics is a promising sport for contributing numerous medals. For example, a sprinter alone has the potential to win four or more medals in a single championship: the 100m, 200m, long jump, triple jump, and javelin. Therefore, all children with impressive potential will be identified through this process, and it is possible that Indonesia's achievements in athletics will also improve.

The scope of this research includes the creation of a valid and reliable athletic talent scouting model instrument, encompassing (1) anthropometric measurement components consisting of weight, height, arm span, sitting height, and leg length. (2) biomotor test components consisting of flexibility (sit and reach), 40M sprint, vertical jump, hop jump test (right and left), shocken throw, and beep test (VO2max).

The general objective of this research is to produce a valid and reliable instrument for scouting talented athletics, both in terms of anthropometric components and motor qualities. Specifically, this research aims to produce a guideline for a talent scouting model for young athletic athletes related to valid and reliable anthropometric measurement norms, biomotor test norms, and giftedness category norms.

2. Methods

The research was quantitative, employing research and development (R&D) methods. Generally, this is a correlational study developed into a talent scouting standard through the R&D phase. The population was children aged 11-14. The research locations were Surabaya State University (Surabaya), and Solo State University (Solo).

The physical parameter test components for Athletics were developed based on a review of references from sports experts and related journals, as well as discussions with the Indonesian Athletics Association (PASI) Executive Board regarding the physical fitness requirements of Athletics. The selected tests are indicators of supporting factors for athletics achievement. They are easy to administer and accurate enough to measure anthropometric indicators and physical abilities of athletes according to their respective athletics disciplines. These variables are anthropometric: height, weight, arm span, leg length, and biomotor components: sit and reach, vertical jump, 40m sprint, and beep test.

The developed instrument was then consulted with subject matter experts in a focus group discussion (FGD) to validate and evaluate the product's strengths and weaknesses. Experts in the field of athletics were appointed. The correlation between the data results and expert judgment scores was then evaluated, assessing the instrument's strengths and weaknesses. The resulting data were then analyzed to determine its validity and reliability. The Kolmogorov-Smirnov test for normality was used to determine whether the data were normally distributed.

Data analysis used Exploratory Factor Analysis (EFA) to weight the athletic talent of athletes. After all data had been validated and reliable, norms were created using categorization with standard deviations and means. For each norm level, a score of 1 (one) was assigned to the lowest scale, "Very Poor," and a score of 5 was assigned to the highest scale, "Very High." Next, percentage of each anthropometric and bio motor component was performed using SPSS calculations.

3. Results

3.1. Validity Test

3.1.1. Anthropomtery Validity Test

Anthropometric validity tests on boys in large groups are presented in the following table.

Tabel 1 Anthropometry Validity Test

No	Item Test	Boys		
		Corrected Item-Total Correlation		**Category**
		p.value	***r-Tabel***	
1	Body Height	0.811	0.285	Valid
2	Body Weight	0.621		Valid
3	Arm Span	0.614		Valid
4	Leg Length	0.499		Valid

Note:

*) =Valid if *p. value.* > *r-Tabel*

The results of the validity test of anthropometric measurements, in boys are the four indicators for measuring anthropometry were declared valid (p.value > r-Table), except for the weight item in female test children, which was declared invalid with a p.value < r-Table.

3.1.2. Biomotor Validity Test

Biomotor validity tests on boys in large groups are presented in the following table.

Tabel 2 Biomotor Validity Test

No	Item Test	Boys		
		Corrected Item-Total Correlation		**Category**
		p. value	***r-tabel***	
1	Flexibility	0.574	0.285	Valid
2	*Vertival Jump*	0.571		Valid
3	Sprint 40m	0.556		Valid
4	*3Hops Jump* Right	0.690		Valid
5	*3Hops Jump* Left	0.766		Valid
6	*Throw Shocken*	0.871		Valid
7	*Beep Test*	0.581		Valid

Keterangan: *) =Valid if *p. value.* > *r-Tabel*

According to results that all biomotor items are valid.

3.1.3. Reability Test

Reliability testing in this study used the Cronbach Alpha coefficient, the results are summarized in the following table.

Tabel 3 Reability Test

		Cronbach's Alpha Based on Standardized Items		Category
		p. value	*r - Tabel*	
Anthropometry	Boys	0.842	0.285	Reliabel
Biomotor	Boys	0.511	0.285	Reliabel

The table above shows that the Anthropometry measurement instrument and biomotor test, both in male children, were all declared reliable with a p.value > r-Table.

3.1.4. Normality Test

The normality test for data distribution uses the Shapiro Wilk test analysis technique and the results of the normality test for distribution are presented in the following table.

