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Lower Limb Power, Strength, and BMI for Student Athletes' Physical Development

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Keywords

Jump Power; Leg Strength; BMI; Student Athletes

Abstract

This study aimed to analyze the profile of lower limb explosive power, lower limb muscle strength, and body mass index (BMI) of Sports Science student athletes. The study employed a quantitative method with a descriptive approach. The research sample consisted of 48 male student athletes selected using purposive sampling techniques. Data collection was conducted through direct testing and measurements, including the Jump DF test to measure lower limb explosive power, a leg dynamometer to assess lower limb muscle strength, and body height and weight measurements to calculate body mass index. The data were analyzed using descriptive statistics, including mean, standard deviation, minimum value, maximum value, frequency, and percentage. The results showed that the average Jump DF score was 56.7 cm, with the majority of students categorized as Good (54.17%) and Excellent (20.83%). The average leg dynamometer result was 155.5 kg, with most students categorized as Excellent (75.00%) and Good (25.00%). The average BMI was 22.3 kg/m², with the majority of students classified as Normal (56.25%). The findings of this study indicate that male student athletes possess good lower limb explosive power, very good lower limb muscle strength, and predominantly normal BMI values. The results also revealed that lower limb muscle strength tended to be more dominant than lower limb explosive power. Therefore, physical development programs should focus on converting strength into explosive ability through power and plyometric training. These findings may serve as a basis for designing physical development programs for student athletes.

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INTRODUCTION

Sports Science student athletes are a group of students who have greater physical demands compared to students in general. In addition to carrying out academic activities, they are also required to participate in training sessions, practical courses, and sports activities with adequate physical condition. Good physical condition is an important factor in supporting movement skills, the efficiency of sports activities, and the achievement of optimal performance. Therefore, the evaluation of student athletes' physical condition needs to be conducted systematically so that their biomotor profile and body composition can be objectively identified. Exercise-based physical activity has been shown to improve physical function, exercise tolerance, and muscular strength, indicating that structured exercise programs are important for supporting physical development(Park et al., 2019).

Biomotor abilities play an important role in sports activities because they are directly related to the body's ability to perform movements. Biomotor ability is an individual's ability to perform movement through physical work, which consists of several components, such as endurance, strength, speed, agility, reaction, explosive power, and flexibility (Humaedi Wahyudhi et al., 2023). Biomotor ability can also be understood as the basic ability of an organism that develops through the processes of growth, maturation, and training, and is influenced by innate factors. The basic components of biomotor ability include strength, endurance, speed, mobility, and coordination (Sercan & Serkan, 2019). Biomotor components such as strength, explosive power, speed, agility, endurance, and flexibility serve as the foundation for supporting sports performance. Among student athletes, lower limb explosive power and lower limb muscle strength are important components that require special attention because many sports activities involve jumping, running, pushing, kicking, changing direction, and maintaining body stability. Maslikah et al., (2021) stated that anthropometric and biomotor profiles play an important role in supporting athletic achievement; therefore, both can be used as a basis for evaluating physical condition. Anthropometric measurements and biomotor ability tests, such as body height, body weight, flexibility, and lower limb explosive power, can be used to describe athletes' physical condition profiles through descriptive analysis (Hermawan et al., 2022). Field-based physical performance tests are commonly used in sport and educational settings because they provide practical information about physical capacity and can be applied with minimal equipment (Martínez-Romero et al., 2021). Physical exercise is an efficient and cost-effective strategy for improving functional capacity, indicating that structured exercise programs are important in supporting physical development (Layon et al., 2026).

