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Development of a sprinter talent identification model in children aged 10–12 years

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ABSTRACT

This study aimed to develop a talent identification model for sprinters based on anthropometric components, physical qualities, and biomotor abilities in children aged 10–12 years. A research and development model was employed. The sample consisted of 172 children aged 10–12 years, including 89 boys and 83 girls, all of whom were healthy. The development of a sprinter talent identification model using anthropometry, physical qualities, and biomotor abilities in children aged 10–12 years begins with identifying the problem, designing a model or product, and evaluating the model's feasibility before producing the final product in the form of software. The study's findings indicated that the talent identification model for boys sprinters is represented by the equation: D = -9.909 + (1.255 × Speed) + (0.062 × Flexibility) – (0.122 × Jump Height) + (6.011 × Auditory Reaction Time). For girls, the talent identification model is represented by the equation: D = 9.334 – (0.048 × Height) + (0.140 × Leg Length) + (4.759 × Anaerobic) – (2.111 × Speed) + (0.090 × Flexibility). It was concluded that in the model for developing sprinter talent identification in boys aged 10–12 years, four variables were selected: speed, flexibility, jump height, and auditory reaction time. For girls aged 10–12 years, five variables were selected: height, leg length, anaerobic capacity, speed, and flexibility. There are differences in the variables contributing to the development of a biological talent identification model for young sprinters.

KEYWORDS

Sprinter Talent; Anthropometry; Physical Quality; Biomotor Quality; Children

1. INTRODUCTION

Sports achievement is a benchmark or barometer in the progress of a nation. The pride of a nation in sports achievements requires the quality of human resources from an early age in the field of sports. Sports achievements cannot be obtained instantly, but through various long stages. The stages start from talent search, nursery, coaching process, and evaluation process to achieve a good sporting achievement. This stage involves multidisciplinary knowledge by applying Science and Technology (IPTEK) which is studied scientifically from an early age to achieving sports achievements from athletes (Kusnanik et al., 2018). The process of becoming a talented and potential athlete from an early age is a form of athlete regeneration in the future in achieving sporting achievements (Gonçalves et al., 2012).

Achievements in the field of sports have not yet achieved optimal results and have always encountered obstacles in the form of the difficulty of finding athletes who have talent in the field of sports to achieve achievements (Bramantha, 2017). In the talent identification process in several sports, there are no clear variables that consistently predict the success of talent identification in the future (Johnston et al., 2018). The process of identifying talent requires a variety of interdisciplinary fields in determining an athlete's talent, including the genetics of the ACTN 3 gene in skeletal muscles sprinter (Galič, 2011), kinesiology, biomechanics, sports medicine, psychology (Žvan & Čoh, 2018; Cobley et al., 2020).

Number athletics sprinter is a sport that is quite prestigious and achieves in all sports competitions, this has resulted in many young athletes with potential from children to teenagers. Identification of athletic sports talent numbers sprinter requires components - components in identifying or getting the best athlete candidates. Anthropometric measurements are important factors of success in the main predictors and identification of competitive sports talent (Vileep, 2017). Athletesprinter required to have anaerobic endurance to be able to work with high intensity and short duration or explosive work (Sukadiyanto, 2011). In addition, sprinter athletes must have good biomotor skills in order to achieve the highest peak performance (Harsono, 2015).

Survey preliminaries that were carried out previously on school student group children when participating in talent identification during tests sprint 60 M found that the steps of the right and left feet were not the same, the anthropometric measurements of the length of the right and left lower limbs were not the same. Identify achievement sports talent in this case sprinter Until now, there is still no standardized system, both at the national and international levels. Some sports researchers try

to find a suitable system model to achieve individual sports performance in the long term. Based on research conducted by Zhao et al. (2023) proposes to use Neural Networks as a prediction model for athletes' sports performance. Also John, et al. (2019) formulates a model for predicting the fastest sprinting time using MATLAB, then evaluated based on Sum of Square Error (SSE), R-Square, adjusted R-Square, and Root Mean Square Error (RMSE). This study aims to develop a talent identification model for sprinters based on anthropometric components, physical qualities, and biomotor abilities in children aged 10–12 years.

