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Analysis identification of the dominant physical needs of archery athletes

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Abstract

This study aims to determine the quantitative relationship between physical factors such as height, weight, arm length, length of the span of both arms and hand pull strength on archery performance in archery athletes participating in the Central Java National Sports Week. This study uses a quantitative survey method. The sample involved was 28 athletes of the Central Java National Sports Week (PON) who were selected using a purposive sampling technique. The data collection techniques in this study are tests and measurements. The results showed that there was no significant relationship between height, weight, arm length, length of the span of both arms, and hand-pulling strength with archery results. These physical factors are not the main determinants of archery achievement. The results showed that there was a significant relationship between height, weight, arm length, length of the span of both arms, and hand-pulling strength with archery results. Each variable is marked with an R-value of 0.82. Based on these results, height, weight, arm length, length of the span of both arms and hand pull strength are very important factors in supporting the dominant physical needs of archery athletes. This research has important implications for coaches and athletes, namely that the focus in training should be more directed at developing mental techniques and skills rather than simply relying on or modifying physical factors. Comprehensive skill development and experience enhancement can be a more effective strategy to improve achievement in archery.

Keywords: Analysis, physical, archery, athletes.

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INTRODUCTION

The dominant physical needs in archery show that although anthropometric factors such as height, weight, arm length, and hand pull strength are often considered important, they are not the main

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determinants of achievement (Hidayat & Munandar, 2023). Achievement in archery is more influenced by a combination of good technique, mental abilities such as concentration and composure, and a structured training program (Sahabuddin et al., 2022). Archery demands posture stability and proper muscle control when pulling the bow and releasing arrows. Therefore, the focus of training should include the development of basic techniques, the strengthening of certain relevant muscles, and the management of mental stress. A thorough understanding of these dominant physical needs can help coaches and athletes design effective training programs and improve performance in the competitive arena (Fitriyani et al., 2023).

Archery, a sport requiring precision and consistency, is influenced by several factors, including physical and mental abilities. While traditionally associated with anthropometric characteristics like height, weight, arm length, and pulling strength, recent studies suggest that these physical elements alone do not determine success (Islami et al., 2024). Instead, achievements in archery rely on a combination of technical skills, mental focus, and structured training programs (Bramantha & Setiawan, 2022). This study focuses on the dominant physical needs of archery athletes, exploring how factors such as arm span, pulling power, and specific muscle strength contribute to performance. By identifying these critical components, the research aims to provide actionable insights for coaches and athletes, emphasizing the need for tailored training strategies to optimize performance in competitive archery.

Previous research on archery has revealed various factors that affect athletes' performance. Açıkada et al. (2019) showed that heart rate levels can affect archers' accuracy, highlighting the importance of physiological control during competition. Meanwhile, Briliansyah et al. (2024) observed that upper arm strength exercises, such as plank exercises, can improve muscle endurance and shooting accuracy in archery athletes. Faqiha and Pratama (2022) also found that exercise methods such as blind shoot and blank shooting could improve kinesthetic

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perception and shooting accuracy. Moreover, Lachance et al. (2024) highlighted the importance of managing basic techniques, such as stable body position and consistent arrow release, in favor of optimal results. These studies confirm that success in archery depends on physical factors, technique, and mentality, so holistic training is indispensable.

Archery cannot be separated from the aspect of physical condition as the achievement of achievement must include aspects of all components, starting from the aspect of the physical component (Dwijawanti & Satria, 2024). The physical condition of something is always inherent and needed in a person's daily process, starting from opening the eyes to life, is not conceived by the body (Fahrizqi et al., 2021). High achievement is achieved through a planned training process, having goals, and evaluation. Training aims to help athletes improve their skills and achieve peak achievement (Rizal et al., 2023). Achieve achievement performance must go through a process of 4 stages of training components that must be observed, trained, and realized by athletes: (1) physical condition, (2) technique, (3) mental, (4) tactic (Rizal et al., 2023).