Table 4 Normality Test

	Putra	
	Item	Sig.
Anthropometry	Body Height	0.211
	Body Weight	0.367
	Arm Span	0.221
	Leg Length	0.321
Biomotor	Flexibility	0.327
	Vertical Jump	0.676
	Sprint 40m	0.561
	3Hops Right	0.781
	3Hops Left	0.341
	Shocken Throw	0.219
	Beep Test	0.311

The normality test results table above shows that all variables are normally distributed. Therefore, all items are interrelated and were included in the study.

3.2. Factor Analysis (EFA)

3.2.1. KMO Test

Model feasibility was assessed using the Keiser-Meyer-Olkin Measure of Sampling Adequacy (KMO) and Bartlett's Test of Sphericity. The KMO is used to measure sample suitability, while the Bartlett's Test of Sphericity is used to determine whether factors in a variable are significantly correlated. The resulting KMO value must be above 0.5 for the factor to be considered suitable for use in research. If the Bartlett's Test of Sphericity and significance values are expected to be very small (<0.05), there is a significant relationship between the variables.

The results of the analysis are presented in the following table, while the complete analysis results can be seen in the appendix.

3.2.2. KMO and Bartlett's Test

Tabel 5 KMO and Bartlett's Test of Sphericity

Kaiser-Meyer-Olkin Measure of Sampling Adequacy.	**0.770**
Bartlett's Test of Sphericity	356.453
Approx.hi-Square df sig.	660.000

Based on the table above, the Bartlett's Test of Sphericity value was 356.453 with p<0.05, which means that there is a very significant correlation between the factors; while the KMO result of 0.770 indicates that the sample suitability is high (>0.5).

3.2.3. Anti-Images

Tabel 6 MSA (Measure of Sampling Adequacy

No.	Items	MSA	Note
1.	Body Height	0.867	Include
2.	Body Weight	0.777	Include
3.	Arm Span	0.825	Include
4.	Leg Length	0.691	Include
5.	Flexibility	0.728	Include
6.	Vertival Jump	0.865	Include
7.	Sprint 40m	0.740	Include
8.	3Hops Jump Right	0.718	Include
9.	Hop Jump Left	0.752	Include
10.	Shocken Throw	0.809	Include
11.	Beep Test	0.819	Include

The Anti-Image Matrix is essentially used to identify variables/factors that should not be included in factor analysis due to their low significance level. This matrix displays the diagonal values marked "a," indicating the MSA (Measure of Sampling Adequacy) of the factor/variable. If an MSA value is less than 0.5, the indicator should be removed (not included in the test). The results of the MSA (Measure of Sampling Adequacy) analysis are presented in the following table.

Referring to the analysis results above, all MSA values were above 0.5 (>0.5). Therefore, all indicators were included in the analysis and none were excluded.

3.3. Communalities

The communalities value is the variance explained by the factors formed for each research variable. The communalities values are presented in the following table.

Tabel 7 Nilai Communalities Item tes Antropometri

No	Item Tes	Communalities
1.	Body Height	0.858
2.	Body Weight	0.821
3.	Arm Span	0.822
4.	Leg Length	0.605

Tabel 8 Nilai Communalities Item tes Biomotor

No	Item Tes	Nilai
1.	Flexibility	0.861
2.	Vertival Jump	0.852
3.	Sprint 40m	0.849
4.	3Hops Jump Right	0.832
5.	Hop Jump Left	0.712
6.	Shocken Throw	0.519
7.	Beep Test	0.345

From the table above, for example, it can be seen that in the variables of this athletic talent scouting model, the first indicator (height) has a value of 0.818, meaning that 81.8% of height can explain the athletic talent scouting model; the second indicator (weight) is 56.8%; arm span is 85.1% and so on.

3.4. Norms

Norms are compiled using a categorization process based on value intervals. The classification process is carried out using standard deviation and mean. Classification is done by dividing into five levels: the highest category: Very Good, Good, Moderate, Low, and Very Low. The range between these categories is determined by utilizing the data mean and standard deviation. The following table provides guidelines for determining norm categories:

Tabel 9 Pedoman Klasifikasi Norma

Klasifikasi	Interval
Very Good	X > M+1,5 SD
Good	M + 0,5 SD < X ≤ M + 1,5 SD
Medium	M – 0,5 SD ≤ X ≤ M + 0,5 SD
Low	M – 1,5 SD ≤ X ≤ M – 0,5 SD
Very Low	X < M – 1,5 SD

3.5. Anthropometry Norms

3.5.1. Body Height Norms

The norm results for measuring body height for boys are presented in the following table:

Tabel 10 Body Height Norm

No	Height(Cm)	Category
1	>173	Very Good
2	163-172	Good
3	153-162	Intermediate
4	143-152	Low
5	<142	Very Low

3.5.2. Body Weight Norms

Body Weight Norms are presented in the following table.

Tabel 11 Norma Body Weight

No	Weight (Kg)	Category
1	>62	Very Good
2	51-61	Good
3	39-50	Intermediate
4	28-38	Low
5	<27	Very Low

3.6. Arm Span

The Arm Span measurement results are presented in the following table.

