Anthropometric Measurements, Physiological and Biomotoric Test to Identify Talented Basketball Athletes

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Abstract: This research was aimed at developing an equation model and software to identify talented basketball athletes. To this end, a quantitative research and development approach was employed. The research subjects were 145 student basketball players aged 10-12 in Surabaya. Data were analyzed using factor and discriminant analysis. This research resulted in the following equation: D = - 3.420 + (- 0.22 Body Height) + (- 0.031 Sitting Height) + (- 0.020 Arm Span) + (- 0.153 Right Leg Length) + (0.204 Left Leg Length) + (- 0.111 Palm Length) + (0.247 Back Muscular Flexibility) + (- 0.007 Illinois Agility Run) + (0,067 Right Leg Vertical Jump) + (0.071 Left Leg Vertical Jump) + (0,011 Double Leg Vertical Jump) + (- 0.60 20-Meter Sprint) + (0.044 Multistage Fitness Test) + (0.009 Ball Throwing). It was concluded that the developed equation and software could be used to identify talented basketball players.

1 INTRODUCTION

Talent identification is a structured and systematic effort to identify potential sports talents. The development of talent identification tools has been a fundamental to the projection of athletes' potentials (Vaeyens, Roel et al., 2009; Smith, David. J. 2003; Wolstencroft, Elaine., 2002). Talent identification is necessary in sports including basketball. Basketball is a fast, dynamic, and high-intensity game with a constantly changing tempo between attacking and defending. In addition, basketball also requires pace, acceleration, explosive moves, and anaerobic/aerobic energy to do high-intensity activities like rebounding, passing, jumping, shooting, fast-breaking, and performing a high-speed play (Ahmed, 2013; Alemdaroğlu, 2012; Erculj, 2010). Basketball players are required to possess the following attributes: strength, speed, agility, accuracy, vertical jump, anaerobic capacity, aerobic capacity, and power to perform in the highest level. Sports researchers, practitioners, and coaches carefully develop instruments to identify and select potential athletes (Abbott & Collins 2002).

Talent identification model has been developed in many countries such as Australia, China, Japan, Scotland, and Germany (Abbott & Collins, 2002; Aussie Sport, 1993). Research on talented athlete identification model has been previously conducted by focusing on certain sports like paddling, volleyball, lawn tennis, football, and basketball (Chahal, 2013; William & Reilly, 2000; Hoare, 2000). This research was aimed at developing an anthropometric measurement instrument, physiological test, biomotoric test, equation model and software to identify talented basketball athletes. The success of sporting development is a result of a long-term, programmed, organized, structured, and measurable coaching process. It also heavily relies on the quality of sports talents' potentials. No matter how good the training program or the coaches are, things will not work out if the athletes have poor potentials.

2 METHODS

This research and development used a quantitative method.

2.1 Sample / Participants

The research population were student basketball players aged 10-12 in Surabaya. 55 samples were taken in Phase 2 using a purposive sampling technique, and 90 samples were taken in Phase 3. Thus, the total number samples were 145.

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2.2 The tested variables

Obviously, variables in this research were anthropometric measurements, biometric testing and physiological testing.

2.2.1 Anthropometric measurement

An anthropometric measurement is a process to assess the size of certain parts of body anatomically. Athlete anthropometry has been a focus of many studies. In basketball, it is not only a performance predictor, but also a determinant factor in the selection process. A player's physical size will determine where he will play in a team (Alejandro, et al., 2015; Drinkwater, 2008). The anthropometric measurement in this research included: body height, sitting height, body weight, arm span, right/left leg length, palm length, and reaching height.

2.2.2 Physiological testing

A physiological test is a systematic and objective procedure to assess the function of body organs and functional relationship between the organs in question. In this research, the physiological test measured basketball players' aerobic and anaerobic skills. In basketball, anaerobic skills are crucial to do defensive-offensive transitions, shooting, jumping, blocking, passing, layup, and other technical skills (Araujo, et al., 2013, Çetin & Muratli, 2013; Köklü, et al., 2011).

Aerobic endurance is body capacity to resist fatigue caused by persistent aerobic burden; i.e., some relatively long physical activities with low to moderate intensity. Maximum aerobic capacity (VO2max) is the best indicator of maximum aerobic power in basketball (Köklü, et al., 2011; Chaouachi, 2019). The physiological test in this study included: 20-meter sprint, 30-meter sprint, and multistage fitness test.

