Identification Of Mountain Bike Sports Talent In Children Aged 10-15 Years Based On R Programming Software

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ABSTRACT

MTB has strategic potential in the context of global and local sports development. Internationally, this discipline is one of the most popular events in the Olympics and world championships. In Indonesia itself, MTB is growing rapidly as both a recreational and competitive sport, with an increasing number of communities and events being held. This potential opens up great opportunities to produce accomplished athletes if training is directed appropriately from an early age. Therefore, accurate talent identification methods are needed to ensure that a high interest in MTB can be converted into real achievements in the future. This study aims to identify mountain biking talent in children aged 10-15 years using R programming software. Based on the results of the study, it was found that 13 respondents (10.83%) had talent in mountain biking. Meanwhile, the remaining 107 respondents (89.13%) did not have talent in mountain biking. The results of this study conclude that the application of technology and statistical methods through R Programming contributes positively to identifying athletic talent at the elementary school level. This study only focuses on identifying talent. For future research, it is hoped that this study can be developed specifically in the anthropometric aspects related to badminton talent.

AUTHORS' CONTRIBUTION
A. Conception and design of the study;
B. Acquisition of data;
C. Analysis and interpretation of data;
D. Manuscript preparation;
E. Obtaining funding

INTRODUCTION

Global developments in sports show a paradigm shift from intuition-based coaching to an evidence-based approach. Talent identification is now seen not merely as selecting athletes who stand out at a given moment, but as a systematic process that combines anthropometric, physiological, motor, psychological, and environmental context data to predict long-term potential. Contemporary studies emphasize the importance of using quantitative metrics and multivariate analysis to reduce subjectivity and improve the accuracy of talent selection, thereby making training programs more efficient and sustainable (Telaumbanua et al., 2024).

Mountain biking (MTB) is a challenging sport that occupies a special position because it requires a complex combination of physical, technical, and psychological

factors. An MTB athlete must possess high aerobic and anaerobic endurance to tackle long trails with varying intensities. Additionally, muscle strength, particularly in the legs and core muscles, is necessary to maintain stability when navigating steep and obstacle-filled trails. Despite its challenges, MTB offers an experience that goes far beyond simply covering distance; it is an exploration of oneself and nature (Arifianto et al., 2021). Technical factors such as the ability to read trails, the skill of controlling a bike on uneven terrain, and the speed of decision-making also play a big role in performance. This makes MTB a sport that requires athletes with multidimensional profiles.

MTB represents a multidimensional sport that demands optimal integration between physiological capacity, technical skills, and psychological resilience. With all its challenges, MTB offers an experience that goes far beyond simply covering distance; it is an exploration of oneself and nature (Arifianto et al., 2021). MTB is an effective means of training motor skills. Constantly controlling a bike on uneven and obstacle-filled trails trains balance, coordination, and reflexes. The ability to adapt quickly to changing trail conditions is a highly valuable motor skill. This skill is not only useful in MTB, but also aids in children's overall motor development (Khikmah, 2016). MTB athletes have complex physical characteristics because they must navigate trails with varied terrain, ranging from steep climbs, sharp descents, to rocky paths.

This combination makes MTB a sport that demands maximum physiological capacity from the body. The selection of the 10–15 age range in this study also has a strong scientific basis. This age range is a crucial period of biological and motor development in the formation of basic sports skills (sensitive period). In this phase, children experience a growth spurt, increased cardiovascular capacity, and significant development of coordination and balance.

According to the Long-Term Athlete Development (LTAD) model, the age range of 10–15 years is categorized as the "Learn to Train" to "Train to Train" stage, which is the period when the foundations of basic technical and physical skills are built before moving on to specialization in a particular sport. If talent identification is carried out too early (under the age of 10), the accuracy of long-term predictions tends to be low because the variation in biological maturation between individuals is still large. Conversely, if it is done after the age of 15, some of the opportunities to optimize physiological and technical adaptation have already diminished.

Several local studies have shown a correlation between anthropometric/motor parameters and athletic performance, but the utilization of these findings in practical coaching policies is often minimal (Mansur et al., 2020). This creates a gap between the potential of the young population and measurable achievements at the regional and national levels. In response to this issue, this study proposes the application of R Programming as an analysis platform for developing a data-based MTB talent identification model. R provides an ecosystem of statistical and machine learning packages (e.g., PCA, cluster analysis, discriminant analysis, logistic regression, Random Forest, SVM) that enable multivariate data processing, dimension reduction, predictive modeling, and model validation through cross-validation and performance metrics (ROC, AUC, confusion matrix).

