A study on the key predictors of 100m sprint performance: identification and ranking

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Abstract

Background and Study Aim	The sprint is one of the most prestigious events in athletics, requiring a combination of explosive power and acceleration. However, talent identification remains a challenge, as early sprint performance does not always predict long-term success. The aim of this study is to identify and rank the most relevant predictors of 100m sprint performance among young athletes.
Material and Methods	This study involved 11 subjects (6 boys and 5 girls) born in 2008, who were in their first year of the U18 category in 2024. They participated in the 100m event both in 2023 and 2024. Speed, strength, coordination, and mobility were assessed using tests, including 30m sprint from a standing start, 60m sprint from a standing start, 30m sprint with a flying start, bounding strides over 30m, standing long jump, triple jump, countermovement jump, medicine ball throw, and Sit and Reach test. Specific agility was evaluated using the Witty SEM system. Balance parameters and lower limb strength were assessed with the SensaBalance platform and the OptoJump system, respectively. Statistical analysis was conducted using Pearson's correlation, Spearman's rank correlation, and Bootstrapped Pearson's correlation to identify the most relevant predictors. The bootstrapping technique was applied to enhance the reliability of the correlation estimates. Statistical significance was set at p < 0.05.
Results	The analysis revealed that not all of the 12 assessed tests had significant predictive value for sprint performance. Parameters such as specific agility, static and dynamic balance, squat jump, and Sit and Reach mobility test did not show strong correlations with 100m sprint outcomes. These findings support the use of selected physical and anthropometric variables in a secondary selection model for young sprinters.
Conclusions	This study confirms that specific physical, psychomotor, and anthropometric variables significantly influence 100m sprint performance among young athletes. It also proposes a secondary selection model that incorporates the most relevant predictors to support talent identification and training optimization.
Keywords:	sprint performance, selection model, predictive factors, young athletes, anthropometric characteristics

Introduction

The 100m sprint serves as the fundamental benchmark for assessing human speed and is the standard for identifying the fastest athlete in the world at any given time. Its widespread popularity and media exposure make sprinting highly appealing to young athletes. However, not all young athletes possess the psychomotor abilities required for high-performance sprinting. Therefore, coaches must evaluate whether an athlete's physical and psychological profile aligns with the specific demands of sprinting at an elite level. This evaluation requires careful consideration of the biomechanical, physiological, psychological, and anthropometric determinants of sprint performance.

The 100m sprint can be divided into three distinct phases: block start with acceleration, maximum velocity, and deceleration [1]. Each phase presents unique biomechanical and physiological challenges, and performance in these phases is influenced by various factors described in scientific literature. While many studies have analyzed the kinematic parameters of elite sprinters during competitions, experimental research directly involving elite athletes remains limited. Most existing studies rely on competition data to develop mathematical models, including biomechanical simulations, force-velocity profiles, and sprint performance predictors [2].

Some authors argue that neurological and mechanical factors are more critical to sprint performance than purely physiological ones, particularly emphasizing the ability to generate high ground reaction forces (GRF) relative to body weight (BW) and to apply these forces in minimal contact time [3]. Furthermore, during sprint acceleration, the orientation of the resultant ground reaction force vector, rather than its absolute magnitude, has been shown to have a stronger correlation with sprint performance [2].

Among physiological factors, two are consistently associated with sprint performance: muscle fiber composition, particularly a higher proportion of fast-twitch fibers [4, 5], and the capacity to utilize high-energy phosphate compounds efficiently [6]. In addition to these functional parameters, several anthropometric characteristics have been identified as advantageous for sprinting success, such as a high body mass index (BMI) due to greater muscle mass [7, 8], and longer lower limb length, which contributes to stride length and mechanical efficiency [9].

Analysis of previous studies has shown that sprint performance is influenced by a complex interaction of physiological, biomechanical, and anthropometric factors. Various authors highlight the importance of identifying specific physical and structural characteristics that contribute to sprinting success, particularly in young athletes. Despite numerous investigations into sprint mechanics and performance determinants, there remains a need for more in-depth research aimed at establishing objective, comprehensive selection models. Such models should integrate multiple performance indicators to better support talent identification and optimize training strategies in youth sprinting.