2. METHODS

2.1. Design and Participants

The research design uses a research and development (R&D) model to develop and validate a product or model. The research subjects in this study were elementary school students, aged 10-12 years, 89 male and 83 female, totaling 172 students with inclusion criteria of being able-bodied, willing to be research subjects, and taking measurement tests. The research data collection sites were at SDN Tandes Kidul 1 Surabaya, SDN 236 Menganti Gresik, and MI Ma'arif Nurul Ulum Benjeng Gresik.

2.2. Procedures

The research and development design in this study focuses on developing a talent identification model for sprinters using anthropometric, physical, and biomotor qualities. This research and development model is an assessment of the results of previous studies related to the validity of the components in the product to be developed. Development is intended as a step to test the validity, effectiveness, and practicality of a research product that is produced. At the trial stage there is already a measurement and evaluation process, but the measurement and evaluation is still within the framework of the initial product development process (Gall et al., 2007). The procedures or steps in this research and development include (a) preliminary studies and data collection, (b) planning process, and (c) developing models.

The variables in this study consisted of (a) anthropometry in the form of measurements of body weight (Kg), height (Cm), body mass index (BMI), right and left leg length (Cm); (b) anaerobic physical quality in the form of endurance measurement anaerobic with RAST(Running-Based Anaerbic Sprint Test); (c) biomotor quality in the form of measuring the biomotor components including a speed test with a 40 meter sprint, a leg muscle strength test with leg dynamometer, flexibility test with sit and reach test, and reaction speed with whole body reaction time.

2.3. Statistical Analyses

The Statistical Package for the Social Sciencec (SPSS) was used for data analysis. Descriptive statistics, including means and standard deviations, were calculated to summarize the data for boys and girls. To determine which variables significantly distinguished between athletes and non-athletes, a test of equality of group means was conducted using Wilks' Lambda, F-values, and significance (p) values. Finally, canonical discriminant analysis was performed to develop discriminant functions, with canonical discriminant function coefficients indicating the relative contribution of each variable in predicting talent identification for sprinters. A p value < 0.05 was considered statistically significant.

3. RESULTS

Table 1 presents the descriptive statistics (mean and standard deviation) of anthropometric, physical, and biomotor variables for boys (n = 89) and girls (n = 83) aged 10–12 years. The data include measurements of height, weight, body mass index, and leg length under anthropometry; anaerobic capacity under physical qualities; and speed, strength, flexibility, jump height, visual reaction time, and auditory reaction time under biomotor qualities.

Table 1. Descriptive statistics of anthropometric, physical, and biomotor characteristics of study participants

	Boys group (n=89)		**Girls group (n=83)**	
	Mean	**SD**	**Mean**	**SD**
Anthropometry				
Height	133,78	9,81	134,98	9,19
Weight	35,12	9,21	35,29	7,54
Body mass index	19,42	3,78	19,32	3,41
Leg length	74,67	6,36	77,36	6,49
Physique				
Anaerobic	,89	,43	,53	,19
Biomotor				
Speed	8,02	,97	8,83	,75
Strength	45,92	23,04	42,45	24,33
Flexibility	26,23	5,45	27,13	4,16
Jump height	35,00	5,62	33,57	6,32
Visual time	,35	,08	,41	,10
Audio time	,41	,12	,43	,00

Based on the results of Table 1 above, the boys' group had an average height (133.78±9.81 cm), an average body weight (35.12±9.21 kg), an average body mass index (19.42±3,78), average leg length (74.67±6.36 cm), average anaerobic (0.89±0.43 watts/sec), average speed (8.02±0.97 m/s), average strength (45.92±23.04 kg), average flexibility (26.23±5.45 cm), average jump height (35±5.62 cm), average visual time (0.35±0.08 sec), and audio time average (0.41±0.12 sec). Meanwhile, the girls' group had an average height (134.98 ± 9.19 cm), average body weight (35.29±7.54 kg), average body mass index (19.32 ± 3.41), average leg length (77.36±6.49 cm), average anaerobic (0.53±0.19 watts/sec), average speed (8.83±0.75 m/s), average power (42.45±24.33 kg), average flexibility (27.13±4.16 cm), average jump height (33.57±6.32 cm), average visual time (0.41±0.10 sec), and average audio time (0.43±0.00 sec).

Table 2 presents the results of the test of equality of group means for boys and girls.