2.2.3 Biomotoric testing

A biomotoric test is a systematic and objective procedure to assess movement skills. Muscular strength and muscular explosive power are two important factors to determine movement mobility independently. Physical abilities like leg and arm muscular strength are very important in sports (Tschopp, 2011; Erculj, 2010). The biomotoric test in this research included: push up, sit up, back muscular flexibility, standing board jump, Illinois agility run, single leg vertical jump, double leg vertical jump, and ball throwing.

2.3 Experimental procedure

This research was carried out in three phases: Phase 1 was designing selected test instrument, phase 2 trying out selected test instrument, and phase 3 implementing selected test instrument.

2.4 Statistical analysis

Data were analyzed using factor and discriminant analysis. The research was carried out in 2016 to 2017. The data used in this study consisted of primary data and secondary data, including: number of pipeline orders, number of coats required for a pipe, number of coatings required for all pipes, lead time (raw material ordering time), ordering cost and storage cost incurred for the project, organizations and projects structure, data and events from the internet and journals.

This research uses quantitative approach with descriptive research type. Especially descriptive comparative analysis is used to compare three lot sizing techniques in MRP; Lot for Lot, EOQ, and POQ. The analysis starts with MRP step which include: 1) creating a Master Production Schedule, 2) creating a product structure or Bills of Materials, 3) collecting lead time data of raw material ordering, 4) preparing a Gross Requirements Plan, 5) Make a Net Requirements Plan, 6) determine the ordering time of goods (Planned Order Release) with lot sizing method, 7) determine the right lot sizing method (Heizer, 2014).

Determining the right lot sizing method will result in a minimum total inventory cost. Determination of this method is done by comparing total inventory cost based on company calculation with total cost obtained through calculation by lot sizing method. Lot sizing methods used in this research are Lot for Lot, Economic Order Quantity (EOQ), and Periodic Order Quantity. The software for data analysis use Production and Operation (POM) for Windows ver. 3 (build 18).

3 RESULTS AND DISCUSSION

At the first phase, 21 instruments were developed; i.e., anthropometric measurements including body height, sitting height, body weight, arm span, right/left leg length, palm length, and reaching height measurement; physiological test including 20-meter sprint, 30-meter sprint, and multistage fitness test; biomotoric test including push up, sit up, back muscular flexibility, standing board jump, Illinois agility run, single leg vertical jump, double leg vertical jump, and ball throwing. The second phase was trying out the selected test instrument by identifying the discriminant variable. The object identification was aimed at identifying research variables to be used to test the discrepancies between groups. The variables in questions were body height, sitting height. arm span, right leg length, left leg length, palm length, back muscular flexibility, Illinois agility run, single leg vertical jump, standing board jump, double leg vertical jump, 20-meter sprint, multistage fitness test, 30-meter sprint, and ball throwing. The third phase was implementing the selected test instrument by identifying selected discriminant variables. The variables in questions were body height, sitting height. arm span, right leg length, left leg length, palm length, back muscular flexibility, Illinois agility run, single leg vertical jump, standing board jump, double leg vertical jump, 20-meter sprint, multistage fitness test, 30-meter sprint, and ball throwing.

The category of a variable in a discriminant analysis can be explained by the used discriminant variables. Table 1 presents the canonical correlation score. The canonical correlation score can be said good if it is >0.50 or 50%. Table 1 shows that the category of basketball and non-basketball can be explained by the variables body height, sitting height, arm span, right leg length, left leg length, palm length, back muscular flexibility, Illinois agility run, right leg vertical jump, left leg vertical jump, double leg vertical jump, 20-meter sprint, multistage fitness test, and ball throwing. The canonical correlation score was 0.612 or 61.2%. The other 38.8% could be explained by other variables. The difference in the average of discriminant variables of basketball and non-basketball group can be identified by looking at the Wilks's lambda adjusted by the chi-square score. This difference can be seen in the p-value (sig) in Table 2.

Table 1: Eigenvalues.

Function	Eigenvalue	% of Variance	Cumulative %	Canonical Correlation
1	.600a	100.0	100.0	.612

a. First 1 canonical discriminant functions were used in the analysis

Table 2: Wilks's Lambda.

