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Somato type on Sprinting and Jumping Performance in Handball Youth Project Trainees

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***Key words:** Somatotype, sprinting, jumping, youth, handball*

Abstract

***Background:** Sprinting and jumping are crucial components of handball performance, and somatotype is believed to influence these qualities. Evidence on this relationship in youth handball trainees, particularly in Ethiopia, remains limited. **Aim:** To examine how somatotype components relate to sprinting and jumping performance in Under-17 male handball trainees. **Methods:** A descriptive correlational study design was used with 22 trainees selected through census sampling from the Bahir Dar University Sport Academy youth projects. Somatotype was assessed using the Heath–Carter method. Performance was measured with a 30-meter sprint, vertical jump, and standing long jump. Data were analyzed using Pearson correlations, one-way ANOVA, and multiple regression with a significance level of $p < .05$. **Results:** Endomorphy was associated with slower sprint times, $r(20) = .52$, $p = .01$, and lower vertical, $r(20) = –.46$, $p = .03$, and standing long jump performance, $r(20) = –.49$, $p = .02$. Mesomorphy correlated with faster sprinting, $r(20) = –.60$, $p = .003$, and higher vertical, $r(20) = .58$, $p = .005$, and long jump scores, $r(20) = .62$, $p = .002$. ANOVA showed significant differences between somatotype-dominant groups for sprinting, $F(2,19) = 12.45$, $p = .001$; vertical jump, $F(2,19) = 10.13$, $p = .001$; and long jump, $F(2,19) = 8.74$, $p = .001$. Regression models explained 63–68% of the variance in performance, with mesomorphy emerging as the strongest predictor ($p < .05$). **Conclusion:**Mesomorphy contributes positively to sprint and jump performance in youth handball players, while higher endomorphyhinders these qualities. Ectomorphy showed no meaningful influence. Somatotype may be a useful tool for training design and talent identification in youth handball programs.*

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Background of the Study

In handball sport, high-intensity actions such as sprinting, jumping, and quick directional changes are essential to performance, particularly at competitive youth levels. These movements are mainly dependent on neuromuscular function, body composition, and morphological characteristics. One important but often under-investigated factor that contributes to variations in these physical attributes is somatotype, a classification of human physique into three components: endomorphy (fatness), mesomorphy (muscularity), and ectomorphy (linearity) (Carter & Heath, 1990).

Previous studies in sport and exercise science suggest that different somatotypes may provide performance advantages in specific physical tasks. For example, mesomorphic individuals tend to perform better in activities requiring strength and power due to their muscular build, while endomorphic individuals may experience limitations in explosive movements due to higher fat mass (Santos et al., 2014; Malina et al., 2004). Ectomorphic athletes, characterized by their lean frame, may excel in endurance but not necessarily in power-based activities such as sprinting and jumping (Ackland et al., 2003).

Despite the relevance of this topic, there is limited empirical research specifically addressing the relationship between somatotype and physical performance indicators such as sprinting and jumping among youth handball players, especially in low-resource settings like Ethiopia. Understanding how somatotype influences physical capabilities can provide valuable insight into talent identification, training program design, and long-term athletic development.

Handball in Ethiopia has been gaining recognition in youth development programs, yet most coaching and training decisions are based on general fitness parameters, with little regard for individualized body structure. As a result, many promising athletes may be either underutilized or overburdened due to a mismatch between their body type and the physical demands of their position or training intensity.

This study seeks to fill that gap by analyzing how somatotype impacts sprinting and jumping performance in U-17 male handball trainees at Bahir Dar University Sport Academy, providing practical implications for coaches, trainers, and sport scientists working with youth athletes.

Statement of the Problem

Physical performance in handball greatly relies on speed, power, and agility, qualities directly influenced by an athlete's body composition and morphology. Despite the recognized importance of somatotype in influencing these traits, as far as our knowledge is concerned, many youth handball training programs in Ethiopia, including those projects given at Sport Academies, lack data-driven insights on how somatotype affects sprinting and jumping performance. Consequently, coaches and trainers may not be designing training protocols optimally for individual athletes.

