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Impact of anthropometric variations on acceleration and speed maintenance in sprinters

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Abstract

The goal of the current study was to find out how anthropometric differences affected sprinters' ability to accelerate and maintain speed. Three groups of short, medium, and long-distance sprinters were formed from a total of thirty male sprinters, ages 18 to 25. The anthropometric factors measured including Waist Girth, Hip girth, Leg length and Arm Length. ANOVA was used for statistical analysis in order to compare the groups. The results showed that the groups' capacities for acceleration and speed maintenance were impacted by notable variations in a few anthropometric characteristics. According to the study's findings, some anthropometric characteristics are advantageous for varying sprint lengths, and knowing them can aid in identifying potential and creating training plans.

Keywords: Anthropometric variations, sprinters, anthropometric variables, hip girth, waist girth, leg length, arm length

Introduction

Sprinting efficacy is profoundly contingent upon an athlete's capacity to achieve rapid acceleration and sustain elevated velocities across a specified distance (Uth, 2005) [1]. These competencies are influenced by an array of determinants, among which anthropometric traits encompassing limb length, girth measurements, and body composition are of paramount importance (Stachoń A, 2023) [2]. Anthropometric factors dictate leverage, stride length, the distribution of muscle mass, and biomechanical efficiency, all of which exert a direct impact on the various phases of sprinting, from the explosive start to the maintenance of speed (Ravi, 2012) [3]. Variations in metrics such as waist and hip circumference, arm length, and leg length may confer advantages for particular sprint distances through the optimization of power production, stability, and stride mechanics (Das, 2020) [4]. A comprehensive understanding of these differences among sprinters can facilitate talent identification, the formulation of specialized training regimens, and the enhancement of performance across events ranging from 100 meters to 400 meters (Ameti, 2023) [5].

Anthropometry offers a methodical approach to quantifying human body dimensions, morphology, and composition (Casadei, 2022) [6]. Within the domain of sports science, these measurements are instrumental in discerning the physical characteristics that are most advantageous for particular athletic events (Vučetić, Babić, Šentija, & Nekić, 2005) [7]. Previous research has indicated that shorter sprint distances generally favour athletes with compact and muscular physiques, thereby enhancing their explosive acceleration, while longer sprint distances often favour competitors endowed with elongated limbs that facilitate stride efficiency and sustained velocity (Shephard, 1974) [8]. Nevertheless, a significant lacuna in the existing literature persists regarding the specific relationships between these anthropometric variations and the phases of acceleration and speed maintenance across diverse sprinting distances (Molla, 2017) [9].

The current study aims to fill this void by examining essential anthropometric characteristics among male sprinters who focus on the 100 m, 200 m, and 400 m events. Gaining insight into these distinctions can be beneficial for coaches and sports scientists in spotting talent, customizing training regimens, and preventing injuries (Mande, 2016) [10]. For example, differences in waist and hip measurements may affect the centre of mass and power

generation, while variations in the lengths of legs and arms could impact stride length, rhythm, and overall running efficiency. By analysing how these physical attributes relate to the requirements of sprinting, training programs can be specifically designed to enhance the strengths of individual athletes (Sumal, 2021) [11].

This research holds particular importance for advancing evidence-based methods in sports performance (Preda, 2023) [12]. It draws upon existing literature while emphasizing the practical use of anthropometric profiling in sprinting events. The results are anticipated to enhance the larger athletic principle that "form follows function," indicating that an athlete's body type is suited to the biomechanical requirements of their specific event (Adrien Sedeaud, 2014) [13]. These insights not only support competitive performance but also assist in long-term athlete development and selection strategies.

Statement of problem

To assess how anthropometric differences affect sprinters' ability to accelerate and maintain speed.

Methodology

Selection of subject

30 male sprinters from the Lakshmbai National Institute of Physical Education (LNPE), Gwalior, who were experts in the 100-, 200-, and 400-meter races, participated in the study. All of the players, who were between the ages of 18 and 25, had prior intercollegiate competition experience.

Selection of variables

Waist circumference, hip circumference, leg length, and arm length were among the anthropometric factors examined. Because of their biomechanical significance to sprinting performance specifically for the acceleration and speed maintenance phases these factors were selected.

Criteria measures and instruments

The researcher followed established procedures to obtain all measurements, recording arm, leg, hip, and waist lengths using a flexible, non-stretchable measuring tape. For uniformity, all variable units were recorded in centimetre's (cm). Arm length is measured from the acromion process to the tip of the middle finger while the arms are relaxed, and leg length is measured from the anterior superior iliac spine (ASIS) to the medial malleolus. Waist girth is measured horizontally at the midpoint between the lower rib and iliac crest during a typical exhale. Hip girth is measured at the widest circumference around the hips and buttocks.