Tabel 12 Norma Arm Span

No	Arm Span(Cm)	Category
1	>178	Very Good
2	167-177	Good
3	155-166	Intermediate
4	143-154	Low
5	<142	Very Low

3.6.1. Leg Length Norms

The normal results for leg length measurements are presented in the following table.

Tabel 13 Norma Leg Length

No	Leg Length (Cm)	Category
1	>101	Very Good
2	95-100	Good
3	89-94	Intermediate
4	83-88	Low
5	<82	Very Low

3.7. Biomotor Norms

3.7.1. Sit and Reach (Flexibility)

The norms for sit and reach measurement results are presented in the following table.

Tabel 14 Norma *Sit and Reach* (Flexibility)

No	Flexibility (Cm)	Category
1	>41	Very Good
2	33-40	Good
3	25-32	Intermediate
4	17-24	Low

5	<16	Very Low

3.7.2. Vertical Jump

The normal results for vertical jump measurements are presented in the following table.

Tabel 15 Norma *Vertical Jump*

No	Jump (Cm)	Category
1	>60	Very Good
2	49-59	Good
3	38-48	Intermediate
4	26-37	Low
5	<25	Very Low

3.7.3. Hop Jump Norms

The Hop Jump measurement results norms are presented in the following table.

Tabel 16 Norma *Hop Jump* Putra

No	Right(Cm)	Left (Cm)	Category
1	>6,60	>6,55	Very Good
2	5,60-6,59	5,57-6,54	Good
3	4,61-5,59	4,60-5,56	Intermediate
4	3,62-4,60	3,62-4,59	Low
5	<3,61	<3,61	Very Low

3.7.4. Shocken Throw

The shock throw norms are presented in the following table.

Tabel 17 Shocken Throw Norm

No	Meter	Category
1	>11,28	Very Good
2	8,54-11,27	Good
3	5,80-8,53	Intermediate
4	3,07-5,79	Low
5	<3,06	Very Low

3.7.5. Sprint 40M (Speed)

The 40M sprint norms are presented in the following table.

Tabel 18 Sprint 40M

No	seconds	Category
1	<5,76	Very Good
2	6,26-5,77	Good
3	6,76-6,27	Intermediate
4	7,25-6,77	Low
5	>7,26	Very Low

3.7.6. Beep Test (VO2Max)

The beep test norms (VO2Max) are presented in the following table.

Tabel 19 Beep Test (VO2Max)

No	(mlHg)	Category
1	>41,79	Very Good
2	35,95-41,78	Good
3	30,12-35,94	Intermediate
4	24,28-30,11	Low
5	<24,27	Very Low

4. Discussion

Anthropometry is made up of height, weight, arm span, and leg length. We already have known from references that height and leg length are of prime significance for optimal performance attainment. The values obtained for the variance calculations are given below: height (0.839), arm span (0.838), weight (0.614), leg length (0.586)."Ultimately, to move faster, humans increase a measure of stride rate and stride length. For slow and medium pace runners, stride length is optimized by increasing support forces, while for fast and sprint runners, stride rate is optimized by increasing leg swing speed."(Dorn, et al., 2012, p. 215).

Athletics comprises two categories of events, which are track and field. The track events include short, middle, and long-distance running, plus race walking. The other category, which is the field events, includes throwing, jumping, which can be further divided into vertical and horizontal jumps.

From the categories of events, the major events in each can be readily classified. Track events include the short distance, middle distance, long distance, and race walking events. These events can be seen to be events that require, to a great extent, running and walking. From the nature of the activities, the body parts extensively used, the major muscles involved, and the conditions that favor the activities can be worked out. Pandi and Sultana said that the sprinters and jumpers achieve the ultimate efficiency from their running style when they utilize the potential of all the muscles in their body. During running, athletes have to use all their energy for the utmost power. All the available strength is utilized significantly in propelling while running. Along with that, athletes also have to learn how to effectively handle their speed during running to run at or around highest possible velocity of running. (Pandi, Sultana, 2013)

In general, all muscles of the body are involved in running. Nevertheless, there are those muscles that play a dominant role in propelling one's self when running. That is inseparable from the athlete's running technique and motor skills. Some muscles become more dominant than others, especially the lower body and arm muscles. "*Humans run faster by increasing a combination of stride length and stride frequency. In slow and medium-paced running, stride length is* *increased by exerting larger support forces during ground contact, whereas in fast running and sprinting, stride frequency is increased by swinging the legs more rapidly through the air."*(Dorn, Schache dan Pandi, 2012, p 215)