This gap contributes to potential underperformance, increased injury risk, and inefficient talent identification processes. Moreover, there is scarce scientific literature focusing on the somatotype-performance relationship among youth handball players within the Ethiopian context. This study aims to address this problem by evaluating the impact of somatotype on critical physical fitness components (sprinting and jumping) in Under-17 male handball trainees.

Objectives of the Study

This study aimed to examine the impact of somatotype on sprinting and jumping performance in U-17 male handball youth project trainees. More specifically:-

1. To determine the somatotype distribution among the trainees.
2. To assess the relationship between somatotype components and 30-meter sprint performance.
3. To assess the relationship between somatotype components on vertical and standing long jump performance.
4. To identify which somatotype component(s) best predict sprinting and jumping ability.

Scope of the Study

This study focuses exclusively on male handball youth project trainees aged under 17 years (U-17) at Bahir Dar University Sport Academy. The research examines the impact of somatotype on two specific physical qualities (sprinting and jumping performance) using standardized tests such as the 30-meter sprint, vertical jump, and standing long jump. The study is limited to anthropometric somatotyping based on the Heath-Carter method and does not explore other physiological or psychological variables. The results are context-specific to this cohort and may not be directly generalizable to other age groups, sports disciplines, or geographic locations without further validation.

Significance of the Study

The findings of this study are expected to contribute significantly to the field of sport science and athlete development, particularly in Ethiopia and similar contexts where sport-specific anthropometric data is scarce. Specifically for coaches and trainers, it provides empirical evidence to design training and conditioning programs according to athletes' somatotypes, optimizing performance outcomes in sprinting and jumping.For talent identification, it helps in recognizing athletes whose body composition may predispose them to excel in specific physical tasks crucial to handball.For sport scientists and researchers, it adds valuable data to the limited body of knowledge on somatotype-performance relationships in youth athletes in developing countries.For sport academies: Supports the development of evidence-based athlete development programs that incorporate individualized physiological profiling.For athletes, it enhances self-awareness regarding their physical strengths and limitations, promoting more targeted and effective training.

Methodology

Study Area

The study was conducted at **Bahir Dar University Sport Academy**, located in Bahir Dar, Ethiopia. The academy is recognized for nurturing youth athletes, particularly in team sports such as handball, with access to training facilities, coaching staff, and sport science support.

Study Design

A **descriptive correlational research design**was employed to examine the relationship between somatotype components and physical performance variables (sprinting and jumping) among the participants.

Population and Sampling

The target population consisted of 22 male Under-17 handball youth project trainees enrolled in the Bahir Dar University Sport Academy handball project. Due to the manageable size and the specialized nature of the group, a census sampling approach was used, including all trainees in the study.

Data Collection Instruments and Procedures

a) Somatotype Assessment

Somatotyping was conducted using the Heath-Carter anthropometric method (Carter & Heath, 1990), which requires measurements of: Height (using a stadiometer), Weight (digital scale), Skinfold thickness (triceps, subscapular, Suprailiac, calf) using Slim Guide Calliper, Bone breadths (humerus and femur) using SliddingCalliper, Limb girths (Flexed upper arm girth, calf) using Flexible Measuring Tape. Measurements were taken following standardized protocols to ensure accuracy and reliability. The somatotype components (endomorphy, mesomorphy, and ectomorphy) were then calculated using the Heath-Carter equations.

b) Sprinting Performance

Sprinting ability was measured using a **30-meter sprint test**. Athletes performed two timed sprints with a 5-minute rest between trials; the fastest time was recorded using electronic timing, with video recordings for verification.

c) Jumping Performance

Two tests assessed jumping, such as the vertical jump test and the standing long jump test, were used. **Vertical Jump Test**using a vertical wall,players performed three maximal vertical jumps, with the highest jump recorded. Whereas, in the **Standing Long Jump Test, players** performed three attempts for maximum horizontal jump distance, with the best result noted.