Administration of tests and data collection

To prevent variability, measurements were made while participants were standing straight and in a comfortable position. Every measurement was taken twice to guarantee accuracy, and the mean value was recorded. Reliable data collection was ensured by recording the performance variables in accordance with track standards

Statistical test

In addition to using One-Way ANOVA to compare the anthropometric variables across the 100-, 200-, and 400-meter groups, the collected data was subjected to descriptive statistics (mean and standard deviation) to summarize characteristics and variation. The Tukey's HSD Post Hoc Test

was utilized to identify specific intergroup differences. SPSS version 27.0 (USA) was used for all analyses, and the significance level was set at 0.05.

Result and Discussion

Table 1: Descriptive statistics of anthropometric variables (100m, 200m, and 400m Sprinters)

Variable	Group	N	Mean (cm)	SD (cm)	Std. error	95% CI lower	95% CI upper	Min	Max
Waist girth	100m	10	71.67	1.87	0.59	70.33	73.01	67.70	74.00
	200m	10	81.51	3.43	1.08	79.06	83.96	76.20	86.40
	400m	10	68.70	5.16	1.63	65.01	72.39	58.50	76.00
Hip girth	100m	10	89.62	1.84	0.58	88.30	90.94	87.00	92.50
	200m	10	90.29	2.88	0.91	88.23	92.35	86.30	95.40
	400m	10	85.49	2.55	0.81	83.66	87.32	81.20	89.00
Leg length	100m	10	95.50	4.42	1.40	92.33	98.66	91.00	106.40
	200m	10	96.41	4.99	1.57	92.84	99.98	90.00	103.70
	400m	10	100.99	5.35	1.69	97.15	104.82	91.20	107.00
Arm length	100m	10	74.36	3.31	1.05	71.99	76.73	70.00	79.20
	200m	10	77.58	4.33	1.37	74.48	80.68	72.50	85.00
	400m	10	79.57	4.44	1.40	76.39	82.75	73.00	86.00

Table 1 shows the examination of anthropometric factors showed clear differences amongst sprinters in various competitions. A slimmer abdominal profile was indicated by the 200-meter sprinters' highest waist circumference (81.51 cm) and the 400-meter sprinters' lowest (68.70 cm). The 100- and 200-meter sprinters' hip girths were larger (89.62 cm and 90.29 cm, respectively) than the 400-meter sprinters' (85.49 cm), indicating that shorter-distance runners' hips are broader, which may help with explosive power. From 100 to 400 meters, both leg and arm length increased gradually; 400-meter sprinters had the longest measurements, underscoring the significance of these measurements for stride efficiency, arm drive, and running economy. All things considered, the results indicate that 100-meter sprinters choose a small frame for quick acceleration, 200-meter sprinters show muscle growth that supports both speed and endurance, and 400-meter sprinters have longer limb proportions and thinner girths, which maximize performance for sustained velocity.

Table 2: Key anthropometric differences identified (ANOVA + Tukey HSD)

Variable	Significant difference	Groups with significant variation
Waist girth	Yes ($p < 0.05$)	200m > 100m & 400m
Hip girth	Yes ($p < 0.05$)	200m > 100m; 400m < 100m & 200m
Leg length	Yes ($p < 0.05$)	400m > 100m
Arm length	Significant only between 100m & 400m	400m > 100m

In Table 2 the Significant anthropometric disparities between sprinters were found using an ANOVA with Tukey HSD. Compared to 100- and 400-meter sprinters, 200-meter sprinters have a larger waist circumference. While 400-meter sprinters displayed noticeably lower hip girth than both 100- and 200-meter sprinters, 200-meter sprinters had larger hip girth than 100-meter sprinters. The 400-meter sprinters' legs were noticeably longer than those of the 100-meter sprinters, and the 400-meter sprinters' arms were longer than those of the 100-meter sprinters.

Table 3: Tukey HSD post hoc – arm length (cm)

Comparison	Mean difference	Std. error	p-value	95% CI (Lower–Upper)
100m – 400m	-5.21	1.82	0.021*	-9.71 – -0.70
100m – 200m	-3.22	1.82	0.198	-7.72 – 1.28
200m – 400m	-1.99	1.82	0.525	-6.49 – 2.51

*Significant at 0.05 level

Table 3 Shows that Only the 100- and 400-meter sprinters' arm lengths differed significantly ($p=0.021$), according to the Tukey HSD post hoc analysis. The 400-meter racers' arms were longer. There were no discernible differences between sprinters who ran 100 and 200 meters or between those who ran 200 and 400 meters.

Discussion

The results show major anthropometric differences amongst sprinting specialty. The 200-meter sprinters had the biggest hip and waist circumferences, which was indicative of the event's combined physiological needs for strength and

stamina. On the other hand, 400-meter sprinters had noticeably longer arms and legs, which are characteristics that support sustained velocity, rhythm maintenance, and stride efficiency. The most compact and homogeneous bodies were seen in 100-meter sprinters, who favoured rapid acceleration and maximum power output over short distances. The close relationship between sprint specialization and particular anthropometric features was further supported by statistical analysis using ANOVA and Tukey HSD, highlighting the importance of body structure in event-specific performance optimization.

