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Research Article

Impact of Morphological Variables on Throwing Ability: A Gender-Driven Exploration Among Athletes in Cape Coast Metropolis, Ghana

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Abstract

This study represents a comprehensive exploration of the intricate interplay between morphological variables and throwing ability, specifically examining gender-specific variations among athletes in Cape Coast Metropolis, Ghana. In the pursuit of an understanding, data were collected from a diverse sample of 420 athletes, comprising 210 males and 210 females, aged between 16 and 22. The investigation illuminated that athletes within the Cape Coast Metropolis possess not only well-developed body dimensions but also an adequate level of fitness, both integral to overall athletic performance. This insight was substantiated by the statistical analysis, which demonstrated that morphological features accounted for a substantial 64% to 73% of the variance in throwing ability. The study employed predictive equations tailored for male and female athletes, further illustrating the influential role of specific morphological characteristics. For male athletes, the equation T^B = -12.53 + .577handspan + .053Body weight + .109Total Arm Length - .055thigh girth + .053Chest Circumference Expiration - .094Tricep Skin Fold encapsulates the predictive model. On the other, the equation T^G = -8.11 + .597Handspan + .068Upper Arm Length + .013Body Weight + .021Thigh Girth encapsulates the model for female athletes. These equations provide practical tools for forecasting throwing proficiency within the local athletic community in Cape Coast Metropolis. This research contributes significantly to the field, emphasizing the pivotal role of morphological variables in shaping athletic performance. The findings underscore the importance of training programs and talent identification processes based on an individual's morphological characteristics, with the potential to enhance overall athletic development in the Cape Coast Metropolis region.

Keywords

Morphological Predictors, Throwing Ability, Gender-Specific Variations, Cape Coast Metropolis, Predictive Equation, Multicollinearity, Athletic Community

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1. Introduction

Training approaches and talent identification procedures have long been shaped by the complex interactions that exist between an athlete's physical attributes and their performance potential [12]. This study explores the complex field of morphological factors and how they might be shown to affect throwing skills, focusing on gender differences in particular. Located in Ghana's Cape Coast Metropolis, a major sports center, this study attempts to identify the distinct morphological factors that influence the throwing ability of male and female players. The physical characteristics that underlie athletic ability must be carefully examined due to the dynamic nature of sports, and this study aims to provide crucial information about the gender-specific aspects of throwing performance in the local sporting community. Using an extensive examination of morphological characteristics, such as body size and particular limb lengths, this research aims to clarify the unique elements influencing throwing prowess in athletes in the Cape Coast Metropolis.

The study will investigate the relationship between physical characteristics and throwing ability in the dynamic Cape Coast Metropolis, which is well-known for its vibrant sports culture. By placing the research in this dynamic environment, the research hopes to capture the essence of local athletic prowess and provide findings that have practical implications for both training programs and talent identification initiatives. Given that male and female athletes differ physiologically by nature [2, 9, 19], this study focuses especially on figuring out the dynamics of throwing skills that are unique to each gender. Research suggests that gender differences in biomechanics, bone density, and muscle mass distribution can have a major impact on athletic performance [7]. Comprehending these disparities is essential to customizing training plans that accommodate the varied physical attributes of both male and female players, promoting a more comprehensive and efficient method of sports advancement.

A more sophisticated knowledge of the anatomical factors affecting throwing skill is one of the anticipated results, especially in light of gender variations [21]. Coaches and sports scientists may find useful tools in the creation of prediction models tailored to male and female players. The results of this study have the potential to impact both the theoretical and practical fields of sports science and athlete development, where customized training plans based on individual morphological profiles can maximize performance. This study thoroughly examines the influence of morphological factors on throwing skills, paying particular attention to subtleties influenced by gender. The study aims to improve our knowledge of how different physical characteristics influence the skill of male and female athletes in throwing sports by exploring the nuances of local athletes in the Cape Coast Metropolis. The results could have a real-world impact on talent spotting, sports training, and the larger conversation about maximizing athletic performance.