This study not only pursues scientific validity, but also an implementative orientation so that the findings can be directly utilized to design fair, efficient, and sustainable coaching programs at the regional level, as well as serve as a reference for similar studies in other geographical and cultural contexts.

METHODS

This study uses a technology-assisted observational approach that is systematically designed to objectively identify recreational mountain biking (MTB) talent. This design is a combination of conventional physical data collection methods and modern data analysis that relies on R Programming software.

This study consists of several stages.

1. In the first stage, Called the Planning Stage (Define), the entire foundation of the study is laid, identifying MTB talent in children aged 10-15 years in predetermined locations. Next, a comprehensive research design is prepared, including the formulation of hypotheses, determination of variables, and selection of relevant test instruments.

2. he second stage is the Measurement Stage (Test & Measurement), where data collection is carried out directly at the research location. These measurements include anthropometric data, such as height, weight, sitting height, and arm span. In addition, physical fitness tests, such as endurance, muscle strength, agility, and speed, are also conducted. Each measurement and test is carried out thoroughly and carefully to ensure data accuracy.

3. The final stage, the Dissemination Stage, is the stage of formulating research results and disseminating them. At this stage, all findings from data analysis are formulated into a comprehensive research report. This report includes conclusions, suggestions, and recommendations that can be used by coaches and sports trainers.

To obtain individual data for each variable, R Programming talent search tests and measurements were used, each consisting of four measurements and six tests, namely Anthropometric Measurements (Fornasiero et al., 2018). According to (Sugiono, 2018), purposive sampling is an appropriate technique for research that requires subjects with specific characteristics. The criteria used in this study were students aged 10-15 years, residing in Bungo Regency, willing to participate in physical tests, and obtaining approval from parents/guardians. According to (Sugiono, 2018), purposive sampling is an appropriate technique for research that requires subjects with specific characteristics.

Data collection in this study was conducted directly at the research site through a systematic procedure. The process began with explaining the purpose and procedure of the study to the subjects and their parents/guardians, as well as requesting informed consent. Next, a research team consisting of several trained enumerators conducted a series of tests and measurements according to the research instruments. Each test result was carefully recorded on a provided form and then entered into a digital database.

The collected and validated data was analyzed in depth using R Programming software. The first stage in this process was data preparation, where the test and measurement results were entered into an Excel file. This file was then imported into the R Programming environment for processing.

RESULTS AND DISCUSSION

Anthropometry

The results of the anthropometric survey of fifth and sixth grade elementary school students in Rantau Pandan Subdistrict showed that the respondents' height ranged from 135.75 cm to 152.5 cm, with an average of 143.19 cm. The anthropometric description of the respondents is presented in the following table:

Table 1.
Descriptive Statistics of Anthropometry of 5th and 6th Grade Elementary School Students in Rantau Pandan District

Parameters	Height	Steated height	Weight	Arm span
Minimum	135.5	72.5	31	134.5
Maximum	152.5	81.5	42	153
Average	143.185	76.79167	35.47	143.4233
Standard Deviation	5.33	2.61	3.33	5.43

Biomechanically, mountain bikers need precise control of the handlebars to navigate uneven, rocky, uphill, and downhill terrain. The ideal arm span—approximately 1.00–1.05 times the rider's height—provides advantages in terms of leverage and mechanical control. Arms that are too short cause the body to be too hunched over or the elbows to be too bent, which can increase shoulder muscle fatigue and reduce stability. Conversely, an arm span slightly longer than body height allows the rider to maintain an optimal distance between the saddle and handlebars, resulting in more balanced body weight distribution and more efficient bike maneuvering (Norton & Olds, 1996; Jeukendrup & Craig, 2012).

Aptitude Test

Based on the research results, the scores for each test were obtained, such as the tennis ball throw and catch (LTBT), basketball throw (LBB), vertical jump (LT), agility run (LK), 40 m sprint (L 40 m), and multi-stage run (MFT). These scores were simplified visually using a frequency distribution table for mountain biking talent identification components, and the results are presented in the following table.