Analysis of existing research provides a foundation for formulating specific hypotheses regarding the predictors of sprint performance and for defining the aim of the present study.

Working Hypotheses: H1. There is a statistically significant relationship between specific physical, psychomotor, and anthropometric variables and 100m sprint performance in young athletes. H2. A selection model incorporating key physical, psychomotor, and anthropometric predictors can effectively differentiate young athletes with higher sprint potential from their peers.

The aim of this study is to identify and rank the most relevant predictors of 100m sprint performance among young athletes.

Materials and Methods

Participants

This research is part of a broader project involving 16-year-old athletes specializing in sprint, hurdles, and jumping events. From this group, 11 athletes who competed in sprint events were selected as participants for the present study (5 girls and 6 boys). They were in their first year of the U18 junior category (born in 2008) and took part in the 100m event in both 2023 and 2024.

Written informed consent was obtained from the parents of all minor participants, in accordance with the Declaration of Helsinki. The protocol for anthropometric measurements, as well as the procedures for field and laboratory testing, was explained in detail to both the athletes and their parents. Participants were also informed of their right to withdraw from the study at any time. The study was approved by the respective sports clubs through the coaches of the participating athletes.

Research Design

The study was structured as an in-depth case analysis for each athlete, enabling a comprehensive assessment of the alignment between individual psychomotor predispositions and the specific demands of the 100m sprint. This design prioritized qualitative depth over sample size, allowing for a detailed and individualized evaluation of factors influencing sprint performance. Multiple testing sessions were conducted to monitor trends, adaptations, and fluctuations in performance, providing a more accurate understanding of how these variables affect sprint success in a longitudinal context.

Testing Procedure and Measurements

The subjects were tested in three distinct stages: T1, T2, and T3. Anthropometric measurements were performed only during T1 and T3, as the interval between T1 and T2 was too short for significant anthropometric changes to occur. The period between T1 and T3 was approximately nine months. The initial testing (T1) took place during the preparation period in the fall of 2023, while the intermediate (T2) and final tests (T3) were conducted in 2024, following the national indoor and outdoor championships, respectively.

To assess speed, strength, coordination, and mobility, the following tests were conducted:
- 30m sprint from a standing start (30m s.s.);
- 60m sprint from a standing start (60m s.s.);
- 30m sprint with a flying start (30m f.s.);
- Execution time of bounding strides over 30m (BS 30m);
- Standing long jump (SLJ);
- Two-foot take-off triple jump (STJ);
- Countermovement jump (CMJ);
- 3 kg medicine ball throw from a supine position (MBT);
- Sit and Reach mobility test (SR).

Additional assessments included:
- Specific agility (Ag.) measured using the Witty SEM light system;
- Static bipedal balance (SBiB), lateral dynamic bipedal balance (LDBiB), and vertical dynamic

bipedal balance (VDBiB) assessed with the Sensamove SensaBalance platform;
- Explosive lower limb strength measured using CMJ and squat jump (SQJ), both performed with the OptoJump system.

Anthropometric indices measured included: height (H), torso length (T), body mass (BM), lower limb length (LLL), left and right foot length (LFL, RFL), left and right thigh circumference (LTC, RTC), left and right calf circumference (LCC, RCC), left and right ankle circumference (LAC, RAC), biacromial diameter (BiaD), and bitrochanteric diameter (TrohD).

All testing equipment used in this study belongs to the Human Performance Research Center of the Doctoral School of Sports Science and Physical Education in Piteşti, affiliated with the National University of Science and Technology Politehnica Bucharest.

Based on these evaluations, the dynamics of the subjects' physical and psychomotor development were analyzed. However, statistical analysis in this study was performed exclusively using the data recorded during the final testing stage (T3). The evolution of the investigated parameters across the three stages was interpreted within the framework of individual case studies.

Statistical Analysis

The best performance achieved by each athlete in official 100m competitions [10] was used as the dependent variable. This was correlated with independent variables from the physical and psychomotor domains. To account for the small sample size and assess the robustness of the results, Pearson's correlation was complemented by Spearman's rank correlation. Additionally, bootstrap resampling techniques were applied, generating multiple resampled datasets to estimate confidence intervals and to minimize the risk of Type I and Type II errors.