Table 2. Test of equality of group means for anthropometric, physical, and biomotor variables in boys and girls

	Boys group			**Girls group**		
	Wilks' Lambda	**F'**	**p value**	**Wilks' Lambda**	**F'**	**p value**
Height	,950	4,558	,036	1,000	,029	,865
Weight	,906	8,974	,004	,893	9,670	,003
Body mass index	,699	37,503	,000	,829	16,652	,000
Leg length	,884	11,467	,001	1,000	,006	,941
Anaerobic	,849	15,510	,000	,751	26,926	,000
Speed	,518	80,981	,000	,424	110,040	,000
Strength	,993	,571	,452	,999	,071	,791
Flexibility	,984	1,441	,233	,960	3,409	,068
Jump height	,586	61,438	,000	,877	11,349	,001
Visual time	,815	19,776	,000	,987	1,090	,300
Audio time	,852	15,068	,000	,988	1,020	,316

Based on Table 2, the boys' group shows that height, weight, body mass index, leg length, anaerobic capacity, speed, jump height, visual reaction time, and auditory reaction time have significance values ($p < 0.05$). This indicates that these variables contribute to differences in the decision-making process between athletes and non-athletes. In the girls' group, the variables of weight, body mass index, anaerobic capacity, speed, and jump height have significance values ($p < 0.05$), suggesting that these factors play an important role in predicting prospective athletes and non-athletes. Table 3 presents the canonical discriminant function coefficients for the boys' and girls'

groups. These coefficients indicate the relative contribution of each variable to the discriminant function, which is used to distinguish between athletes and non-athletes.

Table 3. Canonical discriminant function coefficients

Boys group		**Girls group**	
Speed	1,255	Height	-0,048
Flexibility	0,062	Leg length	0,140
Jump height	-0,122	Anaerobic	4,759
Audio time	6,011	Speed	-2,111
		Flexibility	0,090
(Constant)	-9,909	(Constant)	9,334

The canonical discriminant function coefficients of the boys' group above shows a discriminant function with the following equation Z Score = -9.909 + (1.255*Speed) + (0.062*Flexibility) + (-0.122*Jump height) + (6.011*Audio). The canonical discriminant function coefficients in the group of girls show the discriminant function with the following equation Z Score = 9.334 + (-0.048*Height) + (0.140*Leg length) + (4.759*Anaerobic) + (-2.111*Speed) + (0.090*Flexibility).

4. DISCUSSION

The process of identifying talent from talented athlete candidates from an early age in preparing long-term athletes must be gradual and sustainable. The talent identification process is expected to be able to see the potential of early childhood to achieve sports achievements. Sports talent is a combination of biomotor abilities and individual motivation. Sports talent is determined by genetic, anatomical, psychomotor, functional, cognitive, social, and motivational characteristics (Cobley et al., 2020). Based on the speed item discriminant equation (sprint 40 M) is the most dominant in predicting athletes sprinter student age. Sprint 40 M is a form of one of the measurement tests for the speed component. An athlete sprint requires one of the biomotor components for physical condition, especially speed and acceleration to support its performance (Murphy et al., 2003). Athlete sprint must have good speed, it will be advantageous to finish the match with a fast run in a short time. Speed in short distance running is the result of strong and fast contractions of the muscles that are converted into smooth, fluid, and efficient movements needed by runners to get high speed. A potential sprinter can be seen from the composition or arrangement of muscle fibers, white muscle fibers (fast twitch) has a higher percentage than red muscle fibers (slow twitch) (Sujiono, 2021). Skeletal muscles are highly adaptable to the various stresses that can be placed on them.

Despite the importance of skeletal muscle, little is known about genetic factors that suggest a major influence on muscle size, function, strength, and adaptation to various environmental factors. One of the first to characterize and most frequently studied genetic variants was polymorphism in a gene *angiotensin converting enzyme* I. The ACTN3 gene is the first structural skeletal muscle gene with a link between genotype and performance sprinter (Galič, 2011).

Athletes *sprinter* has special motion characteristics that require prospective athletes with posture and body shape that match the characteristics of the 100 meter run (Doddy, 2017; Wulansari et al., 2017). The components of height and leg length will affect the footsteps when running 100 meters. Leg length is related to height, someone who has a higher height will have a longer stride length compared to someone who has a shorter height. McComas said that the development of muscles and skeleton in children aged 1-5 years will increase by 45%, aged 5-18 years will increase by 60%, after the age of 18 it will increase by 20%. Therefore, children aged 10-12 years in this study are the right age for the growth and development of muscles and bones because their growth is relatively high (Kusnanik et al., 2018).