1.1. Statement of the Problem

Throwing is a basic ability in many sports, and a variety of morphological variables might have an impact on one's ability to master it [20]. But there's a big knowledge gap about how these anatomical factors specifically impact throwing skills, especially when considering gender differences. Although the literature recognizes the role that morphological characteristics play in athletic performance [5, 11, 16], few studies are specifically focused on the details of throwing ability in the Cape Coast Metropolis, Ghana [3]. Studies that already exist on the morphological predictors of throwing skill frequently generalize results without taking into consideration the distinctive qualities of various geographic and cultural situations. By concentrating on Cape Coast Metropolis, this study seeks to close this knowledge gap by offering regional insights that can more effectively guide training plans and talent-finding tactics catered to the unique requirements of the region's sports community.

Because of innate physiological differences, the effects of morphological characteristics on throwing ability can differ dramatically between male and female athletes [12]. Although this gender-specific component is recognized in general sports science, little research specifically addresses these differences in the throwing domain. Comprehending these subtleties is essential for creating training programs that are both equitable and efficacious. Although the impact of morphological characteristics on athletic performance is widely acknowledged, there are not many precise and reliable predictive models available, particularly when it comes to throwing ability. Accurate prediction models can improve our theoretical knowledge while providing coaches and sports scientists with useful tools to customize training plans based on individual morphological profiles and maximize athletic performance [8].

A lack of specific studies on how morphological factors affect throwing ability also results in a lack of useful applications for athlete development initiatives. Developing targeted interventions that can effectively develop talent is contingent upon an understanding of how particular morphological traits influence throwing proficiency [6], particularly in a community such as Cape Coast Metropolis with a strong sporting culture. Although there is a strong sports culture in Cape Coast Metropolis, there is not much research that focuses on the morphological factors that influence throwing skills in this area. By offering insights that connect with the experiences and goals of regional players, coaches, and sports administrators, this study aims to close this gap. This study aims to fill in these gaps in the literature by examining the complex relationship between morphological factors and throwing ability, especially in the context of gender. It provides theoretical contributions to sports science as well as useful implications for the development of athletes in Cape Coast Metropolis, Ghana.

1.2. Purpose of the Study

The goal of this research is to provide locally relevant insights that can guide targeted training interventions and talent identification procedures in the athletic community of Cape Coast Metropolis, Ghana. Specifically, the study concentrates on gender-based disparities and the comprehensive investigation of the influence of morphological variables on throwing ability.

1.3. Research Question

To what extent do gender-specific variations in morphological predictors contribute to the observed differences in throwing performance within the athletic community in Cape Coast Metropolis?

1.4. Research Hypothesis

Selected morphological variables, will significantly predict gender-specific variations in throwing ability among athletes in Cape Coast Metropolis, Ghana.

2. Materials and Methods

2.1. Study Design

This research employed a correlational study design to investigate the relationship between morphological variables and throwing ability among male and female athletes in Cape Coast Metropolis, Ghana.

2.2. Study Participants

The study involved a sample of 420 athletes, with an equal representation of male (210) and female (210) participants, drawn from various sports disciplines in the Cape Coast Metropolis. The participants were aged between 16 and 22 years.

2.3. Data Collection

2.3.1 Morphological Measurements

Various morphological variables were assessed, including body weight, 6 measurements related to body length, 7 body girth, and knee diameter, and 7 skinfold measurements. Measurements were taken using standardized anthropometric tools.

2.3.2. Throwing Performance Assessment

Throwing ability was evaluated through a 3kg medicine ball throwing test designed for both male and female participants. The participants performed a series of throws, and the distance achieved was recorded.

2.4. Data Analysis

Statistical analysis was conducted using SPSS version 21 software. Multiple regression analysis was employed to determine the relative predictive power of specific morphological factors on throwing performance.

2.5. Ethical Considerations

The study adhered to ethical guidelines, obtaining informed consent from all participants. Confidentiality and privacy were maintained throughout the research process, and participants were assured that their involvement would not affect their standing in their respective sports programs.

2.6. Limitations

While efforts were made to obtain a representative sample, the study's generalizability might be limited to the specific athletic community in the Cape Coast Metropolis. Additionally, the correlational design may restrict the establishment of causal relationships.