Results

Given the small sample size (n = 11), Pearson's correlation (to assess linear relationships), Spearman's rank correlation (to assess monotonic relationships), and bootstrapping (for stability assessment) were applied to enhance the robustness of the analysis. The statistical correlations between 100m sprint performance and the variables assessed using specialized equipment are presented in Table 1.

The strength and direction of the observed correlations, as well as their statistical significance, were interpreted according to established thresholds. Correlation coefficients (r) with absolute values greater than 0.7 were considered strong, those between 0.3 and 0.7 as moderate, and values below 0.3 as weak or negligible. Positive correlation coefficients (r > 0) indicated that higher values of the independent variable were associated with better sprint performance, while negative values (r < 0) suggested the opposite relationship [11]. Statistical significance was determined using a threshold of p < 0.05; p-values exceeding this level were regarded as non-significant and potentially attributable to random variation [12].

As shown in Table 1, countermovement jump (CMJ) demonstrated the strongest and most consistent negative correlation with 100m sprint performance across all statistical methods. This indicates that higher CMJ values are associated with faster sprint times, and the association is both statistically significant and stable. In contrast, squat jump (SQJ) exhibited a moderate negative correlation, but the lack of statistical significance and the inclusion of zero within the confidence interval suggest that this relationship is not reliable.

Agility and balance-related variables showed weak correlations, with correlation coefficients close to zero and p-values far exceeding the significance threshold. Additionally, their confidence intervals included zero, confirming the instability and low predictive value of these parameters in relation to sprint performance.

These results indicate that only CMJ can be considered a valid predictor of sprint performance among the tested parameters, while agility and

Table 1. Statistical correlation between 100m performance and the variables assessed using specialized equipment

Tests	Pearson (r)	p-value	Spearman (r)	p-value	Bootstrapped Pearson (r)	95% CI Lower	95% CI Upper
CMJ (cm)	-0.857	0.0007	-0.882	0.0003	-0.844	-0.975	-0.562
SQJ (cm)	-0.551	0.0791	-0.555	0.0767	-0.537	-0.840	0.047
Ag. (s)	-0.104	0.7614	-0.191	0.5739	-0.105	-0.693	0.488
LDBiB (%)	0.214	0.5267	0.091	0.7894	0.196	-0.664	0.837
VDBiB (%)	0.209	0.5369	0.282	0.4011	0.210	-0.355	0.674
SBiB (%)	-0.183	0.5896	-0.257	0.4446	-0.180	-0.755	0.423

Note: CMJ - Countermovement Jump; SQJ - Squat Jump; Ag. - Agility; LDBiB - Lateral Dynamic Bipedal Balance; VDBiB - Vertical Dynamic Bipedal Balance; SBiB - Static Bipedal Balance; CI - Confidence Interval.

balance measures do not offer meaningful insight in this context.

In addition to the variables assessed using specialized equipment, statistical correlations were calculated for the independent variables derived from physical performance tests conducted under field conditions. The results of these analyses are summarized in Table 2.

The interpretation of correlation coefficients in this analysis followed established statistical conventions. Correlations with absolute r-values greater than 0.7 were considered strong, those between 0.3 and 0.7 were classified as moderate, and correlations below 0.3 were regarded as weak or negligible. Positive r-values indicated that higher values of the independent variable were associated with slower sprint performance (i.e., longer time), whereas negative r-values suggested that higher values of the independent variable corresponded to faster sprint performance (i.e., shorter time) [11]. Statistical significance was determined at a threshold of $p < 0.05$; p-values equal to or greater than this level was interpreted as non-significant, implying that the observed relationships might have occurred by chance [12].

As shown in Table 2, among the parameters evaluated through tests, anterior spinal mobility—as assessed by the Sit and Reach test—was the only variable that exhibited a weak and statistically non-significant relationship with 100m sprint performance. All other tested variables demonstrated strong and significant correlations, confirming their relevance as predictors.

Due to the close alignment between Pearson's and Spearman's correlation coefficients across variables, the ranking of predictors was determined based on the width of the confidence intervals derived from bootstrapped correlation estimates. Narrower intervals reflect greater statistical stability, thereby indicating higher reliability of the associated predictor.