Sprinting requires increasing the value of both stride length and stride frequency. The stride frequency can be achieved by increasing the speed of movement while in the air or by quickly alternating between left and right foot steps. We understand that the act of running involves many things, such as strength, speed, balance, or biomotor abilities. The strength and speed needed by short-distance runners usually lie on the muscles of the lower extremities. Nonetheless, for a good balance, one would have to build up the arm muscles needed for this stabilizing movement, as well as the middle section, or torso, to avoid inefficient movement as one runs. The muscles of the lower extremities usually include the thighs, calves, and feet. As reported in Wang et al., their studies about lower extremity muscles engaged in running treadmills as well as other ground surfaces claim that the rectus femoris, tibialis anterior, biceps femoris, and gastrocnemius muscles function dominantly in facilitating the process of human running. (Wang, Hong & Li Xian, 201, p. 161)

"*A muscle group which is very important for jumping and running is the calf muscle* (*triceps surae*). *This mucle have three parts: (a) the "twin" calf muscle (gastocnemius) with its two heads of origin (one from each of the condyles of the thigh bone) and (b) the "flounder" muscle (soleus) (a flat muscle originating from the back of the lower leg). Together the three parts form the heel tendon (tend achilles) wich is inserted into the heel bone (calcaneum)."* (Wirhed, n.d., p.57)

According to research conducted by Kusnanik, Hariyanto, Herdiyanto & Satia (2017 n.d.), there are 5 items in the process of measuring talent in young athletes, where the 5 items are: sitting height, weight, leg length, 40m sprint, and MFT (VO2Max). In addition, there are factors that have a dominant position that affect speed in performing a run. Research explains that the rise in speed is affected more by the movement of the pelvis compared to the knee movement (Simpson & Bates,1990; Beli et al.,2001; Kuitunen et al.,2002; Schache et al.,2011).

Later research confirmed this, as the percentage increases in hip extension net joint moments with increasing running speed were greater than the percentage increases in knee extension net joint moments. Therefore, the process of running is an intricate procedure and is based on the coordination of muscles, joints, and overall motor skills of the human body. It demands not just strength in the human system but the capability to harness coordination and balance the human energy in such a way that the highest speeds can be achieved. Middle to long distance running is not different from running short distance. However, middle to long distance running requires the stamina to endure."This is not too much of an estimate for elite athletes, but there is considerable variation related to training – elites are generally able to maintain velocities while running that are 85%-90% of their VO2 max for an hour. Marathons are performed at 80% of VO2 max, while 10,000m racing is performed at 95% of VO2 max" (Ross, 2010, February 3, 2017).

Apart from track events, athletics also comprises field events. Field events consist of throwing events and jumping events. The throwing events consist of javelin throw, discus throw, hammer throw, and shot put events. The jumping events consist of vertical jumps and horizontal jumps. The vertical jumps consist of high jump events and pole vault events; the horizontal jumps consist of long jump events and triple jump events.

In throwing events, there are various differences in the body motions in trials. The javelin throw begins with approaching, while the hammer throw and discus throw events involve body rotation. The shot put has evolved from the Obrain/Orthodox technique to involve rotation in the takeoff.

The javelin throw consists of a motion of running in a starting track measuring 30m. "The minimum length of javelin throwing start track is 30m" (IAAF, 2016, p. 71). Then, after completing the process of running start, it is continued by completing javelin release, which consists of javelin throwing. Fattahilah and Mintarto (2016) explained that, "The javelin throw consists of a process of running start, this is to create propulsion in the direction of javelin movement (Newton's First Law), and in javelin throwing, the largest force appears from the motion of swinging the arm when javelin is thrown." Fattahilah and Mintarto (2016) explained in their research with title "Contribution of Arm Muscle Strength, Back Muscle Strength, and 30M Sprint to Javelin Throwing Achievement", which actually consisted of "The largest contribution to javelin throwing achievement distance is arm muscle strength which contributes 35.05%, back muscle strength 21.34%, 30M sprint 8.43%, and others which support javelin throwing achievement".

Additionally, the muscle groups involved in throwing are the abdomen, shoulder, elbow, and wrist. According to Wirhed, when throwing an object, the muscle groups are tensed according to the sequence:

"abdomen, shoulder, elbow, wrist. All four muscle groups must be tensed for a throw, and they must be tensed in order," (Wirhed, n.d., p. 105).

Wirhed further explains:

The javelin thrower obtained better results when his throwing arm was straight, opposite to his body rotation, than when his throwing arm was bent towards his body, (p. 107).

When tossing the javelin, the arm acts like a propulsion system that has angular and linear motion. The arm acts like the swing arm, with the shoulder being the pivot point. From physics, for any given angular angle, using a longer swing arm with the same angular velocity, the resulting object will have higher linear velocity than an object that has a shorter swing arm radius (Linear and Angular Velocity, n.d.). The effect is that there is a higher momentum force.