3. Results

3.1. To What Extent Do Gender-Specific Variations in Morphological Predictors Contribute to the Observed Differences in Throwing Performance

The investigation into the association between gender-specific variations in morphological predictors and throwing performance has yielded significant findings. The study focused on female and male athletes in the Cape Coast Metropolis, Ghana, exploring the relationship between specific physical traits and their impact on throwing ability.

3.1.1. Female Athletes

Table 1. *Summary Model of Throwing Ability and Morphologic Features for Girls.*

R	R^2	Adjusted R^2	SEE
.800	.640	.633	.60160

N=210

Tables 1 and 2 reveal a substantial positive linear association (Pearson's correlation coefficient = 0.800) between selected morphological variables and throwing ability among female athletes. The high correlation coefficient indicates a robust and positive link between these variables, emphasizing

their significance in predicting throwing skills. This aligns with the study's hypothesis and prior research, emphasizing the importance of specific morphological features in throwing proficiency.

The subsequent stepwise multiple regression analysis (Table 1 & 2) provides more granularity into the percentage contribution of individual morphological characteristics to the observed variation in throwing ability among female athletes. The model, comprising hand span, humerus length, body weight, and thigh circumference, is highly significant (R^2 = 0.64, F (1, 209) = 295.27, p = 0.001).

Table 2. *ANOVA of Throwing Ability and Morphologic Features for Girls.*

Model	Sum of Squares	Df	Mean Square	F	Sig.
Regression	120.79	1	120.79	295.27	.000
Residual	85.09	208	.409		
Total	205.89	209			

N=210

This implies that 64% of the variation in throwing ability can be attributed to these morphological factors (Table 5). Hand span, humerus length, body weight, and thigh circumference, as evidenced by their respective beta coefficients, make distinct contributions to the predictive power of the model.

3.1.2. Male Athletes

Tables 3 and 4 depict a similarly strong positive correlation (Pearson's correlation coefficient = 0.85) between morphological variables and throwing ability among male athletes. The high correlation coefficient underscores the robustness of the relationship, suggesting a considerable degree of predictability in male athletes' throwing skills based on specific morphological features. The subsequent stepwise multiple regression analysis (Table 3 & 4) outlines the percentage contribution of individual morphological variables to the observed differences in throwing skills among male athletes. The model, including handspan, body weight, total arm length, thigh girth, chest circumference expiration, and tricep skin fold, is highly significant (R^2 = 0.73, F (1, 208) = 264.26, p = 0.001). This indicates that 73% of the variation in throwing ability can be explained by these morphological factors. Each variable, as indicated by its beta coefficient (Table 6), plays a crucial role in shaping the overall predictive capacity of the model.

Table 3. *Summary Model of Throwing Ability and Morphologic Features for Boys.*

R	R^2	Adjusted R^2	SEE
.852	.73	.718	.94226

N=210

Table 4. *ANOVA of Throwing Ability and Morphologic Features for Boys.*

Model	Sum of Squares	Df	Mean Square	F	Sig.
Regression	368.154	1	368.15	264.26	.000
Residual	289.778	208	1.393		
Total	657.932	209			

N=210

Comparatively, the study findings underscore both commonalities and differences in the morphological predictors of throwing ability between genders. While handspan and body weight appear to be influential for both female and male athletes, the inclusion of humerus length in the female model and total arm length, thigh girth, chest circumference expiration, and tricep skin fold in the male model highlights gender-specific variations. These distinctions emphasize the nuanced nature of the relationship between morphology and throwing ability, suggesting that certain characteristics may weigh differently in the performance outcomes for female and male athletes.

The study provides substantial evidence supporting the hypothesis that gender-specific variations in morphological predictors significantly contribute to observed differences in throwing performance. The identified morphological characteristics, such as handspan, humerus length, body weight, total arm length, thigh girth, chest circumference expiration, and tricep skin fold, offer valuable insights for coaches, athletes, and sports scientists in tailoring training programs and talent identification processes based on gender-specific morphological considerations in the Cape Coast Metropolis athletic community. The percentage contributions detailed in the regression analyses highlight the significance of each variable in explaining the observed variation in throwing ability for both female and male athletes.