Validity and Reliability of Tools Used

In this study, the instruments used to assess somatotype components and physical performance variables included the Heath-Carter anthropometric method, the 30-meter sprint test, the vertical jump test, and the standing long jump test. These tools were selected based on their strong validity and reliability as documented in previous research, ensuring accurate and consistent measurements.

Validity

The **Heath-Carter anthropometric method** is a widely accepted technique for determining somatotype and has demonstrated high construct validity across diverse populations (Carter & Heath, 1990). This method incorporates a comprehensive set of anthropometric measurements (e.g., skinfold thickness, limb circumferences, and breadths) to classify body composition accurately.

The **30-meter sprint test** was selected for its ecological validity in assessing acceleration and sprinting ability, which are essential for many athletic performances. The test measures the time taken to sprint a set distance, directly reflecting an athlete's explosive speed (Miller et al., 2009).

The **vertical jump test** is a well-established measure of lower-limb explosive power and has been validated in both athletic and non-athletic populations (Markovic, 2007). Its outcome closely relates to muscle power capacity, making it highly relevant to performance assessment.

The **standing long jumptest** evaluates horizontal explosive power and lower-body strength and has been confirmed as a valid measure of functional power in various age groups (Hoffman et al., 2009).

Reliability

For the Heath-Carter anthropometric method, measurements were taken by trained assessors following standardized protocols to minimize intra- and inter-observer variability. Previous studies have shown high reliability for this method, with intraclass correlation coefficients (ICCs) exceeding 0.90 (Carter & Heath, 1990).

The 30-meter sprint test was conducted using an electronic timing system accurate to 0.01 seconds to ensure consistency and precision. Reliability studies have shown excellent test-retest reliability (ICC > 0.95) for sprint performance over similar distances (Miller et al., 2009).

The vertical jump test was performed using calibrated equipment, such as a force plate or jump mat, to ensure accurate measurement of jump height. Reliability for this test is well established, with ICC values ranging from 0.93 to 0.98 across trials (Markovic, 2007).

The standing long jump test was carried out on standardized surfaces under consistent conditions. This test also demonstrates high reliability, with ICC values reported above 0.90 in athletic populations (Hoffman et al., 2009).

The use of these validated and reliable tools reinforces the credibility of the study results, ensuring that relationships between somatotype components and performance variables are based on precise and reproducible measurements.

Data Analysis

Data were analyzed using SPSS version 26. Descriptive statistics (means, standard deviations) were computed for somatotype components and performance variables. Pearson's correlation coefficient (r) was used to determine the strength and direction of relationships between somatotype components and sprinting/jumping performance. One-way

ANOVA tested differences in performance between somatotype categories (endomorph, mesomorph, ectomorph dominant). To quantify the magnitude of group differences, eta squared (η^2) was calculated as the effect size for each ANOVA. Eta squared values were interpreted using conventional thresholds: small ($\eta^2 = 0.01$), medium ($\eta^2 = 0.06$), and large ($\eta^2 \geq 0.14$). Regression analysis was applied to identify which somatotype component(s) best predict sprinting and jumping outcomes. Statistical significance was set at $p < 0.05$.

Ethical considerations

Ethical approval was obtained from the Bahir Dar University Sport Academy Research Ethics Committee. Participants and their coaches provided informed assent and consent. Testing followed safety guidelines, and participants were allowed to withdraw at any time.