The release speed of the javelin is the most important factors affecting the distance of the javelin flying, as much as 70 % of the speed is developed in the last 0.1 second (Morriss & Bartlett, 1996). In the last phase of throwing, the arm movements play an important role in raising the speed, and also play an irreplaceable role in the factors' control such as release angle, angle of attack and rotation.(Wang, He&He, n.d. p. 1)

Further, the muscles that propel this action are the abdomen, shoulder, arm (elbow), and wrist. "When throwing an object, the muscle groups are activated in the following order: abdomen, shoulder, elbow, wrist." (Wirhed, n.d., p. 105). Wirhed further says that in the javelin throw action, the straight arm opposing the rotation of the body and the bent arm towards the body should be avoided during the throw (Wirhed, p. 107).

When throwing a javelin, there is angular and linear motion when using the arm as a propulsion system. The arm represents a swing arm and shoulder as a pivot point. Using physics principles for a given angle of rotation, a swing with a longer radius than that of a swing with a given angle of rotation results in a higher velocity than a body moving with a shorter swing arm radius (Linear and Angular Velocity, n.d.). Consequently, there is a greater momentum force.

In the discus and hammer throw events, the throwing action is done in two distinct ways, unlike the javelin and shot put. However, in the starting motion mechanism, the motion is rotational, where the foot acts as the pivot/pivot and the arm acts as the swing arm.

The movements here involve discus throwing and hammer throwing and utilize a combination of body rotation strength and arm strength. Wirhed et al. report that "during preparation for throwing, furthermore, it should be noted that the other arm also plays a role in body transition and arm swing before releasing the discus, and also plays a role in all other throwing motions."

"When preparing to throw, (the discus, or whatever), the skilful athlete pulls his "non-throwing arm" well back as shown in figure 262 (f). Before actually hurling the object this movement is blocked. The arm is thrust in the opposite direction in order to increase rotation of the trunk which in turn increases the velocity of throwing arm." (Wirhed n. d. p. 100) According to Peng, Huang & Peng, 2005; Young & Li, 2005; Terziz, et al. 2012, in a throw, having strong arms is what is most crucial. Hence, in hammer and discus throw events, it is the arms that remain the foremost driving mechanism. Mechanically, the launching or throwing force originates from the swing of the arm and the rotation of the body. Thus, for maximum performance to be attained, the linear speed of the object and the height of the release point must be optimized. Fattahilah and Mintarto (2016) asserted that for objects under similar conditions of speed, angle of release, and acting force, the higher the release point, the more probable the object will fall. Hence, taller individuals are more likely to attain maximum performance.

Shot put is considered a throwing event, but the movement itself is not performed with any actual throwing. As the name states, the movement involves pushing the shot put. In this process of pushing, the force generated comes from a series of movements: the starting position, the power of the position, and the push-off. According to Peng, Huang & Peng, 2005; Young & Li, 2005; Terziz, et.al., 2012, the most important factor in throwing is arm strength. The force acting on the shot put primarily comes from the push-off by the arm. Terziz et.al., 2012 also reported that the velocity of shot put at the end of its release is an accumulation or summation of a series of forces from the starting position, the power of the position and the push-off velocity. It therefore implies that for maximum force, the process of pushing off cannot occur in steps but instead occurs almost simultaneously so that it can provide momentum to the body and the shot put, hence increasing the force that acts on the shot put.

In addition, Terzis et al. (2012) declared that shoot put needs a 31-36-degree angle. In fact, as Fattahilah and Mintarto (2016) added, the more height reached, the longer it will fall with the same speed. This is where height is a significant element for shoot put athletes in order to have maximum results. The triple jump is an event within track and field that involves complex movement patterns. Complex movement patterns are done in a series, precisely, and at a fast pace.

The triple jump also involves three phases that include running start, takeoff (hop, step, and jump), and flight phase. “The result is determined mainly by running speed and by that proportion of distances of three phases of flight which is optimal” (Hay, 1992). Equally, triple jump performance is a result of a force created during acceleration and running up and strength and propelling force created during final three phases of triple jump (hop, step, and jump) (Hay & Miller, 1985; Grahman-Smith & Lees, 1994; Miladinov & Bonov, 2004).

The pushing force that triggers the jump comes from the running start, in accordance with Newton’s first law, which means that the pushing force acting in the direction of the pushing force causes motion. The motion that follows will result in the propulsion for the takeoff stage, hop, step, and finally the jump. In the takeoff stage, the propulsion will result in the cumulative force that comes from the initial velocity and the propulsion that happens in the hop, step, and then the jump transition. The transition between the hop and the step and finally the jump needs an accurate takeoff angle and velocity and height. An accurate angle of the velocity change will give an optimal velocity and ultimate pushing or propulsion force that leads to the optimal jump.

Maintaining the optimal horizontal speed during the hop, step, and jump phases of the triple jump is one of the essential elements that can lead to a maximal distance during the triple jump action. The changeover of phases from hop to step is a very crucial moment within the triple jump activity.