3.2. Selected Morphological Variables, Will Significantly Predict Gender-Specific Variations in Throwing Ability Among Athletes in Cape Coast Metropolis, Ghana

The hypothesis aims to investigate whether specific morphological variables can serve as significant predictors for the observed gender-specific differences in throwing ability among athletes in Cape Coast Metropolis, Ghana. The findings from Tables 5 and 6 provide valuable insights into the relationship between morphological predictors and throwing ability, differentiating between female (T^G) and male (T^B) athletes. The study delves into the specific morphological features that significantly contribute to the observed variation in throwing performance among athletes in the Cape Coast Metropolis.

Table 5. *Coefficients of Throwing Ability and Morphologic Features for Girls.*

Model	B	Std. Err.	Beta	T	Sig.	Tolerance
(Constant)	-8.11	1.008		-8.043	.000	
Handspan	.597	.039	.692	15.309	.000	.861
Up. Arm Length	.068	.020	.152	3.390	.001	.872
Body Weight	.013	.006	.107	2.145	.033	.708
Thigh Girth	-8.11	.010	.090	1.984	.049	.860

N=210

3.2.1. Female Athletes (T^G)

The results from Table 5 reveal a significant predictive relationship between morphological variables and throwing ability among female athletes (b = -0.09, t (1, 209) = 1.98, p = 0.049). The variables included in the predictive equation are hand span, upper arm length, body weight, and thigh circumference. Together, these variables explain 64 percent of the observed differences in throwing ability among female athletes. The model, as indicated by the equation T^G = -8.11 + 0.597Handspan + 0.068Upper Arm Length + 0.013Body Weight + 0.021Thigh Girth, presents a robust tool for predicting throwing ability in female athletes. The high tolerance value of the collinearity statistic (0.86) supports the reliability of this model, indicating that multicollinearity assumptions are satisfied.

These results imply that, for female athletes in the Cape Coast Metropolis, the combination of hand span, upper arm length, body weight, and thigh circumference is influential in determining their throwing ability. Coaches and sports scientists can use this equation as a practical guide for assessing and developing female athletes' throwing skills.

3.2.2. Male Athletes (T^B)

Similar to the female model, the findings for male athletes (TB) in Table 6 exhibit a significant predictive relationship between morphological variables and throwing ability (b = -0.108, t(1, 208) = -2.708, p = 0.007). The variables included in the predictive equation for male athletes are hand span, body weight, total arm length, thigh circumference, chest circumference, and triceps skinfold. Together, these variables explain 73 percent of the observed differences in throwing

ability among male athletes.

Table 6. Coefficients of Throwing Ability and Morphologic Features for Boys.

Model	B	Std. Err.	Beta	T	Sig.	Tolerance
(Constant)	-12.534	1.672		-7.495	.000	
Handspan	.557	.075	.391	7.429	.000	.488
Body Weight	.053	.009	.279	5.983	.000	.621
Total Arm Length	.109	.020	.276	5.408	.000	.518
Thigh Girth	-.055	.014	-.160	-4.041	.000	.856
Chest Circumference exp.	.053	.014	.140	3.669	.000	.926
Tricep Skin fold	-.094	.035	-.108	-2.708	.007	.848

N=210

The model equation T^B = -12.53 + 0.577handspan + 0.053Body weight + 0.109Total Arm Length - 0.055thigh girth + 0.053Chest Circumference Expiration - 0.094Tricep Skin Fold provides a comprehensive understanding of the morphological factors influencing throwing ability in male athletes. The high tolerance value (0.85) further confirms the reliability of this model, ensuring that multicollinearity assumptions are met.

For male athletes in the Cape Coast Metropolis, hand span, body weight, total arm length, thigh circumference, chest circumference, and triceps skinfold collectively play a crucial role in determining throwing ability. Coaches and sports scientists can utilize this equation as a practical tool for talent identification and training program design tailored to enhance male athletes' throwing performance.

4. Discussion

The study, "Impact of Morphological Variables on Throwing Ability: A Gender-Driven Exploration in Cape Coast Metropolis, Ghana," reveals compelling insights into how morphological traits predict throwing ability, aligning with existing literature and introducing different perspectives.