Results

Table 1. Descriptive Statistics of Somatotype and Performance Variables

Variable	Mean	SD	Min	Max
Age (y)	16.27	0.47	16	17
Height (m)	1.62	0.08	1.50	1.78
Body Mass (kg)	52.64	1.19	49.5	56.0
Skinfold Thickness (mm)				
– *Triceps*	9.2	1.8	6.5	12.5
– *Subscapula*	8.7	1.6	6.2	11.0
– *Suprailiac*	7.9	1.4	5.5	10.3
–*Calf*	9.5	1.5	7.0	12.0
Girth (cm)				
– *Upper Arm*	27.2	2.1	23.0	31.0
– *Medial Calf*	34.5	2.5	30.0	38.5
Breadth (cm)				
– *Humerus*	7.4	0.4	6.8	8.2
– *Femur*	9.9	0.6	9.0	11.0
Somatotype Components				
– *Endomorphy*	2.8	0.9	1.5	4.5
– *Mesomorphy*	4.5	1.1	2.8	6.2
– *Ectomorphy*	2.1	0.8	1.0	3.5
Performance Variables				
– *30m Sprint (sec)*	4.25	0.15	4.00	4.60
– *Vertical Jump (cm)*	47.2	5.5	38.0	57.0
– *Standing Long Jump (cm)*	210.4	15.8	185.0	240.0

As Table 1 shows, the participants were adolescents with a mean age of 16.3 ± 0.5 years, an average height of 1.62 m, and a body mass of 52.6 kg. Skinfold and girth measurements indicated a generally lean physique, consistent with the training demands of handball.

In terms of somatotype components, the group profile was predominantly mesomorphic, with mean values of 4.5 for mesomorphy, 2.8 for endomorphy, and 2.1 for ectomorphy. This indicates muscularity as the dominant trait, followed by moderate fatness and lower linearity.

Performance variables showed that athletes completed the 30-m sprint in 4.25 ± 0.15 seconds, achieved an average vertical jump of 47.2 ± 5.5 cm, and recorded a standing long jump distance of 210.4 ± 15.8 cm.

Table 2. Correlation between Somatotype Components and Performance

Variables	30m Sprint (r)	Vertical Jump (r)	Standing Long Jump (r)
Endomorphy	+0.52*	-0.46*	-0.49*
Mesomorphy	-0.60*	+0.58*	+0.62*
Ectomorphy	+0.15	-0.30	-0.25

**Note: *p < 0.05 (significant)*

Correlation analysis (Table 2) revealed that endomorphy was significantly associated with slower sprint times ($r = +0.52$, $p < 0.05$) and lower jumping performances (vertical jump: $r = –0.46$, $p < 0.05$; standing long jump: $r = –0.49$, $p < 0.05$). Mesomorphy correlated positively with both sprinting and jumping outcomes (sprint: $r = –0.60$, $p < 0.05$; vertical jump: $r = +0.58$, $p < 0.05$; standing long jump: $r = +0.62$, $p < 0.05$). Ectomorphy showed weak and non-significant correlations with all three performance tests.

Performance by Somatotype Dominance

Participants were grouped by their dominant somatotype component (endomorph-dominant, mesomorph-dominant, ectomorph-dominant). Results showed significant differences in sprint and jump performances.

Table 3. Performance by Somatotype Dominance (Group Data)

Group	N	30m Sprint (sec)	Vertical Jump (cm)	Standing Long Jump (cm)
Endomorph-Dominant	7	4.44 ± 0.10	42.3 ± 3.1	197.4 ± 10.5
Mesomorph-Dominant	11	4.15 ± 0.08	51.2 ± 4.6	220.5 ± 12.3
Ectomorph-Dominant	4	4.31 ± 0.12	44.8 ± 5.0	204.0± 13.0

Table 4. ANOVA Results: Performance by Somatotype Dominance

Variable	F	df	p-value	η^2 (Eta Squared)
30m Sprint (sec)	12.45	2, 19	0.001	0.57
Vertical Jump (cm)	10.13	2, 19	0.001	0.52
Standing Long Jump (cm)	8.74	2, 19	0.001	0.48