Lower limb explosive power is the ability of muscles to generate force rapidly within a short period of time. This ability is highly needed in various sports, especially in explosive movements such as jumping, Physical training components are important for athletes, coaches, and sport practitioners because they provide a foundation for developing physical condition and achieving optimal sport performance (Saharullah, 2022). The leg dynamometer can be used as a simple and practical test to measure lower body strength and may serve as an alternative assessment tool to more demanding strength tests such as squat and deadlift 1RM (Kaintako et al., 2019). The back and leg dynamometer is a measurement instrument used to assess back and leg muscle strength in athletes, patients, and workers as a basis for evaluating physical performance status (Kusnandi et al., 2023). Vertical jump testing is one of the most commonly used methods to assess explosive athletic performance and can help evaluate athletes' development and training program outcomes (Güçlüöver & Gülü, 2020). take-offs, short sprints, and directional changes. One of the instruments that can be used to measure lower limb explosive power is the vertical jump or Jump DF test. Wang et al., (2024) explained that the vertical jump can be used to assess lower limb ability in male student athletes, and jump height can serve as an important indicator in evaluating athletes' jump training outcomes. Lower extremity strength assessment is important because leg strength is closely related to functional performance, and dynamometry can be used as a practical method to evaluate lower limb strength(Grootswagers et al., 2022).

In addition to explosive power, lower limb muscle strength is also an important element in supporting sports performance. Lower limb muscle strength functions to generate force,

support body weight, maintain balance, and improve movement efficiency. One instrument that can be used to measure lower limb muscle strength is the leg dynamometer. Research conducted by Dwijayanti et al., (2024) on physical education students utilized physical condition test instruments such as the vertical jump and back and leg dynamometer, and analyzed the results using descriptive percentages. This indicates that biomotor measurement among sports students is relevant for obtaining an objective overview of physical condition. Countermovement jump testing is important for evaluating lower-body explosive power, neuromuscular function, and overall sport performance across different athletic populations (Sharma & Singh, 2025).

Besides biomotor components, body composition is also an important aspect of the physical development of student athletes. Body mass index (BMI) is a simple indicator used to describe body status based on the comparison between body weight and height. Body mass index, body height, body weight, and physical fitness are important indicators that can be used to describe the physical condition of Sports Science students (Sudibo et al., 2019) . Body composition is an important determinant of functional performance, and variables such as body mass, fat mass, and muscle mass are associated with countermovement jump performance (Coutinho et al., 2026). BMI can provide preliminary information regarding body condition, such as underweight, normal, overweight, or obesity. However, the use of BMI in athletes must be interpreted carefully because BMI cannot distinguish between muscle mass and fat mass. Milanese et al., (2025) stated that athletes' body composition is generally characterized by greater muscle mass and lower body fat levels, so the use of general BMI cut-off points may not be entirely appropriate for assessing athletes' body condition.

Measuring biomotor profiles and body composition in student athletes is important as a basis for identifying their initial physical condition. This information can be utilized by lecturers, coaches, and students in evaluating physical abilities and designing more appropriate training programs. Sari & Nelson, (2023) explained that the physical condition of students in the Faculty of Sports Science, such as strength, explosive power, and flexibility, needs to be identified in order to anticipate declines in physical ability during practical course activities.

Several studies on athletes' physical condition profiles have also shown that anthropometric and biomotor measurements are frequently used as the basis for evaluation. Hermawan et al., (2022) used anthropometric measurements in the form of body height and body weight, as well as biomotor tests in the form of vertical jumps to determine lower limb explosive power in centimeters. The data were analyzed using descriptive percentages to describe athletes' physical condition profiles. This is in line with the present study, which focuses on measuring body characteristics and biomotor abilities of student athletes.

Based on the explanation above, research regarding the profile of lower limb explosive power, lower limb muscle strength, and BMI of Sports Science student athletes is important to conduct. Student athletes require good physical condition to support sports activities and practical coursework. However, the biomotor abilities and body status of each student may differ due to factors such as type of sport, training intensity, training experience, nutritional status, and anthropometric characteristics. Therefore, objective measurements are needed so that the physical condition of student athletes can be identified more accurately.

This study aims to analyze the profile of lower limb explosive power, lower limb muscle strength, and body mass index of male Sports Science student athletes. Lower limb explosive power was measured using the Jump DF test, lower limb muscle strength was measured using a leg dynamometer, while BMI was obtained through body height and body weight measurements. The results of this study are expected to provide an overview of the biomotor condition and body composition of student athletes, as well as serve as a basis for designing more effective, targeted, and appropriate physical development programs according to the needs of student athletes.