Now, after the takeoff phase, comes the aerial phase. The aerial phase constitutes the final stage of the movement pattern in the triple jump exercise before landing. The main aim of the aerial phase is to maximize the distance of the jump. The aerial movement is the net effect of a series of forces at the two stages of the triple jump exercise. The more optimized the forces at the first and second stages, the more optimized the speed at takeoff and the time in the air.For maximum effectiveness, it is important that the athlete be able to utilize each phase.

“Each of the units represents a particular motor task with particular properties, which has to be fulfilled by the athlete in order for a successful triple jump to be performed,” as pointed out by several previous studies (Panoutsakopoulos & Kollias, 2008).

Every step of the triple jump involves a set of complicated motor skills that is distinct on its own. There have to be muscles that can work optimally during these activities (Conrad & Ritzdorf, 1990; Grahman-Smith & Lees, 1994; Hay, 1999; Jurgens, 1998; Panoutsakopoulos & Kollias, 2008).

When you carefully observe, you will find that the actions are comprised of both running and jumping. The muscles of the lower extremities are responsible for actions like running and jumping. These muscles include the gluteus maximus, quadriceps, hamstring muscles, gastrocnemius, Achilles, and tibialis anterior.“One of the muscle groups very essential for jumping and running is the calf muscle (triceps surae). The calf muscle consists of three parts. (a) The ‘twin’ calf muscle (gastocnemius); (b) The ‘flounder’ muscle (soleus) – a flat muscle, the attachment of which is to the posterior surface of the lower leg. All these three parts form the heel tendon (Achilles tendon) which is joined to the heel bone (calcaneum).” (rn. Wirhed, n.d., p. 57).

The long jump is not much different from the triple jump. The long jump also has three phases, but in the second phase, which is the takeoff phase, there is only "jump." Hence, the forces and the muscles needed for the long jump and the triple jump will be almost the same. Seeing that the run-up will remain the same, as in the sprint start, the speed economy will include the length and rate of strides, as well as the benefit of leg length and height. Vertical jumps include the high jump, while the other one is the pole vault. The high jump is different from the pole vault.

There are three phases in the high jump. These phases include the run-up, take-off, and flight phases. In the run-up phase, the action involved is running. However, the high jump running motion is not the same as in the long jump and the triple jump. The high jump run-up area should not be less than 15 to 25 meters.

During the run-up motion, the semicircular motion is expected to give centripetal force to the body immediately after the run-up and take-off. This is expected to ensure that the force during the take-off is optimized, since this force is not reduced and is instead optimal for the body as it clears the bar.

Forces at play in the flop high jump technique include the speed of the run-up process and the centripetal force of the half circle run-up, followed by the vertical force of push-off in the jump. The most critical factor in this technique for its successful execution is the positioning of the body’s center of mass at the optimal height for the jump. Compared and contrasted, the higher the body’s center of mass, the better the chance for optimal performance levels in the result of the jump. As such, athletes who have greater body height and body mass and therefore a higher body center of mass have a better chance at optimal performance levels independent of other factors necessary for the result of the jump. As such, the higher the body's center of mass, the easier it is for the athlete to elevate his/her body to heights. This favoring factor in body's center of mass can be achieved through having longer legs and greater body height. *"The single most important factor and es-sential contributor to the height cleared, is the height of the flight of the body's centre of mass (BCM), which is a result of the vertical impulse produced during the take-off phase"*(Vassilious & Kollias, 2012, p. 31).

Furthermore, other variables which influence excellent contractile force during takeoff as well as during the flight phase include, according to Vassilious and Kolias, the angle of the knee during takeoff, the angle of thigh lifting, as well as the position of the body during takeoff.

The most important biomechanical parameters that fully describe the takeoff process include the angle of the knee of the leg performing the takeoff, the angle of the thigh of the lead leg, the angle of the position of the trunk, as well as the angles of leaning forward and backward as well as leaning inward, 4.5" (Vassilious & Kollias, 2012, p. 32).

In the pole vault, the movements are not the same as in the long jump. The pole vault requires the movements to be done through the combination of strength and control over the apparatus (pole). The run-up action in the pole vault involves the running with the pole.

"The primary purpose of the approach, therefore, is to reach the take-off position with as much controlled speed as possible. At take-off, the performer places the pole in the take-off box and performs an upward running jump." (Linthorne, 2000, p. 1).

The run-up aims at attaining maximum speed and strength prior to the position of the pole in the take-off box. While positioning the pole in the take-off box, the poler grips the pole and pushes it. Owed to the flexible materials that make up the pole, the energy produced by the run and the push applied on the pole causes the poler to jump up. Other than that, one aspect to be considered is that prior to taking off to the support block, the angle should be positioned directly in line with the direction running.

"Like the angle of contact, angle of departure uses the perpendicular line to the runway as the zero point for reference measurement of the body angle just prior to the take off foot leaving the ground" (Nielsen n.d).