Standing long jump (SLJ) emerged as the most robust predictor of sprint performance, showing the strongest absolute correlation and the narrowest confidence interval. The 60m sprint from a standing start also demonstrated a very strong relationship with 100m performance, although its statistical stability was slightly lower than that of SLJ. Bounding strides over 30m ranked closely behind, confirming its importance in assessing sprinting ability.

Standing triple jump (STJ) and countermovement jump (CMJ) also proved to be strong negative predictors, indicating that greater explosive strength is associated with better sprint performance. The Medicine Ball Throw (MBT) further reinforced this trend by demonstrating a consistent and significant correlation. Additionally, sprint times over 30m from both standing and flying starts provided meaningful predictive value, with the flying start variation being more indicative of sprint potential.

Overall, the data suggest that power-based tests, particularly those evaluating lower limb explosive strength and sprinting efficiency over short distances, are the most reliable indicators of 100m performance in young athletes.

In addition to psychomotor and performance-related tests, anthropometric measurements were analyzed to determine their association with 100m sprint performance. The results of these statistical correlations are presented in Table 3.

The correlation coefficients obtained for anthropometric variables were interpreted according to conventional statistical thresholds. Absolute r-values exceeding 0.7 were considered indicative of strong correlations, values between 0.3 and 0.7 reflected moderate associations, and those below 0.3 were regarded as weak or negligible. Positive r-values signified that greater values of

Table 2. Statistical correlations between performance in 100m and independent variables assessed through tests

Tests	Pearson (r)	p-value	Spearman (r)	p-value	Bootstrapped Pearson (r)	95% CI Lower	95% CI Upper
30m s.s. (s)	0.783	0.0044	0.815	0.0022	0.805	0.607	0.952
30m f.s. (s)	0.865	0.0006	0.820	0.0020	0.874	0.716	0.973
60m s.s. (s)	0.893	0.0002	0.945	0.0000	0.899	0.749	0.979
BS 30m (s)	0.886	0.0003	0.851	0.0009	0.873	0.686	0.980
BS 30m (no.)	0.786	0.0041	0.751	0.0078	0.783	0.539	0.962
SLJ (m)	-0.913	0.0001	-0.870	0.0005	-0.916	-0.980	-0.806
STJ (m)	-0.880	0.0004	-0.918	0.0001	-0.899	-0.989	-0.773
CMJ (cm)	-0.857	0.0007	-0.882	0.0003	-0.840	-0.964	-0.592
MBT (m)	-0.819	0.0020	-0.847	0.0010	-0.835	-0.945	-0.670
SR (cm)	-0.270	0.4227	-0.278	0.4080	-0.298	-0.747	0.194

Note: s.s. - Standing start; f.s. - Flying start; BS - Bounding strides; SLJ - Standing Long Jump; STJ - Standing Triple Jump; MBT - Medicine Ball Throw; SR - Sit and Reach; CI - Confidence Interv

Table 3. Statistical correlations between performance in 100m and independent variables assessed through anthropometric measurements

Anthropometric Indices	Pearson (r)	p-value	Spearman (r)	p-value	Bootstrapped Pearson (r)	95% CI Lower	95% CI Upper
H (cm)	-0.555	0.0766	-0.469	0.1454	-0.563	-0.853	-0.068
T (cm)	-0.604	0.0489	-0.552	0.0785	-0.578	-0.858	-0.122
BM (kg)	-0.752	0.0076	-0.655	0.0289	-0.743	-0.948	-0.395
LLL (cm)	-0.314	0.3463	-0.384	0.2442	-0.343	-0.827	0.337
LFL (cm)	-0.657	0.0281	-0.648	0.0310	-0.653	-0.873	-0.330
RFL (cm)	-0.657	0.0281	-0.648	0.0310	-0.653	-0.873	-0.330
LTC (cm)	-0.515	0.1053	-0.381	0.2480	-0.472	-0.930	0.298
RTC (cm)	-0.499	0.1180	-0.318	0.3406	-0.446	-0.919	0.474
LCC (cm)	-0.642	0.0334	-0.469	0.1456	-0.578	-0.925	0.097
RCC (cm)	-0.642	0.0334	-0.469	0.1456	-0.578	-0.925	0.097
LAC (cm)	-0.780	0.0046	-0.687	0.0195	-0.752	-0.938	-0.251
RAC (cm)	-0.780	0.0046	-0.687	0.0195	-0.752	-0.938	-0.251
BiaD (cm)	-0.752	0.0075	-0.790	0.0038	-0.759	-0.960	-0.463
TrohD (cm)	-0.801	0.0030	-0.732	0.0105	-0.771	-0.965	-0.321