METHODS

This study employed a quantitative research method with a descriptive approach. This approach was used to describe the profile of lower limb explosive power, lower limb muscle strength, and body mass index (BMI) of Sports Science student athletes based on the results of tests and measurements. Quantitative research is grounded in the philosophy of positivism and is used to examine specific populations or samples through data collection using research instruments, while the data analysis is quantitative/statistical in nature (Sugiyono, 2017).

The study was conducted within the Sports Science Study Program environment after obtaining permission from the relevant authorities. The population of this study consisted of Sports Science student athletes, while the sample included 48 male student athletes selected using purposive sampling techniques. The sample criteria included male Sports Science student athletes who were in good health, willing to participate in the entire testing procedure, and possessed complete measurement data.

The research procedure began with the preparation of instruments, data recording sheets, and an explanation of the testing procedures to the participants. Before the tests were conducted, participants performed a warm-up to reduce the risk of injury and prepare their physical condition. Subsequently, the participants completed a series of tests consisting of Jump DF, leg dynamometer measurements, body height measurements, and body weight measurements.

The research data consisted of measurements of lower limb explosive power, lower limb muscle strength, body height, body weight, and BMI. The instruments used included the Jump DF test to measure lower limb explosive power, a leg dynamometer to measure lower limb muscle strength, a height measuring device, and a body weight scale. Jump DF results were expressed in centimeters, leg dynamometer results in kilograms, body height in centimeters, body weight in kilograms, and BMI in kg/m^2. BMI was calculated by dividing body weight in kilograms by height in meters squared.

Data collection techniques were carried out through direct testing and measurement. In the Jump DF test, participants performed jumps according to the testing procedures, and the results were recorded as lower limb explosive power scores. In the leg dynamometer test, participants performed pulling movements on the device, and the results were recorded as lower limb muscle strength scores. Vertical jump performance is considered an important indicator in evaluating lower limb ability and athletes' training performance (Wang et al., 2024).

The data analysis technique employed descriptive statistics by calculating the minimum value, maximum value, mean, standard deviation, frequency, and percentage. The results of the Jump DF and leg dynamometer tests were classified into five categories: Excellent, Good, Fair, Poor, and Very Poor, while BMI was classified according to body mass index categories. The analysis results were used to describe the biomotor profile and body composition of male Sports Science student athletes as a basis for developing physical training programs that suit the needs of student athletes.

RESULTS AND DISCUSSION

Based on the measurements conducted on 48 male Sports Science student athletes, data regarding subject characteristics and biomotor abilities were obtained, including age, height, body weight, BMI, Jump DF, and leg dynamometer results. The data were analyzed using descriptive statistics, including mean, standard deviation, minimum value, and maximum value. The results of the descriptive analysis are presented in Table.

Table 1. Descriptive Statistics of Characteristics and Biomotor Abilities of Male Student Athletes

Variable	N	Mean ± SD	Min	Max
Age	48	20,4±0,97	19,0	23,0
Height	48	168,9±5,96	155,5	182,5
Body Weight	48	63,2±11,08	48,7	94,9
BMI	48	22,3±3,37	17,3	31,9
Jump DF	48	56,7±8,15	34,0	79,0
Leg Dynamometer	48	155,5±53,49	92,0	300,0

Based on **Table 1**, the average age of the male student athletes was 20.4 years with a standard deviation of 0.97, indicating that most respondents were in the early adulthood age range. The average height of the respondents was 168.9 cm, while the average body weight was 63.2 kg. The mean BMI value of 22.3 kg/m² indicates that, in general, the male student athletes were within the normal category.

In terms of biomotor aspects, the average Jump DF result was 56.7 cm with a standard deviation of 8.15, a minimum value of 34.0 cm, and a maximum value of 79.0 cm. These results indicate that the lower limb explosive power of the male student athletes was generally in good condition, although variations among individuals were still observed. Meanwhile, the leg dynamometer results showed an average value of 155.5 kg with a standard deviation of 53.49, a minimum value of 92.0 kg, and a maximum value of 300.0 kg. The relatively large standard deviation in this variable indicates considerable differences in lower limb muscle strength among the male student athletes.