Before the pole reaches the point of equilibrium at the vertical position of the pole stand, the athlete rapidly changes their position from the hanging position on the pole to a vertical position using upward force. This action demands the use of muscle strength in the upper body to enable the greatest force and change in body position.

The existing reference studies state that the components with the highest coefficients in the weighing process are height and leg length. As for body weight, in athletics, it does largely influences performance, but not all athletic events rely on weight. For instance, long-distance running is different from throwing events and the relationship between the two tends to be reverse. Long distance running requires a light weight body to enable the running to cover long distances at constant speed for long hours. However throwing events, rotational throwing in particular requires a heavy body that serves as the axis to balance and give high momentum during the throw. Moreover, during the growth period, body weight becomes uncontrollable from the growth period and unstable metabolic processes that accompany the changes in the development of the body (Wang et al. 2014). Consequently, body weight has the lowest coefficient value after height, leg length, and arm span.

The first weighting percentage formula that can be employed is based on the ratio of height to leg length. For women to attain ideal body weight, the weight ratio must be 15% less than the height, while for men, it must be 10% less than the height. Thus, if the coefficients for the three factors are the same, then the weight percentage coefficient must be 15% lower for women and 10% lower for men.

Athletics include running, walking, throwing, and jumping. Taken generally, these actions include the biomotor abilities of speed (40m sprint), power (vertical jump, forward jump), and flexibility. Moreover, for a child to be active, he or she must be fit. Thus, testing a child's maximum lung capacity will serve as an indication of how fit, and consequently how active, that child is. For instance, this could be tested by the beep test, which refers to VO2Max. Moreover, at this stage or age, children's natural biomotor ability has not developed enough to serve as an effective guide to specialization in competition events. Thus, these aforementioned biomotor abilities are considered to be important for children at this stage.

The value for the anthropometric component is evenly measured with the biomotor component, with the same magnitude of goodness, such that there is a high giftedness value for the child. Yet, for this age group (from 11-14 years old), biomotor cannot be a very precise standard since it is still natural. During the development stage, the biomotor component may be enhanced and further developed for specialization in terms of numbers for competition. This giftedness standard will be used generally, not yet for specialization for sports divisions. As such, the value for the biomotor component is the same as its percentage value. Further, the biomotor component for children at this age has not been maximally trained. This age group is considered as the fast-growing years for the anthropometric component.

Such as increased height, leg length, and arm span. Therefore, anthropometric can be a better reference for predicting the needs of talented athletes, adapted to the needs of today's athletes, which tend to want tall and strong athletes. However, it is hoped that the biomotor component will not lag too far behind the future development and growth of the child. Therefore, the biomotor coefficient should not be too different from the anthropometric component. That is, the more a child develops physically with good biomotor skills, the farther the biomotor development is, but will not be too poor even if the anthropometric component has a greater advantage. Therefore, if the total percentage of the coefficient is taken as 100%, then to avoid too big a difference, 55% can be set with Anthropometric and 45% biomotor. This value of the coefficient is not a fixed value and may be adjusted in accordance with the situation and conditions of the future needs of the athlete.

5. Conclusion

After analyzing the data and accumulating the references of the journal articles, the result of the research gathered was the percentage value of the weight of athletic talent of kids aged 1-14 years, which were for females: the values for height, arm span, and leg length were 26.25%, and for body weight were 21.25%, and for males and females in biomotor, the coefficient value of 14.29%.

From the above data analysis, it was concluded that the level of accuracy of the data was still low, as was the normality of the distribution of some test items. However, the reliability test showed that the components of test items were reliable. Therefore, from this, the test components were deemed reliable to use as test items in the identification of athletic talent in children aged 11-14 years. However, considering the low level of accuracy and normality, reassessment of the factors that influence data quality is needed. This involves the processes of data collection, both from the tester and the athlete being tested. Differences in measurement instruments also affect data accuracy.

From this study, guidelines and norms for identifying athletic talent in children aged 11-14 were developed. These norms and giftedness weights apply only to children of this age bracket and cannot be applied to children beyond this age bracket. This is related to the differences in the development and growth of children before and after 14 years.

References

[1] Belli, A., Kyröläinen, H., & Komi, P. V. (2002). Moment and power of lower limb joints in running. International Journal of Sports Medicine, 23(2), 136.

[2] Bompa, Tudor O. (1999). Theory and methodology of training. Dubuque, IOWA: Kenall/Hunt Publishing Company.

[3] Bompa, T.O. and Buzzichelli, C. (2015). Periodization training for sport. United States: Human Kinetics.

[4] D. Sultana and J.Manohar Chendur Pandi. (2013). Prediction of Athletic Ability from Talent Identification Model on School Students. 3rd International Conference on Management, Economics and Social Sciences, 118-121.