Table 2.
Frequency Distribution of LTBT, LBB, LT, LK, L40 m, and MFT Capabilities

Skor	LTBT		LT		LBB		LK		L40M		MFT	
	Amt	Ptg	Amt	Ptg	Amt	Ptg	Amt	Ptg	Amt	Ptg	Amt	Ptg
Very Low (1)	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
Low (2)	0	0.00	0	0.00	0	0.00	0	0.00	67	55.83	0	0.00
Fair (3)	0	0.00	65	54.17	0	0.00	0	0.00	33	27.50	17	14.17
Good (4)	6	5.00	42	35.00	17	14.17	12	10.00	19	15.83	76	63.33
Very Good (5)	114	95.00	13	10.83	103	85.83	108	90.00	1	0.83	27	22.50

However, based on the results of the study, it was found that the number of respondents who had a talent for mountain biking was 13 people (10.83%). Meanwhile, the remaining 107 people or 79.13% did not have a talent for mountain biking. The results of this study indicate that, in general, the respondents have good cardiovascular endurance, control, regulate and direct movement, strength and muscle power that can be utilized in mountain biking. The frequency distribution of mountain biking talent is presented in the following figure.
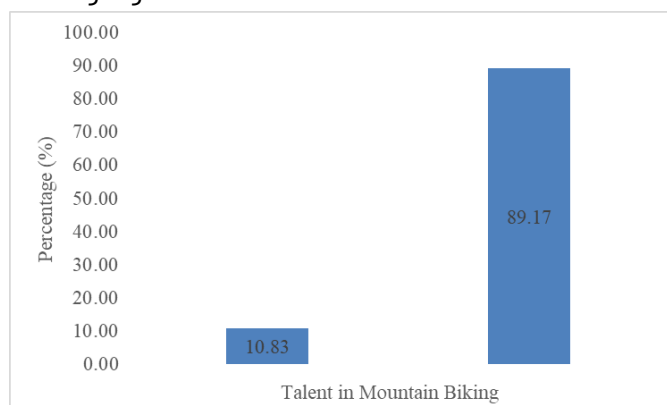

Figure 1.
Distribution of Mountain Biking Talent among 5th and 6th Grade Elementary School Students in Rantau Pandan Subdistrict

The statistical calculation for hypothesis testing should be completed with effect sizes; for example, the t-test using Cohen's d, the F-test using partial eta squared, or other posthoc tests in line with the references under consideration. For qualitative research, data from interviews, observations, text interpretations, and many more. Are condensed or summarized into a brief substantial resume or summary to be reported. These significant findings can be presented in descriptive tables to facilitate ease of reading. Excerpts or extracts from interviews, observation results, texts, and others containing answers to research questions are shown in the discussion. Interpretation of results should not be included in this section unless the research requires a combination of both findings and analysis in one part. The distribution of athletic talent found in the Rantau Pandan District can be seen in the following table:

Table 3.
Distribution of respondents based on athletic ability

Sports	Talented	Not Talented	Percentage of Talent (%)
Running	27	93	22.50
Soccer	14	106	11.67
Handball	13	107	10.83
Cycling	13	107	10.83
Long-distance swimming	11	109	9.17
Gymnastics	11	109	9.17
Basketball	8	112	6.67
Volleyball	8	112	6.67
Badminton	1	119	0.83
Short-distance swimming	1	119	0.83
Total	**120**		**100**

The table above shows that the most dominant types of sports found in Rantau Pandan Subdistrict are running, soccer, handball, and cycling. The results of this study clearly show that cycling is one of the most popular sports among elementary school students in Rantau Pandan Subdistrict. The results showed that 13 respondents (10.83%) had mountain biking talent. This means that the number of respondents who were talented at mountain biking was much smaller than those who were not.

Talent in general is an innate ability possessed by a person, which is a potential that still needs further development and training. The term "hidden talent" refers to natural talent that a person has had since birth but has not been honed and developed (Lena et al., 2020). Therefore, sports training should begin at an early age, especially among elementary school students, who are in their golden age for laying the foundations of motor skills. Thus, through an approach that is appropriate for their age and talent development, sports training can provide a strong foundation for the development of athletes' skills and potential from an early age.

CONCLUSION

The results of the study conclude that the application of technology and statistical methods through R Programming contributes positively to identifying athletic talent at the elementary school level. The results show that out of a total of 120 students studied, only 13 members (10.83%) showed skills or talent in mountain biking.

The research focuses on identifying talent. For future research, it is hoped that this study can be developed specifically on anthropometric aspects related to mountain biking talent.

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