After obtaining the descriptive statistical results, the Jump DF and leg dynamometer data were classified into five categories: Excellent, Good, Fair, Poor, and Very Poor. This classification aimed to identify the distribution of lower limb explosive power and lower limb muscle strength levels among the male student athletes. The distribution of Jump DF and leg dynamometer categories is presented in **Table 2**.

Table 2. Distribution of Jump DF and Leg Dynamometer Categories

Variable	Category	Frequency	Percentage
Jump DF	Excellent	10	20,83%
Jump DF	Good	26	54,17%
Jump DF	Fair	9	18,75%
Jump DF	Poor	2	4,17%
Jump DF	Very Poor	1	2,08%
Leg Dynamometer	Excellent	36	75,00%
Leg Dynamometer	Good	12	25,00%
Leg Dynamometer	Fair	0	0,00%
Leg Dynamometer	Poor	0	0,00%
Leg Dynamometer	Very Poor	0	0,00%

Based on **Table 2**, the Jump DF category results showed that the majority of male student athletes were in the Good category, consisting of 26 individuals or 54.17%. Furthermore, 10 individuals or 20.83% were categorized as Excellent, 9 individuals or 18.75% as Fair, 2 individuals or 4.17% as Poor, and 1 individual or 2.08% as Very Poor. These findings indicate that the lower limb explosive power of male student athletes was generally categorized as good, although a small number of students still required improvement in lower limb explosive power ability.

For the leg dynamometer variable, the majority of male student athletes were categorized as Excellent, consisting of 36 individuals or 75.00%. Meanwhile, 12 individuals or 25.00% were categorized as Good. No students were classified as Fair, Poor, or Very Poor. These findings indicate that the lower limb muscle strength of male student athletes was generally in very good condition. Overall, these results suggest that the biomotor abilities of male student athletes, particularly lower limb muscle strength, were more dominant in the high category compared to lower limb explosive power.

In addition to biomotor abilities, this study also measured the body composition status of male student athletes based on body mass index (BMI). BMI was obtained from the comparison between body weight and height and was then classified into five categories: underweight, normal, overweight/at risk, obesity I, and obesity II. The distribution of BMI categories among male student athletes is presented in **Table 3**.

Table 3. Distribution of BMI Categories of Male Student Athletes

BMI Category	BMI Range	Frequency	Percentage
Underweight	< 18,5	4	8,33%
Normal	18,5 – 22,9	27	56,25%
Overweight / At Risk	23,0 – 24,9	8	16,67%
Obesity I	25,0 – 29,9	8	16,67%
Obesity II	≥ 30,0	1	2,08%
Total		**48**	**100%**

Based on **Table 3**, the majority of male student athletes were categorized as normal, consisting of 27 individuals or 56.25%. Furthermore, 8 individuals or 16.67% were categorized as overweight/at risk, and 8 individuals or 16.67% were classified as obesity I. Students categorized as underweight totaled 4 individuals or 8.33%, while only 1 individual or 2.08% was categorized as obesity II.

These results indicate that, in general, the BMI status of male student athletes was within the normal category. However, some students were still categorized as underweight, overweight, and obese. This demonstrates variations in body status among male student athletes. Therefore, the physical development of student athletes should not only focus on improving explosive power and lower limb muscle strength, but also on body weight management and body composition to better support sports performance.