Every physical condition must be developed as a whole gradually and continuously because an athlete's prime physical condition cannot undergo proper and quality training (Septiana et al., 2020). The main goal is to improve the quality of Faal's potential and increase the biomotor potential to the peak level of achievement (Borges et al., 2020). Some of the biomotor aspects that must be observed are cardiovascular endurance, strength, flexibility, speed, and muscle endurance (Prasetyo et al., 2018). The biomotor component/physical condition is essential for athletes to develop (Vanagosi & Dewi, 2019). The importance of the physical aspect needs to be developed which stages must be known, namely: (1) the Physical preparation stage in general, (2) the Physical preparation stage in particular, (3) the Preparation stage very specifically according to the needs of the Sports Branch.

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Each sport has different characteristics, including archery. This difference will certainly require different handling, namely handling that is adjusted to the characteristics of the sport being fostered. In other words, in the development of training sports, methods, programs and strategies of training approaches are needed that are different from other sports. Many factors also determine the quality level of archery achievements, including being influenced by the dominant physical elements in archery sports. Physical coaching is one of the aspects that is needed and underlies various other aspects because the physical aspect is an inseparable part of overall sports coaching.

This physical aspect can be fostered and trained in a certain way. To determine the level of accuracy in compiling a physical training program, it is necessary to know the need for the necessary physical elements and how much the level of need in archery sports is (Delisle et al., 2024). The dominant physical elements in archery are interesting to study because they also affect the achievements of archery itself. The description of the condition of this physical aspect must be well understood because this will determine the completion and implementation of a physical training program tailored to archery sports. These dominant physical elements are greatly influenced by the parts of the body that are directly used in archery (Cavalcante Neto et al., 2021). The body parts that play an important role in archery are the upper extremities, namely the elbow, forearm, wrist, and hand. These parts have a close relationship with one's ability in archery, especially related to the archer's body structure when pulling the bow. To produce a fast, strong, and precise shot towards the target, adequate strength or power is needed. The dominant physical element in archery plays an important role in supporting the speed and accuracy of the arrow towards the target. In addition, the contribution of anthropometry to the results or achievements in archery is one of the relevant aspects to be evaluated further.

This study aims to evaluate the contribution of dominant physical elements and anthropometric characteristics to the achievement of archery

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results. By identifying the relationship between upper body strength, other physical elements, and archery performance, this study provides insight for coaches and athletes in optimizing archery performance through a data-based and scientific approach.

METHOD

This study used a survey method with a sample of 28 Central Java National Sports Week (PON) athletes selected using purposive sampling. This technique ensured that the participants selected were relevant to the research objectives, namely active athletes with achievements that could be measured in FITA rounds. This study aimed to identify the relationship between predictor variables, including dominant physical elements, with archery performance as the response variable.

The instruments used included measurements of predictor variables such as pulling power (X1), measured with a dynamometer to determine arm pulling strength in kilograms, and accuracy (X2), measured based on the athlete's accuracy in reaching the target in a standard training session. In addition, anthropometric variables such as body weight, height, arm length, the length of the stretch of both hands, and hand grip strength were also measured using tools such as digital scales, stadiometers, flexible tape measures, and grip dynamometers. The archery performance (Y) response variable was assessed based on standardized scores in FITA rounds.

Data analysis was done descriptively, and inferential statistics were performed. Descriptive statistics were used to examine the mean, spread, and range of scores on all variables. The inferential analysis included Pearson correlation to assess the linear relationship between each predictor variable and archery performance and multiple linear regression to evaluate the effect of combinations of predictor variables on archery performance. Assumption tests such as normality and multicollinearity were also conducted to ensure the validity of the model.

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RESULT

In this section, we will discuss data analysis in accordance with the data processing obtained in research activities.

1. Statistical Data of Research Variables

Table 1. Statistical data of research variables

	x1	x2	x3	x4	x5
Mean	64,41	156,38	71,72	165,22	43,81
SD	23,71	32,06	14,69	34,32	18,13
Min	18,91	7,32	3,36	10,27	4
Max	125	176	84	195	66

From the descriptive analysis, each variable (x1), (x2), (x3), (x4), and (x5) showed different characteristics in terms of mean, variation, and range of values. Variable (x1) has a mean of 64.41 with a considerable spread (SD = 23.71), and the range of values from 18.91 to 125 indicates significant variation in the data. This indicates a considerable difference between the lowest and highest values in (x1). The variable (x2) has the second highest mean (156.38) with the largest standard deviation (32.06), showing a very wide distribution with a range of values from 7.32 to 176. This indicates the presence of extreme values at both ends of the (x2) distribution.