[5] Graham-Smith, P. & Lees, A. (1994) British triple jumpers 1993: approach speeds, phase distances and phase ratios. Athletics Coach (28), 5-12

[6] Hay, J.G. & Miller, J.A. (1985). Techniques used in the triple jump. International Journal of Sports Biomechanics, (1), 185-196

[7] Hay, J.G. (1992). The biomechanics of the triple jump: a review. Journal of Sports Sciences, 10, 343-78.

[8] Hsiente Peng, Chenfu Huang and Hsiensen Peng. (2005). Electromyographic Analysis of the Discus Standing Throw. ISBS, 151-155.

[9] World Athleteic Competition Rules 2024. [n.d.]. Diperoleh pada 5 Januari 2024 di https://www.worlathletics.org/news/competition-rules-2024-2025

[10] Kuitunen, S., Komi, P. V., & Kyröläinen, H. (2002). Knee and ankle joint stiffness in sprint running. Medicine & Science in Sports & Exercise, 34(1), 166.

[11] Lin Wang, Youlian Hon & Jing Xian Li. (2014). Muscular Activity of Lower Extremity Muscles Running on Treadmill Compared with Different Overground. Science and Education Publishing. Vol 2(4), 161-165.

[12] Milan Čoh and Otmar Kugovnik. (2011). Variability of Biomechanical Parameters in the Triple Jump Technique – a Case Study. Sportlogia, 7(2), 113–121.

[13] Muhammad Fattahilah & Edy Mintarto, (2016). Contirubution of Arm Strength, Back Strength and Sprint 30M towards Javelin. International Conference of Sports Science, 1,

[14] Nielsen, Dave. "Dartfish Case Study." www.dartfish.com. DartfishSoftware for Video Analysis, n.d. Web. 15 Apr 2013. <http://www.google.com/url?sa=t&rct=j&q=&esrc=s&source=web&cd=7&ved=0CGEQFjAG&url=http://www.dartfish.com/floor/download.cgi?fie=/data/document/document/265.pdf&name=Toby+Stevenson&ei=0htrUf-KHomWiALdlYDIBQ&usg=AFQjCNGK3YQxwvwNT8TKvtA8jtFPK-1izA&sig2=0OYzifF0z2uaM37RKkdA6Q&bvm=bv.45175338,d.cGE>.

[15] Nining. W.K. Agus H., Yonny H., Ali. (2017). TALENT IDENTIFICATION MODEL FOR SPRINTER USING DISCRIMINANT FACTOR. CAPEU.

[16] Ross H. Miller, Brian R. Umberger & Graham E. Caldwell. (2010). Limitations to maximum sprinting speed imposed by muscle mechanical properties. Journal of Biomechanics, 45 (2012) 1092–1097.

[17] Ross, [n.d.]. 2 Hour Marathon Physiology // The Sub-2 Hour Marathon: What Physiology will take? Diperoleh pada 6 Pebruari 2017 dari https://sportsscientists.com/2010/09/2-hour-marathon-physiology/.

[18] S&C Research. [n.d.]. What muscles are important for sprinting?. Diperoleh dari https://www.strengthandconditioningresearch.com/promotions/muscles-for-sprinting/.

[19] Schache, A. G., Dorn, T. W., Williams, G. P., Brown, N. A., & Pandy, M. G. (2014). Lower-limb muscular strategies for increasing running speed. Journal of Orthopaedic & Sports Physical Therapy, 44(10), 813-824.

[20] Simpson, K. J., & Bates, B. T. (1990). The effects of running speed on lower extremity joint moments generated during the support phase. International Journal of Sport Biomechanics, 6, 309-324.

[21] Terzis, G. , Kyriazis, T. , Karampatsos, G. , & Georgiadis, G. (2012) . Muscle strength, body composition, and performance of an elite shot-putter. International Journal of Sports Physiology and Performance, 7(4), 394–396.

[22] Tim W. Dorn, Anthony G. Schache and Marcus G. Pandy. (2012). Muscular strategy shift in human running: dependence of running speed on hip and ankle muscle performance. The Journal of Experimental Biology, 215, 1944-1956.

[23] Vassilios Panoutsakopoulos and Iraklis A. Kollias. (2012). 3D Biomechanical Analysis of Women's High Jump Technique. IAAF, 27:3; 31-44.

[24] Vassilios Panoutsakopoulos, Iraklis A. Kollias. (2008). Essential parameters in female triple jump technique. New Studies in Athletic, IAAF, 23:4; 53-61.

[25] Wirhed, Rolf. (n.d.). Athletic Ability & the Anatomy of Motion. England. Butler & Tanner Ltd.

[26] Young, M. , & Li , L. (2005) . Athletics. Sports Biomechanics, 4(2) , 131–148.

[27] Zefeng Wang, Wenjie He & Wenge He. (2013). Analysis of the Joint Angules of the Throwing Arm in Javelin Throw. ISBS.