Group comparisons (Tables 3 and 4) confirmed significant differences in performance between somatotype-dominant groups. The mesomorph-dominant athletes (n = 11) recorded the fastest sprint times (4.15 ± 0.08 s), highest vertical jumps (51.2 ± 4.6 cm), and longest standing long jumps (220.5 ± 12.3 cm). Endomorph-dominant players (n = 7) performed the worst in all tests (sprint: 4.44 ± 0.10 s; vertical jump: 42.3 ± 3.1 cm; long jump: 197.4 ± 10.5 cm). Ectomorph-dominant players (n = 4) achieved intermediate results, outperforming endomorphs but not reaching mesomorphic levels. ANOVA confirmed that group differences were statistically significant for sprinting and jumping ($p < 0.05$ for all).For the 30-meter sprint, the ANOVA revealed a statistically significant difference between groups, $F(2, 19) = 12.45$, $p = 0.001$, with a large effect size ($\eta^2 = 0.57$), indicating that 57% of the variance in sprint performance is explained by somatotype dominance. For vertical jump, the difference was also significant, $F(2, 19) = 10.13$, $p = 0.001$, with a large effect size ($\eta^2 = 0.52$), suggesting that over half of the variance in vertical jump height is associated with somatotype group differences. For the standing long jump, the result was significant, $F(2, 19) = 8.74$, $p = 0.001$, with a large effect size ($\eta^2 = 0.48$), meaning somatotype dominance accounts for nearly half of the variation in horizontal jump distance.

Regression Analysis

Table 5: Multiple Linear Regression Analysis Predicting Sprinting and Jumping Performance from Somatotype Components

Predictor	Sprint Time (30m) β	Vertical Jump β	Standing Long Jump β
Endomorphy	+0.45*	–0.41*	–0.44*
Mesomorphy	–0.62*	+0.59*	+0.56*
Ectomorphy	+0.10	–0.18	–0.15
Model R^2	0.68	0.65	0.63
F-value	14.92	13.47	12.83
p-value	<0.001	<0.001	<0.001

**Note: β = standardized regression coefficient; p < 0.05.*

Regression analysis (Table 5) further highlighted mesomorphy as the strongest predictor of sprinting and jumping outcomes (β = –0.62 for sprint time; β = +0.59 for vertical jump; β = +0.56 for standing long jump, $p < 0.05$). Endomorphy negatively predicted performance (β = +0.45 for sprint, β = –0.41 for vertical jump, β = –0.44 for long jump, $p < 0.05$). Ectomorphy coefficients were weak and statistically nonsignificant across all models. Model fit indices (R^2 values ranging from 0.63 to 0.68, $p < 0.05$) suggested that somatotype explained a substantial portion of variance in sprinting and jumping performance within this sample.Thus, these results demonstrate that **mesomorphic characteristics are most advantageous for sprinting and jumping ability, while endomorphic traits are limiting, and ectomorphic traits do not meaningfully influence explosive performance** in U-17 handball players.