Meanwhile, the variable (x3) shows an average of 71.72 with a relatively small standard deviation (14.69), reflecting more stable and centered data than the other variables. The range of (x3) values, from 3.36 to 84, is narrower than (x1) and (x2), indicating a smaller degree of variation. The variable (x4) has the highest mean (165.22) with a sizable standard deviation (34.32), indicating that the values of (x4) are spread far from the mean, and its wide range (10.27 to 195) exposes the presence of extreme data.

Finally, the variable (x5) has the lowest mean (43.81) with a standard deviation of 18.13, indicating a moderate level of variation. The range of (x5) values, from 4 to 66, shows that this data is relatively more homogeneous than (x2) and (x4). Overall, the data shows that (x2) and (x4) have the greatest degree of variation, while (x3) and (x5) are more

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stable. These differences may reflect unique characteristics in the measurement context of these variables, depending on further interpretation in the context of the analysis.

2. Normality Test

Table 2. Data analysis of each variable

	Kolmogorov-Smirnov			Shapiro-Wilk		
	Statistic	df	Sig.	Statistic	df	Sig.
Archery Score	.114	28	.200*	.954	28	.249
Weight	.149	28	.115	.873	28	.003
Height	.123	28	.200*	.966	28	.467
Arm Length	.133	28	.200*	.965	28	.444
Length of the span of both hands	.159	28	.067	.948	28	.172
Arm Pulling Strength	.098	28	.200*	.951	28	.207

The normality test results show that most of the variables, namely Archery Score, Height, Arm Length, Length of the Span of Both Hands and Arm Pulling Strength, have a normal distribution as the significance values (p) of Kolmogorov-Smirnov and Shapiro-Wilk are greater than 0.05. However, the Weight variable did not meet the assumption of normality based on the Shapiro-Wilk test (p = 0.003), although Kolmogorov-Smirnov showed (p = 0.115). Most variables were normally distributed, but the Weight variable requires special attention, and non-parametric analysis may be required for this variable.

3. Linearity Test

Table 3. Linearity test anova

Relationship	Sig	*P*	Information
X1 to Y	0,79	0,05	Linear
X2 to Y	0,80	0,05	Linear
X3 to Y	0,86	0,05	Linear
X4 to Y	0,79	0,05	Linear
X5 to Y	0,83	0,05	Linear

The table shows that all variables (X1) to (X5) have a significant (p = 0.05) and linear relationship with (Y). The strongest relationship is with (X3) (r = 0.86), followed by (X5) (r = 0.83), (X2) (r = 0.80), and (X1) and (X4) (r = 0.79). All relationships were significant and linear, with (X3) having the greatest influence on (Y).

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Table 4. Measures of association

	R	R Squared	Eta	Eta Squared
Archery Score* Weight	.82	.000	.950	.903

The requirements for correlational analysis are normal and linear data. The chart above shows that the existing data is normal. Test the normality of all data>0.05 for all normal data, sig. Kolmogorov -Smirnov >0.05 (normal data) means that it has met the first requirement for correlational analysis, but from the linearity test data, it appears that the existing data is not linear, Linearity data sig. All sig is between the score data (y) and var (x). > 0.05 (all data is not linear). Thus, it does not meet the second requirement for correlational analysis.

DISCUSSION

The results showed that physical factors such as height, weight, arm length, and hand pull strength had no significant relationship to achievement in archery (Rahma et al., 2024). This finding indicates that although anthropometric factors are often considered as a basis in athlete selection, they are not the main determinants of success. Instead, other factors such as technique, consistency, and mental ability contribute much more. In this context, concentration and mental composure are essential, as archery demands the ability to replicate precise movements repeatedly. When drawing the bow, postural stability and muscle control become more important than relying solely on specific physical strengths (Sobarna & Hambali, 2020). Therefore, training approaches should include managing both technical and mental aspects simultaneously to achieve optimal results.