Note: H - Height; T - Torso Length; BM - Body Mass; LLL - Lower Limb Length; L/RFL - Left/Right Foot Length; L/RTC - Left/Right Thigh Circumference; L/R CC - Left/Right Calf Circumference; L/R AC - Left/Right Ankle Circumference; BiaD - Biacromial Diameter; TrohD - Bitrochanteric Diameter; CI - Confidence Interval.

the anthropometric measurement corresponded to longer sprint times (i.e., slower performance), while negative r-values indicated that higher values of the variable were associated with shorter sprint times (i.e., better performance) [11]. Statistical significance was determined at the p < 0.05 level; p-values equal to or greater than this threshold was interpreted as non-significant, implying a potential influence of random variation [12].

As shown in Table 3, all anthropometric variables exhibited negative correlations with 100m sprint performance, indicating that greater values of these measurements tend to be associated with faster sprint times. Overall, the strength of these relationships was moderate, rather than strong, for most indices.

Among the measured parameters, bitrochanteric diameter (TrohD) emerged as the most reliable predictor, demonstrating the strongest negative association with sprint performance and the greatest statistical stability. Ankle circumference (LAC/RAC) ranked closely behind, showing consistent significance and a similarly stable correlation pattern. Body mass and biacromial diameter (BiaD) also presented moderate negative relationships with performance, with BiaD showing slightly higher stability based on rank correlation and confidence interval analysis.

Foot length (LFL/RFL) demonstrated a moderate and statistically significant correlation, although wider confidence intervals suggest reduced reliability. In contrast, torso length (T) and calf circumference (LCC/RCC) displayed statistically significant linear correlations; however, the strength of their monotonic (rank-based) relationships was weaker or inconsistent, limiting their predictive value.

Other measurements, including height (H), thigh circumference (LTC/RTC), and lower limb length (LLL), did not show statistically significant correlations with sprint performance, and their confidence intervals indicated a lack of stability. These findings suggest that only select anthropometric characteristics are meaningfully associated with sprint success, while others have limited or no predictive utility in this context.

Based on the key predictors identified in this study, and supported by findings from previous research, a secondary selection model for the 100m sprint event was developed. This model includes the following performance tests and anthropometric measurements: 60m sprint from a standing start (60m s.s.), bounding strides over 30m (BS 30m), standing long jump (SLJ), standing triple jump (STJ), countermovement jump (CMJ), bitrochanteric diameter (TrohD), body mass (BM), and foot length (FL). Using this model, each subject's compatibility with the specific demands of the 100m sprint was evaluated (Table 4).

As shown in Table 4, compatibility was determined by comparing each subject's performance and anthropometric measurements against thresholds derived from the key predictors. A portion of the subjects demonstrated a high level of alignment

Table 4. Subject compatibility with the 100m sprint event

Subjects	STJ (m)	SLJ (m)	CMJ (cm)	60m s.s. (s)	BS 30m (s)	TrohD (cm)	BM (kg)	FL (cm)	Compatibility with 100m event
Boys									
B.A.	9.20	2.85	45.20	6.50	3.88	35.0	73	27.0	Compatible
B.D.	8.60	2.80	43.80	7.00	4.09	35.0	68	26.0	Compatible
B.L.	7.48	2.52	32.30	7.60	4.30	35.0	74	27.5	Not Compatible
M.M.	7.45	2.50	32.50	7.80	4.20	30.0	52	25.0	Not Compatible
T.R.	7.50	2.48	30.00	7.70	4.10	31.0	62	26.5	Not Compatible
T.A.	7.90	2.45	40.40	7.15	4.20	34.0	60	26.0	Compatible
Girls									
C.D.	7.11	2.50	31.90	7.90	4.20	33.0	52.5	24.0	Compatible
C.A.	6.08	2.12	28.60	8.10	4.85	30.0	57	25.5	Not Compatible
C.S.	6.60	2.20	30.90	8.02	4.93	30.0	50	24.0	Compatible
I.R.	6.50	2.10	24.30	8.35	5.15	28.0	47	24.0	Not Compatible
M.S.	6.75	2.25	36.40	7.82	4.85	32.0	53.5	24.0	Compatible