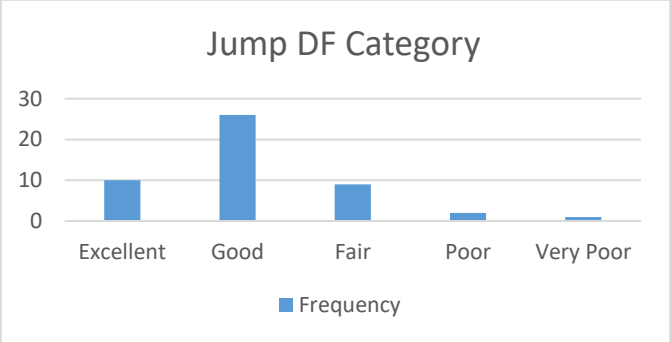

Figure 1. Jump DF Category

Based on **Figure 1**, the Jump DF category of male student athletes showed that the majority were classified in the Good category, consisting of 26 individuals or 54.17%. Furthermore, 10 individuals or 20.83% were categorized as Excellent, 9 individuals or 18.75% as Fair, 2 individuals or 4.17% as Poor, and 1 individual or 2.08% as Very Poor. These results indicate that, in general, the lower limb explosive power of male student athletes was in good condition. Lower limb explosive power is one of the important biomotor components in sports activities, particularly in movements that require jumping, take-off force, changes of direction, acceleration, and explosive movements. The high number of students categorized as Good and Excellent indicates that most students possess lower limb explosive abilities that sufficiently support sports performance.

Nevertheless, there were still students categorized as Fair, Poor, and Very Poor. This condition indicates that lower limb explosive power ability has not been evenly distributed among the students. These differences may be influenced by factors such as sports background, training experience, training intensity, body composition, and each student's physical activity habits. Therefore, the Jump DF results can serve as a basis for designing training programs that emphasize the improvement of lower limb power, such as plyometric training, squat jumps, bounding, skipping, and explosive exercises based on lower limb strength.

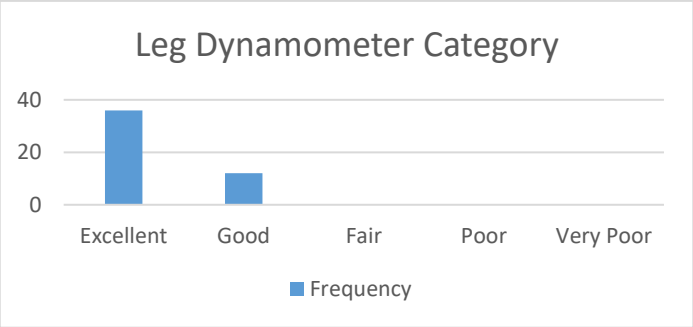

Figure 2. Leg Dynamometer Category

Based on **Figure 2**, the leg dynamometer category results showed that the majority of male student athletes were classified in the Excellent category, consisting of 36 individuals or 75.00%. Meanwhile, 12 individuals or 25.00% were categorized as Good. No students were classified in the Fair, Poor, or Very Poor categories. These findings indicate that the lower limb muscle strength of male student athletes was generally in very good condition. Lower limb muscle strength is an important component in supporting various sports skills, such as running, jumping, kicking, defending, changing direction, and maintaining body stability. The dominance of the Excellent category indicates that most student athletes already possess a strong foundation of lower limb strength.

However, when compared with the Jump DF results, lower limb muscle strength appeared to be more dominant than lower limb explosive power. This indicates that the ability to generate high levels of force has not been fully accompanied by the ability to convert that force into explosive movements. Therefore, physical development programs should not only focus on maintaining lower limb muscle strength, but also on directing training toward the conversion of strength into power. Recommended training methods include combinations of strength and speed exercises, such as jump squats, countermovement jumps, depth jumps, short sprints, and structured plyometric training.

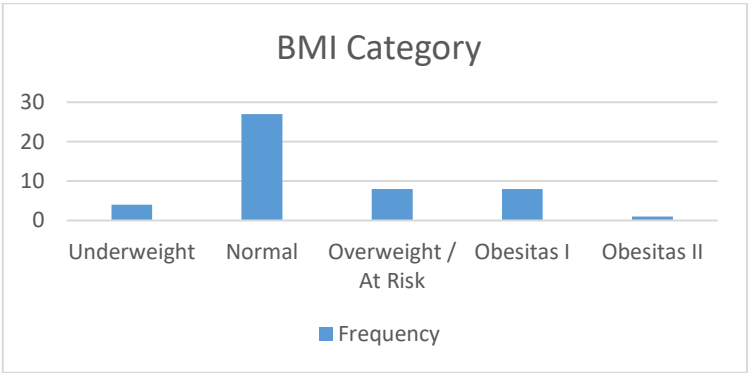

Figure 3. BMI Category

Based on **Figure 3**, the distribution of BMI categories among male student athletes showed that the majority were classified in the Normal category, consisting of 27 individuals or 56.25%. Furthermore, 8 individuals or 16.67% were categorized as Overweight/At Risk, 8 individuals or 16.67% were classified as Obesity I, 4 individuals or 8.33% were categorized as Underweight, and 1 individual or 2.08% was classified as Obesity II. These results indicate that, in general, the body composition of male student athletes based on BMI was within the normal category. This condition may support physical performance because body weight that is proportional to height contributes to movement efficiency, particularly in activities requiring speed, agility, endurance, and power. The majority of students categorized as normal indicate that most respondents had a body condition that was sufficiently ideal to support sports activities.