In addition, factors such as competition experience and structured training strategies are also key elements in supporting the performance of archery athletes (Fachrezi et al., 2023). Exercises designed to improve focus and relaxation, such as meditation or visualization, have been shown to be effective in improving shot accuracy (Sahabuddin et al., 2022). On the other hand, although hand muscle strength is required to draw the bow, excess strength without control can decrease stability while

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aiming (Farah Yumna Faqiha & Pratama, 2022). This emphasizes the importance of training specific muscles that support stability rather than improving general strength. As such, training should be geared towards integrating physical, technical, and mental components in a holistic manner. This interpretation emphasizes that success in archery does not depend on physical attributes alone but on the ability to manage and optimize all relevant aspects.

Height is often considered an indicator of excellence in various sports, but in archery, the role of height is not crucial. Archery is a sport that requires precision and consistency, not excessive physical strength. An athlete's height does not directly affect their ability to shoot arrows precisely at the target. Rather, what is more important is the athlete's ability to maintain a stable posture and high concentration (Yachsie et al., 2021). Many outstanding archery athletes have varying heights, indicating no strong correlation between height and archery results. In addition, weight also does not have a significant relationship with achievement in archery. Indeed, weight can affect body balance, but in archery, balance depends more on correct technique and posture than weight itself, heavier or lighter athletes can equally succeed in archery if they are able to maintain a stable posture and have good technique (Nuradila et al., 2024).

The length of the arm and the span of the two arms are also often considered factors affecting archery, with the assumption that a longer arm may provide an advantage in pulling the bow. However, in reality, arm length does not automatically provide an advantage. A longer arm span can indeed provide a greater angle of pull, but without proper technique, this will not contribute positively to the accuracy of the shot. Athletes with shorter arms but good technique can produce the same accurate shots as athletes with longer arms (Farah Yumna Faqiha & Pratama, 2022). The key is how an athlete makes effective use of their arm length through the correct technique.

The force of the hand pull may sound important, especially since archery involves a bow pull that requires strength (Yuliawan, 2023). However, this strength does not determine overall success in archery. More important is the specific and trained muscle strength for stability when pulling and holding the bow in the right position. In addition, the speed and force of pulling the bow must be accompanied by good control (Briliansyah et al., 2024). Excessive force without control can cause instability and reduce the shot's accuracy. Athletes who are able to control their strength well, regardless of how big or small the force of their hand pull, will be more successful in archery.

Mental factors such as concentration, calmness, and focus have a much greater effect on archery performance than these physical factors (Adhinayana et al., 2020). Archery is a sport that relies heavily on consistency and the ability to repeat the same movements with high precision. Strong concentration and mental stability are essential to achieving good results. Athletes who can stay calm under pressure and maintain their focus in each shot will be more likely to achieve high performance, regardless of their physical factors.

Good technique is also the key to success in archery. Athletes with strong basic techniques, such as proper bow grips, correct body positions, and consistent arrow release, will be more successful than athletes relying solely on physical strength. This exercise focuses on developing technique and mental abilities, which is more important than worrying about physical factors such as height or weight. So although height, weight, arm length, length of the span of both arms and hand pull strength may be considered important by some people, evidence from Central Java National Sports Week athletes shows that these factors do not have a significant relationship with achievements in archery. This sport's achievements depend more on technique, concentration, composure, and experience. Therefore, for athletes who want to achieve success in archery, the main focus should be directed at developing technical and mental skills rather

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than on physical factors alone. Thus, they will be better able to achieve peak achievement in this sport that demands precision and consistency.

CONCLUSION

Based on the results of this study, it can be concluded that there is no significant relationship between height, weight, arm length, length of the span of the two arms, and hand-pulling strength on the archery results (achievements) of Central Java National Sports Week athletes, whether evaluated individually or collectively. This finding suggests that anthropometric conditions often assumed to influence athletic performance do not play a determining role in archery success for this specific group of athletes.

This result has practical implications for coaches and talent scouts. Specifically, it emphasizes that anthropometric factors should not be prioritized in the selection process or used as predictors of archery performance. Instead, coaches should focus on other aspects, such as technical skills, mental focus, consistency, and training discipline, which may have a greater impact on achieving success in archery. Additionally, this insight could guide future research to explore non-anthropometric factors, such as psychological resilience or fine motor control, that better explain variations in archery achievements.

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