Note: Secondary selection model based on key predictors. STJ - Standing Triple Jump; SLJ - Standing Long Jump; CMJ - Countermovement Jump; 60m s.s. - 60m sprint from a standing start; BS 30m - Bounding Strides over 30m; TrohD - Bitrochanteric Diameter; BM - Body Mass; FL - Foot Length.

with the specific demands of the 100m sprint event, indicating potential for successful specialization. These findings support the practical applicability of the proposed secondary selection model and suggest that integrating performance-based and anthropometric assessments can enhance talent identification and training efficiency in young sprinters.

Discussion

The findings of this study confirm that specific physical, psychomotor, and anthropometric variables significantly influence 100m sprint performance in young athletes, thereby supporting the first working hypothesis (H1). Additionally, the results indicate that a scientifically grounded secondary selection model, based on key performance predictors, may improve the identification of athletes with high sprint potential. Although these findings provide partial support for the second hypothesis (H2), further validation of the model with a larger sample is necessary to ensure its applicability.

Among the variables assessed using specialized equipment, countermovement jump (CMJ) emerged as the most significant predictor of sprint performance. This result highlights the importance of explosive lower limb strength, particularly the athlete's ability to rapidly generate force through the stretch-shortening cycle, as a critical determinant of sprint success.

Regarding the tests, standing long jump (SLJ), 60m sprint from a standing start (60m s.s.), bounding strides over 30m (BS 30m), and standing triple jump (STJ) emerged as the strongest predictors of 100m sprint performance. These results confirm that

sprinting ability is supported by horizontal explosive power, stride efficiency, effective force application, and dynamic strength. The countermovement jump (CMJ), when conducted in field conditions, also demonstrated a strong correlation with sprint performance, consistent with the results obtained through the OptoJump system. This reinforces the significance of vertical explosive power in sprinting; however, horizontal power indicators such as SLJ and STJ appear to be even more relevant in predicting sprint success. Numerous specialized studies have sought to identify biomechanical indicators associated with successful 100m sprint performance. These investigations consistently conclude that the primary objective in sprinting is the development of maximum horizontal velocity of the entire body, achieved through force production and optimal running technique [13, 14, 15].

Additionally, the 30m sprint with a flying start (30m f.s.) proved to be a more relevant predictor of 100m performance than the 30m sprint from a standing start (30m s.s.). This suggests that an athlete's ability to accelerate efficiently and sustain high velocity over short distances plays a critical role in overall sprint performance.

The relationships between the investigated anthropometric indices and 100m sprint performance appeared moderate rather than strong. This finding suggests that no single anthropometric measurement can be regarded as a dominant predictor of sprint performance, reinforcing the notion that sprint ability results from a complex interplay of biomechanical, neuromuscular, and technique-related factors, rather than body dimensions alone.

The most relevant anthropometric predictors

identified in this study were bitrochanteric diameter (TrohD), ankle circumference (AC), body mass (BM), biacromial diameter (BiaD), and foot length (FL). Although their correlations with performance were moderate, these variables likely influence sprint ability indirectly by affecting stride length, ground reaction forces, stability, and energy transfer during the acceleration and maximum speed phases. For example, bitrochanteric diameter may impact stride mechanics and lateral stability; smaller ankle circumference could reduce inertial resistance, allowing for more efficient propulsion; optimal body mass is essential to balance acceleration and power output; biacromial diameter may contribute to upper body control during sprinting; and larger feet might enhance push-off efficiency, although this relationship remains debated. These parameters must be considered alongside dynamic performance measures such as explosive strength, acceleration ability, and sprinting technique for a comprehensive evaluation of sprint potential.

Numerous studies have emphasized the role of muscular power in sprint performance, focusing on key kinematic variables. These include spatiotemporal factors (stride length, stride frequency, ground contact time, flight time), lower limb configuration at ground contact and take-off, and segmental velocities before and during ground contact [16]. These determinants are, in turn, influenced by a combination of anthropometric, psychological, and genetic characteristics specific to each athlete, as well as biomechanical factors specific to sprinting and related events [17, 18]. Additionally, research on the musculoskeletal structure of elite sprinters has highlighted the significance of foot morphology in sprint speed development. Specifically, longer toes have been associated with prolonged ground contact time, which may enhance propulsive force and acceleration capacity [19].