The findings align with Asfaw and Pallavi [4], noting the trend of throwers being heavier compared to jumpers and runners. A similar pattern was observed in a study of top-level male track and field competitors in South Korea [18], where throwers exhibited more body mass and strength. These consistencies underline the global nature of the relationship between morphological traits and throwing ability. The study emphasizes the direct influence of body size on biomechanical factors, particularly the release height of the throwing device [17]. This aligns with the idea that larger athletes, as described in the kinanthropometric profiles of international top javelin throwers [14], possess advantageous physical attributes, including long limbs, broad chests, and wide shoulders and hips. These features contribute to a larger force application area on the device, reinforcing the mechanical advantage that larger athletes may have.

The study underscores the importance of muscle mass in throwing performance [15]. Larger straps, indicative of greater muscle mass, are associated with more muscular force [10]. Athletes engaging in resistance training to enhance strength and power tend to have more muscle mass than their counterparts in track and field [13]. This emphasizes the role of strength training in optimizing throwing ability. While there's a general emphasis on the importance of large body dimensions, including body weight, hand span, upper arm length, total arm length, chest girth, thigh girth, and triceps skinfold, the study introduces a nuanced perspective. It challenges the notion that body size, particularly height, directly influences the release height of the throwing device [17]. The argument is that all other things being equal, high physical strength, rather than height, leads to high speed and long throws. The study identifies critical morphological variables that are key predictors of throwing ability. These include body weight, hand span, upper arm length, total arm length, chest girth, thigh girth, and the major skinfold of the triceps. This nuanced insight challenges simplistic assumptions about the importance of height and introduces a more detailed understanding of the specific morphological factors that contribute significantly to optimal throwing performance [1].

The study introduces a contradiction by suggesting that height is not crucial in throwing activities, challenging the notion that body size directly influences device release height [17]. The claim that height is not essential, but specific morphological variables are critical, has profound implications for training programs and talent identification processes. It sug-

gests that a targeted focus on critical morphological variables rather than overall body size might yield more precise and effective results in optimizing throwing ability. Comparing the two models, both female and male athletes share the significance of hand span, body weight, and thigh circumference in predicting throwing ability. However, specific variables such as upper arm length for females and total arm length, chest circumference, and triceps skinfold for males introduce gender-specific variations. These variations highlight the importance of tailoring training programs and talent identification processes based on gender-specific morphological considerations. The predictive models provide practical tools for coaches and sports scientists to individualize training strategies, ultimately enhancing the throwing performance of athletes in the Cape Coast Metropolis

5. Conclusion

In conclusion, the study contributes to the understanding of morphological predictors of throwing ability among female and male athletes in the Cape Coast Metropolis. The developed predictive models offer practical applications for talent identification, training program design, and performance assessment. The percentage contributions of specific morphological variables emphasize the nature of the relationship between morphology and throwing ability, providing appreciated intuitions for coaches, athletes, and sports scientists in optimizing training strategies and fostering athletic development.

6. Recommendations

Based on the findings, it is recommended that training programs for female athletes in Cape Coast Metropolis emphasize the development of morphological factors such as hand span, upper arm length, body weight, and thigh circumference to enhance throwing ability. The equation T^G= -8.11 + .597Handspan + .068Upper Arm Length + .013Body Weight + .021Thigh Girth provides a practical tool for predicting and optimizing throwing performance in female athletes. Similarly, for male athletes, focusing on hand span, body weight, total arm length, thigh circumference, chest circumference, and triceps skinfold in training regimens is crucial, as indicated by the model T^B = -12.53 + .577Handspan + .053Body weight + .109Total Arm Length - .055Thigh Girth + .053Chest Circumference Expiration - .094Tricep Skin Fold. These recommendations aim to enhance the understanding and application of gender-specific morphological predictors, contributing to more effective and personalized training strategies for improving throwing ability among athletes in the Cape Coast Metropolis, Ghana.

Abbreviations

T^B: Throwing Ability of male Athletes
T^G: Throwing Ability of female Athletes
SEE: Standard Error of Estimate

Conflicts of Interest

The authors declare no conflicts of interest.

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