However, there were still students classified as underweight, overweight, obesity I, and obesity II. Students categorized as underweight may have insufficient body mass or energy reserves to optimally support strength and explosive power. In contrast, students categorized as overweight and obese may experience limitations in movement activities that require speed, agility, and explosive power due to greater body mass. Therefore, BMI results should be taken into consideration when designing physical development programs, particularly through exercise regulation, body weight monitoring, and sports nutrition education.

Although BMI can provide a general overview of body status, its interpretation in athletes must be conducted carefully. This is because BMI does not distinguish between muscle mass and fat mass. In student athletes, a high BMI value does not necessarily indicate excess body fat, as it may be influenced by greater muscle mass. Therefore, BMI should be used as an initial indicator of body composition and, if possible, complemented by other measurements such as body fat percentage.

Overall, the results of this study indicate that male Sports Science student athletes possess relatively good biomotor profiles. This is evident from the Jump DF results, where the majority of students were categorized as Good, and the leg dynamometer results, where the majority were categorized as Excellent. These findings indicate that student athletes possess a physical condition foundation that supports sports activities, particularly in terms of lower limb strength and explosive power.

However, differences were observed between the Jump DF and leg dynamometer results. In the leg dynamometer test, most students were categorized as Excellent, whereas in the Jump DF test, the majority were categorized as Good, with several students still classified as Fair, Poor, and Very Poor. This indicates that the lower limb muscle strength of student athletes was relatively better than their explosive power ability. In other words, some students already possessed good lower limb strength, but their ability to generate explosive movements still requires improvement.

From the BMI perspective, the majority of students were categorized as normal, although some students were still classified as underweight, overweight, and obese. This condition indicates that the physical development of student athletes should not only focus on improving biomotor abilities, but also on maintaining appropriate body composition. Proper body composition supports movement efficiency and helps student athletes achieve more optimal physical performance.

Based on these findings, physical development programs for student athletes should be directed toward improving lower limb explosive power, maintaining lower limb muscle strength, and managing body composition. Strength training should continue to be maintained, but it also needs to be combined with power and plyometric training so that strength abilities can be transferred into explosive movements. In addition, BMI and body weight monitoring should be conducted regularly to ensure that student athletes maintain body conditions that support sports performance.

CONCLUSION

The results of the Jump DF measurements showed that the majority of students were categorized as Good, consisting of 26 individuals or 54.17%, followed by the Excellent category with 10 individuals or 20.83%. These findings indicate that the lower limb explosive power of male student athletes was generally good, although a small number of students were still classified in the Fair, Poor, and Very Poor categories, indicating the need for further improvement through lower limb power training programs.

The results of the leg dynamometer measurements showed that most students were categorized as Excellent, consisting of 36 individuals or 75.00%, while 12 individuals or 25.00% were categorized as Good. No students were classified in the Fair, Poor, or Very Poor categories. Therefore, the lower limb muscle strength of male student athletes can be considered to be in very good condition.

Based on the BMI results, the majority of students were categorized as Normal, consisting of 27 individuals or 56.25%. However, some students were still classified as underweight, overweight/at risk, obesity I, and obesity II. These findings indicate that although

the body status of student athletes was generally normal, body composition management still needs to be considered in order to optimally support physical performance.

Overall, the results of this study indicate that male Sports Science student athletes possess very good lower limb muscle strength and good lower limb explosive power, with BMI status predominantly within the normal category. These findings can serve as a basis for designing physical development programs, particularly by emphasizing the improvement of lower limb explosive power, the maintenance of lower limb muscle strength, and the management of student athletes' body composition.

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