Physical quality can reach optimal levels of training starting from an early age which is carried out continuously, in stages and guided by the principles of exercise. Good physical quality has the ability to easily learn new skills and not get tired easily when participating in training or matches. Sports participation will increase many times if children are properly guided to choose the right sports and in accordance with their physical potential (Kansal, 2010). For every athlete to achieve good sporting achievements, excellent physical quality is needed according to the needs and specific sports (Lestari & Herdyanto, 2019). Durability Anaerobic needed by runners sprinter in fulfilling energy in the body to utilize glycogen stores to become a source of energy without using oxygen. Sprinters are required to have a threshold value of endurance anaerobic in maintaining a level of intensity over a long period of time. Anaerobic sprinter Those who are relatively good will have good physical fitness, so that the body is able to carry out high and fast activities without experiencing fatigue. The difference between physical and biomotor will clearly differentiate them based on the sport to be taken (Oloo et al., 2018).

The process of identifying talent and coaching sports in early childhood to achieve achievements requires a long, arduous and uncertain path. In sport science, the process of identifying sports talent for each athlete must be precise and correct according to the abilities and skills according to the sport (Žvan & Čoh, 2018). The early age talent identification model has its own specificities in each sport, including the involvement of motor development and functional abilities

(Bompa & Buzzhicelli, 2015). The early talent identification model requires a holistic or holistic approach that becomes a game based on motivation and positive emotions (Malina, 2010). That differences in anthropometric and biomotor variables according to the sport and discriminant models can assist in the recruitment of athletes for training programs (Oloo et al., 2018). The holistic approach is based on the principles of modern neurophysiology of the development of the nervous system in children. Intellectual and motor development reaches its peak at the age of 4 to 12 years, intellectual capacity depends on the number of neurons and synapses of each individual. With a large number of neurons and synapses, the network between neurons and synapses has motor skills. During childhood and adolescence, several physical and physiological changes occur due to the processes of maturation and puberty (López-Plaza et al, 2017; Mendez-Villanueva et al., 2011). Biological potential in children is directly related to motor skills in psychomotor development. Anthropometric, biomotor and psychomotor factors are very important in developing sports talent in schools (Burhanuddin et al., 2021).

Physical growth is closely related to the process of increasing physiological maturity in each individual. The process of increasing maturity in general will occur in line with increasing chronological age. Growth and level of physical and physiological maturity have an impact on the development of physical abilities. Physical growth and maturity are very important in the process of identifying, selecting and developing the talents of young athletes (Gonçalves et al., 2012). Physical growth where the child is getting taller and bigger, then the physical ability also increases. Several kinds of physical abilities that are quite evident in their development at this time are strength, flexibility, balance, and coordination (Sukamti, 2018).

Every sport in early childhood will stimulate the development of motor programs that serve as the basis for the motor intelligence of every child. The brain is an organ that always adapts to the surrounding environment during brain development. Neurological and neurophysiological findings show that the number of neurons is genetically generated, while the number of synapses depends on a person's motor and intellectual abilities. At the age of 5 years a person can form 50% of the synapses between his neurons, and at the age of 7 this number will increase to 75%, while at the age of 12 it increases to 95% of the synapses between neurons (Sukamti, 2018). Thus the increasing number of synapses and the thickness of the neuron circuit that one has will directly affect one's motor intelligence.

5. CONCLUSIONS

It can be concluded that in the model for developing sprinter talent identification for boys aged 10–12 years, four variables were selected: speed, flexibility, jump height, and auditory reaction time. The discriminant equation is: D = -9.909 + (1.255 × Speed) + (0.062 × Flexibility) – (0.122 × Jump Height) + (6.011 × Audio Time). For the girls aged 10–12 years, five variables were identified: height, leg length, anaerobic capacity, speed, and flexibility. The discriminant equation is: D = 9.334 – (0.048 × Height) + (0.140 × Leg Length) + (4.759 × Anaerobic) – (2.111 × Speed) + (0.090 × Flexibility). These results indicate that there are differences in the variables contributing to the development of the biological talent identification model for young sprinters, suggesting that talent prediction factors may vary between boys and girls.

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CONFLICTS OF INTEREST

The authors declare no conflict of interest.

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