The small number of subjects may affect the statistical robustness of the findings and limit the generalizability of the results. However, all participants were 16-year-old competitive sprinters, which reduced variability related to age, training background, or event specialization. While these findings may not be applicable to athletes of different age groups or performance levels, they offer relevant insights for individuals in the same stage of athletic development. Moreover, previous research in sports biomechanics and sprint performance has frequently employed small sample sizes due to the limited availability of highly trained sprinters. Notably, studies by Morin et al. [2] and Weyand et al. [3] have derived meaningful conclusions about sprint mechanics from similarly small or even smaller cohorts.

Within the broader research framework, the present study adopted an individual case study approach, allowing for a detailed analysis of each athlete's anthropometric, physical, and psychomotor profile in relation to sprint performance. This individualized analysis enabled a more nuanced understanding of the relationships between measured variables and sprint ability, potentially contributing to the refinement of secondary selection models for young sprinters.

Based on the findings of this study, as well as evidence from previous research, the most relevant predictors of 100m sprint performance include anthropometric indices, results from field-based and laboratory-based tests, and specialized evaluation techniques. The complementarity of these factors is essential for the accurate and effective orientation of young athletes toward sprint events.

The individualized analysis of each subject's physical and psychomotor profile, in correlation with their competition performance in the 100m event during the experimental year (2024), enabled an assessment of the alignment between psychomotor predispositions and the specific demands of sprinting. Ensuring this alignment is critical for optimizing training efficiency and achieving competitive success in future athletic development.

This study contributes to sports science by identifying and ranking the most relevant physical, psychomotor, and anthropometric predictors of 100m sprint performance in young athletes. The use of correlation-based analysis, including Pearson's, Spearman's, and bootstrapped correlations, enabled statistically robust interpretation without reliance on complex predictive modeling. These findings offer a practical basis for developing standardized selection procedures and targeted training strategies for sprint performance.

Furthermore, the results may serve as a foundation for future research employing predictive modeling techniques, such as regression analysis or machine learning, to further enhance talent identification frameworks. Additional biomechanical investigations, particularly those examining ankle structure, force application, and neuromuscular coordination, could also contribute to refining evidence-based sprint training methodologies.

Limitations of the Study

This study was conducted as a case-by-case analysis, focusing on detailed athlete profiling rather than population-level generalization. This approach is particularly relevant in talent identification, where individualized performance trajectories provide more actionable insights than group averages. Repeated measurements across three testing stages (T1, T2, and T3) enhanced the reliability of the observations.

A recognized limitation of this research is the small sample size, which is a common challenge in sports science, especially in studies involving

competitive or specialized athlete populations. Limited access to high-performance athletes, along with declining participation in track and field among youth in Romania, restricted the available talent pool and precluded large-scale data collection. Further validation with a larger and more diverse cohort is necessary to confirm the reliability and generalizability of the proposed selection model.

This research was approved by the Ethics Committee of the Doctoral School of Sports Science and Physical Education, Piteşti University Center, Romania.

Conclusions

The results of this study support the first hypothesis (H1), demonstrating that specific physical, psychomotor, and anthropometric variables significantly influence 100m sprint performance among young athletes. The second hypothesis (H2) is partially supported, as the proposed secondary selection model shows potential for practical application but requires further validation.

Key predictors of sprint performance were identified and applied to assess each athlete's compatibility with the 100m event, revealing that some individuals exhibit a stronger natural predisposition for sprinting. From a practical perspective, these findings can be incorporated into athlete selection and training programs by including performance indicators such as explosive strength (CMJ), acceleration ability (e.g., 30m sprint with a flying start), and biomechanical efficiency (e.g., BS 30m, AC) in standardized evaluation protocols. The use of these variables within secondary selection models may help coaches and talent scouts objectively identify young athletes with sprint potential and design training interventions that enhance acceleration, stride efficiency, and force application.

Conflict of Interest

The authors report that there are no competing interests to declare.

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