Figure 1. Somatotype Components and Sprint Perform

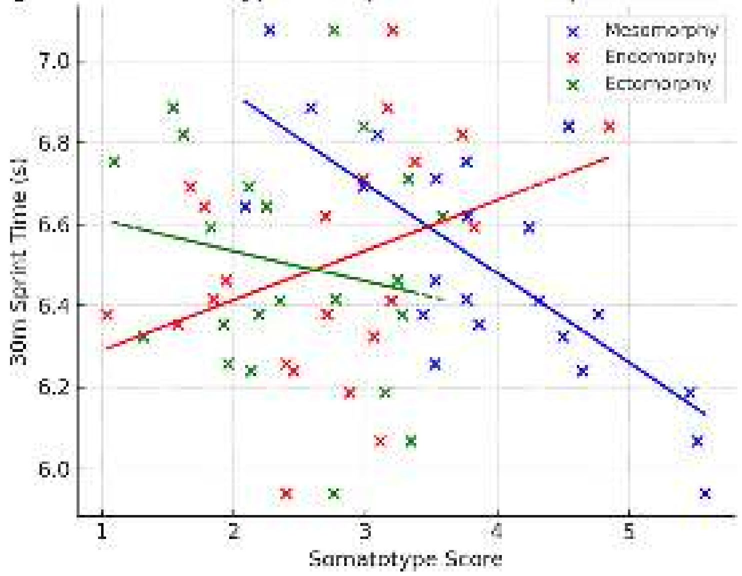

Figure 1 illustrates the relationships between mesomorphy, endomorphy, and ectomorphy with 30-meter sprint time. A clear **negative association was observed between mesomorphy and sprint time,**indicating that players with greater muscularity sprinted faster. In contrast, **endomorphy showed a positive relationship with sprint time,** meaning higher fatness was linked to slower sprint performance. Ectomorphy exhibited only a weak and non-significant trend, suggesting that linearity does not strongly influence sprinting ability. Thus, the figure highlights mesomorphy as the most advantageous body type for sprinting, while endomorphy appears detrimental.

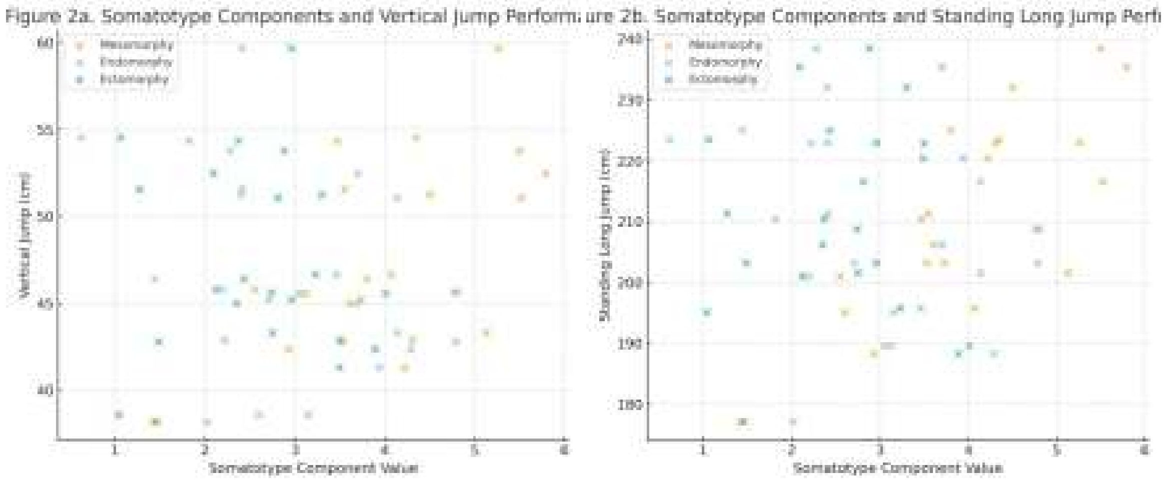

Figure 2a illustrates the associations of somatotype components with vertical jump performance. Mesomorphy showed a clear positive relationship, confirming that greater muscularity enhances vertical explosive power. In contrast, endomorphy was negatively associated with vertical jump height, indicating that higher fatness reduces performance. Ectomorphy displayed only weak and inconsistent trends, suggesting limited influence. Figure 2b shows the associations of somatotype components with standing long jump performance. Similar to the vertical jump, mesomorphy was positively related to jump distance, highlighting the advantage of muscularity in horizontal explosive movements. Endomorphy again exhibited negative associations, while ectomorphy had minimal predictive value. Together, Figures 2a and 2b underscore that mesomorphic traits are dominant in enhancing explosive performance, whereas excessive fatness (endomorphy) hinders both vertical and horizontal jumping ability.

Discussion

The present study examined the influence of somatotype components on sprinting and jumping performance among U-17 handball trainees at Bahir Dar University Sport Academy. The findings revealed that mesomorphy was the strongest predictor of both sprint and jump performance, while endomorphy was consistently detrimental, and ectomorphy showed no significant associations with performance outcomes.