Test of Function(s)	Wilks's Lambda	Chi-square	df	Sig.
1	.625	38.059	14	.001

It was revealed that the average scores of the independent variables (body height, sitting height, arm span, right leg length, left leg length, palm length, back muscular flexibility, Illinois agility run, right leg vertical jump, left leg vertical jump, double leg vertical jump, 20-meter sprint, multistage fitness test, and ball throwing) of both basketball and non-basketball athletes were collectively different. Once it was determined that the used variables could become the discriminant variables, it was necessary to find out the difference between each one of these discriminant variables of both categories.

Table 3: Canonical discriminant function coefficients.

Variables	Function
	1
Height	-.022
Sitting Height	-.031
Arm Span	-.020
Right Leg Length	-.153
Left leg Length	.204
Palm Length	-.111
Back Muscular Flexibility	.247
Illinois Agility Run	-.007
Right Leg Vertical Jump	.067
Left Leg Vertical Jump	.071
Double Leg Vertical Jump	.011
20-m Sprint	-.060
Multistage Fitness Test	.044
Ball Throwing	.009
(Constant)	-3.420
Unstandardized coefficients	

The average score of back muscular flexibility was 0.247. Since it was the highest coefficient, it could be used to predict the difference between basketball and non-basketball athletes' potentials. Since the average score of the discriminant variables used to differentiate potentials among basketball group sometimes were similar so that it was necessary to identify the size of the samples that really belonged to the basketball category and that of those that really belonged to the non-basketball category.

7 out 25 basketball groups belonged to the non-basketball category since the ratio of the average score of their discriminant variables were closer to the non-basketball category. 12 out 25 non-basketball groups belonged to the basketball category since the ratio of the average score of their discriminant variables were closer to the basketball category.

Table 4: Classification results [b,c].

Category			Predicted Group Membership		Total
			Basketball	Non-Basketball	
Original	Count	Basketball	18	7	25
		Non-Basketball	12	53	65
		Ungrouped cases	20	35	55
	%	Basketball	72.0	28.0	100.0
		Non-Basketball	18.5	81.5	100.0
		Ungrouped cases	36.4	63.6	100.0
Cross-validated	Count	Basketball	14	11	25
		Non-Basketball	16	49	65
	%	Basketball	56.0	44.0	100.0
		Non-Basketball	24.6	75.4	100.0

a. Cross validation is done only for those cases in the analysis. In cross validation, each case is classified by the functions derived from all cases other than that case.
b. 78,9% of original grouped cases correctly classified.
c. 70,0% of cross-validated grouped cases correctly classified.

Based on the discriminant equation, it can be seen that back muscular flexibility was the most dominant variable so that it could be used to predict one's potentials in basketball. Back muscular flexibility is one of the biomotoric attributes every basketball player must have. Flexibility refers to the range of movement in a joint or series of joints. Natural joint movements rely on the existing tendons, ligaments, and muscle fibers. Flexibility is particularly useful to avoid a muscle injury because in basketball games the tempo is constantly changing and basketball games require pace, acceleration, and explosive moves (Ahmed, 2013).

The developed software in this study was a statistics computer program. The result of data analysis, which was the discriminant equation model, was encoded into computer programming language to facilitate sports researchers, practitioners, and coaches in identifying basketball talents. The developed form design was then programmed in Microsoft Access. The developed software was named TIBA (Talent Identification Basketball Athletes). This research resulted in the following equation: D = - 3.420 + (- 0.22 Body Height) + (- 0.031 Sitting Height) + (- 0.020 Arm Span) + (- 0.153 Right Leg Length) + (0.204 Left Leg Length) + (- 0.111 Palm Length) + (0.247 Back Muscular Flexibility) + (- 0.007 Illinois Agility Run) + (0.067 Right Leg Vertical Jump) + (0.071 Left Leg Vertical Jump) + (0.011 Double Leg Vertical Jump) + (- 0.060 20 Meter-Sprint) + (0.044 Multistage Fitness Test) + (0.009 Ball Throwing).

4 CONCLUSIONS

It was concluded that the developed equation model and software could be used to identify talented basketball athletes. Instruments to identify talented basketball athletes were anthropometric measurement (body height, sitting height, arm span, right leg length, left leg length, and palm length) physiological test (20-m sprint and multistage fitness test), and biomotoric test (back muscular flexibility, Illinois agility run, right leg vertical jump, left leg vertical jump, double leg vertical jump, and ball throwing).

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