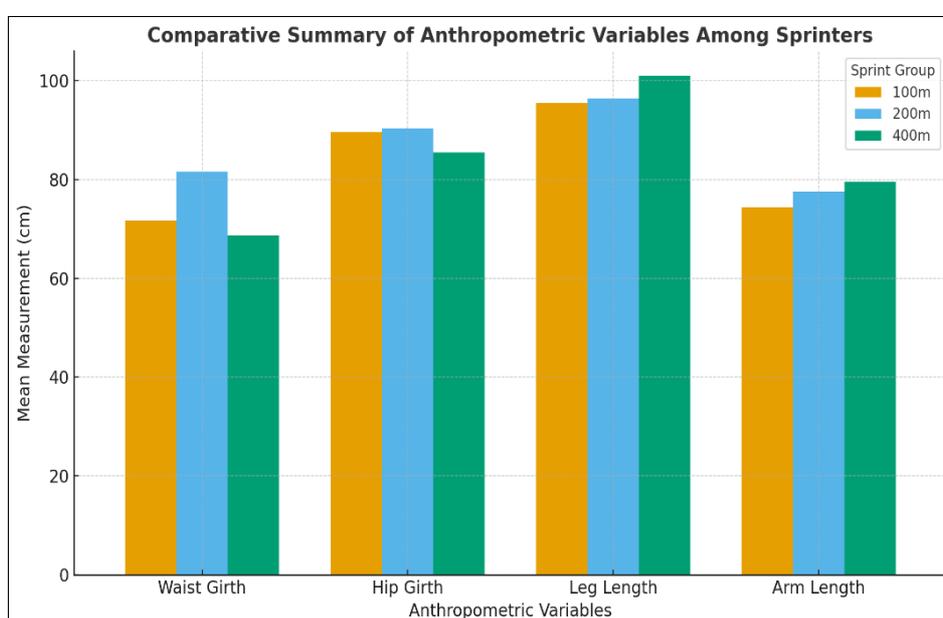


Fig 1: Graph shows the comparison of waist, hip, leg, and arm measurements in 100m, 200m, and 400m sprinters

Conclusion

The current study showed that significant anthropometric variances across several sprinting events are closely linked to sprint performance. The twin demands of power and endurance were reflected in the larger waist and hip girths of 200-meter sprinters. While 100-meter sprinters had a compact body best suited for explosive acceleration, 400-meter sprinters have noticeably longer arms and legs, which improve stride efficiency, rhythm, and speed maintenance. The results demonstrate that body structure affects sprint specialization, and identifying these anthropometric characteristics can help with performance optimization, talent identification, and customized training plans. By using these insights, coaches and sports scientists can better match training regimens to the physiological and biomechanical requirements of certain sprint events, improving long-term athlete development and competitive results.

References

1. Uth N. Anthropometric comparison of world-class sprinters and normal populations. *J Sports Sci Med*. 2005 Dec;6:608-616.
2. Stachoń P, Błażejczyk A, Stachoń A. Anthropometric

profiles and body composition of male runners at different distances. *Sci Rep.*; 2023.

3. Ravi GS, Selvam R. Comparison of anthropometric characteristics among All India inter-university sprinters. *J Phys Educ Sports Allied Discipl*. 2012;13(1):5-11.
4. Das D. Comparative study of physical fitness and anthropometric variables between urban and rural adolescents. Shantiniketan: Shodhganga; 2020.
5. Ameti VI, Hasanaj AI, Lulaj A. The impact of physical fitness and body composition on the success of sprint running at 400 meters. *Res Gate*. 2023;11(1):3-5.
6. Casadei K, Kiel J. Anthropometric measurement. Treasure Island (FL): StatPearls Publishing; 2022. Available from: <https://www.statpearls.com/>
7. Vučetić V, Babić V, Šentija D, Nekić B. Anthropometric and morphological characteristics of runners. *CroRIS*. c2005; p. 612-615. Available from: <https://www.croris.hr/>
8. Gardiner RJ, Grimshaw G, Shephard RJ. Characteristics of sprint, medium and long-distance swimmers. *Eur J Appl Physiol Occup Physiol*. 1974;32(2):99-116.
9. Molla HG. Review of anthropometric characteristics of runners. *J Tour Hosp Sports*. 2017;25:26-31.

10. Mande DS, Bhambure S. Comparative study on selected anthropometric variables among university men sprinters and throwers. *Int J Multidiscip Educ Res.* 2016;1(1):15-19.
11. Sumal RS. Shodhganga; 2021 May 27. Available from: <https://shodhganga.inflibnet.ac.in/handle/10603/327366>
12. Preda ACF, Tanase A, *et al.* Obesity phenotypes and cardiovascular risk: From pathophysiology to clinical management. *Nutr Metab Cardiovasc Dis.* 2023;24:901-919.
13. Sedeaud A, Marc A, Marck A, Schipman J, Dorsey M, Hager JP, *et al.* BMI, a performance parameter for speed improvement. *PLoS One.* 2014;9(2).