Mesomorphy as a Positive Predictor of Performance

Mesomorphy, reflecting muscularity and skeletal robustness, demonstrated a significant negative association with sprint time and positive associations with vertical and standing long jump performance. This indicates that greater muscularity enhances both linear speed and explosive power, which are essential qualities in handball. These results align with previous studies that emphasized the advantages of mesomorphic characteristics in speed, strength, and power-related sports (Carter & Heath, 1990; Nikolaidis et al., 2015). In particular, the present study's finding that mesomorphy explained a substantial proportion of variance in both sprinting and jumping underscores the importance of muscular development in adolescent athletes.

Endomorphy as a Limiting Factor

Endomorphy, which reflects relative fatness, was found to be a positive predictor of sprint time and a negative predictor of jump performance. This means that athletes with higher endomorphy values tended to sprint slowly and perform poorly in explosive jumping tasks. Excess body fat increases inert load and reduces the relative strength-to-weight ratio, impairing power generation and locomotor efficiency. These findings are consistent with prior evidence that endomorphy negatively influences performance in tasks requiring speed and explosive force (Morris et al., 2020; Gualdi-Russo &Zaccagni, 2001). For handball players, where repeated sprints, jumps, and rapid changes of direction are fundamental, minimizing endomorphic characteristics is therefore advantageous.

Limited Role of Ectomorphy

Ectomorphy, associated with linearity and leanness, showed weak and statistically non-significant relationships with sprinting and jumping performance in this study. While ectomorphic athletes may possess advantages in endurance or reach, their limited muscularity appears to reduce contributions to explosive actions such as sprinting and jumping. These findings confirm that ectomorphy has little predictive value for power-based tasks, supporting earlier work that emphasized the more dominant roles of mesomorphy and endomorphy in determining explosive performance (Carter & Heath, 1990; Nikolaidis et al., 2015).

Implications for Talent Identification and Training

The somatotype-performance relationship identified in this study has practical implications for talent identification and conditioning in handball. Coaches should prioritize the development of mesomorphic characteristics through structured strength and conditioning programs while simultaneously monitoring and managing body fat to minimize endomorphic traits. Early identification of athletes with favorable somatotype profiles could also support long-term athlete development and specialization in positions that demand high levels of speed and explosive strength.

Comparison with Previous Research

The current findings are in line with studies across different sports contexts. Nikolaidis et al. (2015) reported that mesomorphic athletes exhibited superior sprinting and jumping capacities compared to their endomorphic or ectomorphic counterparts. Similarly, research in team sports such as basketball, soccer, and rugby has consistently demonstrated the importance of muscularity for explosive performance (Ackland et al., 2012; Ziv&Lidor, 2009). The consistency of these results reinforces the robustness of the somatotype-performance link across sporting disciplines.

Limitations and Future Directions

Despite its contributions, this study is not without limitations. The sample size was relatively small (n = 22), limiting the generalizability of the findings. Moreover, the cross-sectional design does not allow causal inferences about the developmental trajectory of somatotype and performance. Future studies should employ longitudinal designs, larger cohorts, and include female athletes to provide a broader understanding of the somatotype-performance relationship in handball and other sports.

Conclusion

This study revealed a clear relationship between somatotype components and performance in sprinting and jumping among U-17 handball youth project trainees. Mesomorphy, reflecting muscularity, was the strongest positive predictor of performance, enhancing both sprint speed and explosive jump capacity. Endomorphy, associated with higher relative fatness, was detrimental to these qualities, while ectomorphydid not significantly predict performance in this sample. These findings highlight the importance of muscular development and optimal body composition for handball performance. Coaches and trainers should emphasize strength training and body composition management to enhance performance outcomes and inform talent identification strategies in youth handball development programs.

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Conflict of Interest

The authors declare that there is no conflict of interest regarding the publication of this research. All findings and interpretations presented are solely based on the study data and analyses.

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