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Distinctive Waist and Hip Anthropometry of 200 meter sprinters Among different Sprinters: An Event-Specific Comparative Analysis

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Abstract

This study investigated the anthropometric differences among sprinters specializing in 100m, 200m, and 400m events, with a specific focus on waist and hip girth variability. A total of 30 male sprinters (10 from each category, aged 18–25 years) from Lakshmibai National Institute of Physical Education, Gwalior, were assessed using standardized anthropometric protocols. Waist and hip circumferences were measured with precision tape, and data were analyzed using one-way ANOVA followed by Tukey's HSD post hoc tests. Results revealed statistically significant differences across groups ($p < 0.05$), with 200m sprinters exhibiting notably larger waist girths (M = 81.51 cm) and hip circumferences (M = 90.29 cm) compared to both 100m (M = 71.67 cm waist; 89.62 cm hip) and 400m sprinters (M = 68.70 cm waist; 85.49 cm hip). These findings highlight the unique anthropometric profile of 200m sprinters, likely reflecting the combined physiological demands of maximal acceleration and speed endurance. The distinct waist and hip structure may provide biomechanical advantages in maintaining stride power while negotiating curve-to-straight transitions. This study emphasizes the importance of event-specific morphological profiling in sprint performance optimization and talent identification.

Keywords – Anthropometry, Sprint specialization, Waist girth, Hip girth, 200m sprint performance, Morphological profiling And Track and field.

1. Introduction

Sprinting events in track and field demand unique physiological and biomechanical characteristics, with each distance shaping a distinct athlete profile (Joseph P. Hunter, 2005). Among sprint disciplines, the 200-meter race occupies a special position as it requires both explosive acceleration, characteristic of short sprints, and sustained speed endurance, aligned more closely with longer sprints (Krzysztof Maćkała, 2015) . Unlike the 100-meter dash, which emphasizes maximal acceleration and peak power output

(Haugen TA, 2019) , or the 400-meter sprint, which prioritizes rhythm maintenance and speed endurance (Hanon, 2011), the 200-meter event blends these qualities, necessitating a hybrid body composition and structural efficiency (Petrakos, 2016).

Anthropometric variables, particularly waist and hip circumferences, have long been recognized as critical determinants of athletic performance (Kevin Norton, 2001) . Waist girth provides insights into trunk stability, core strength, and the distribution of abdominal musculature (Sands, 2005) , while hip girth reflects lower body power potential and biomechanical efficiency in stride generation (Abe, 2001). These variables not only influence movement mechanics but also determine the athlete's ability to balance explosive strength with sustained velocity—key requirements for success in the 200-meter sprint (F. Kugler, 2010).

Previous comparative studies have highlighted meaningful distinctions in anthropometric traits among sprinters across different distances (Alvero-Cruz, 2010). Evidence suggests that 200-meter sprinters exhibit larger waist and hip measurements compared to their 100-meter and 400-meter counterparts (Noriaki Tsunawake, 2003). This may be attributed to the unique metabolic and biomechanical demands of the event, which require an optimal combination of core stability, hip strength, and muscular endurance (Reed Kent M., 2017). Such traits are likely to enhance acceleration on the curve and maintain stride length and frequency on the straight, ultimately influencing performance outcomes (Kunz H, 1981).

The present study aims to provide an event-specific comparative analysis of waist and hip anthropometry in 200-meter sprinters. By examining these distinctive characteristics, this research seeks to contribute to a deeper understanding of how body structure aligns with performance requirements in sprinting disciplines (Haugen TA, 2019). Furthermore, the findings may offer practical implications for talent identification, training design, and performance optimization in track and field athletics (Sands, 2005).

2. Statement of Problem

To assess the unique waist and hip anthropometry of 200-meter sprinters with 100m and 400m sprinters, requiring a balance of acceleration and endurance, remains underexplored and this study aims to provide an event-specific comparative analysis of 200m sprinters.

3. Methodology

Selection of subject

For the purpose of this study, male sprinters specializing in the 200-meter sprint event were selected as subjects. To enable comparative analysis, groups of 100-meter and 400-meter sprinters were also included. All participants were drawn from inter-university level athletes enrolled at Lakshmibai National Institute of Physical Education, Gwalior. The age of the subjects ranged between **18 to 25 years**, ensuring a homogeneous sample in terms of growth and physical maturity.

Selection of Variables

The study investigated anthropometric variables directly linked to sprint performance, focusing on their impact on body mass distribution and biomechanics. Specifically, **waist girth** and **hip girth** were selected to analyze the unique physical characteristics of **200-meter sprinters** and to facilitate event-specific comparisons with **100-meter** and **400-meter sprinters**.

Criterions measures and instruments

To ensure precision and reliability, waist and hip girth were assessed using a flexible, non-stretchable steel measuring tape. Both variables were recorded in centimetres (cm), with measurements taken to the nearest 0.1 cm to enhance accuracy. The waist girth was measured at the midpoint between the lower margin of the last palpable rib and the iliac crest, while the hip girth was measured at the widest part of the buttocks, corresponding to the level of the greater trochanters. All measurements were conducted in accordance with standardized anthropometric protocols recommended by the International Society for the Advancement of Kinanthropometry (ISAK) and the World Health Organization (WHO) to ensure consistency and validity of the data collected.

Administration of Tests and Data Collection

Data collection was carried out in a systematic manner to minimize measurement error and ensure consistency across all subjects. Waist girth was measured with the participant standing upright, feet shoulder-width apart, and arms relaxed at the sides. The measurement was taken at the midpoint between the lower margin of the last palpable rib and the iliac crest, corresponding to the natural waist level. A flexible, non-stretchable tape was placed horizontally around the torso, ensuring it was snug but not compressing the skin, and the value was recorded at the end of a normal exhalation. Hip girth was assessed with the subject standing upright, feet together, and arms extended sideways to avoid interference. The tape was positioned around the widest part of the buttocks, typically at the level of the greater trochanters, and kept parallel to the floor while maintaining gentle contact with the skin. To improve reliability, each measurement was taken twice, and the average value was used for analysis. All measurements were conducted during training hours while the subjects were in a rested state, following standardized anthropometric procedures recommended by international guidelines.

Statistical test

Descriptive statistics, including the mean, standard deviation, and range, were computed to provide a clear summary of waist and hip anthropometric measurements across the three groups of sprinters (100m, 200m, and 400m). To examine whether significant differences existed among these groups, a one-way analysis of variance (ANOVA) was employed. In cases where the ANOVA results indicated statistically significant differences, Tukey's HSD post hoc test was applied to identify the specific group pairs that differed from each other. The level of statistical significance for all analyses was set at $p < 0.05$, ensuring that the findings were interpreted with a conventional threshold for scientific rigor.

4. Results

Table 1. Descriptive Statistics of Waist Girth (cm) in 100m, 200m, and 400m Sprinters

Group	N	Mean	SD	SE	95% CI (Lower–Upper)	Min	Max
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
Total	30	73.96	6.63	1.21	71.48 – 76.44	58.50	86.40

Table 1 presents the descriptive statistics of waist circumference for sprinters across 100m, 200m, and 400m events. The 200m sprinters displayed the largest waist girth (M = 81.51 cm, SD = 3.43), followed by 100m (M = 71.67 cm, SD = 1.87), while 400m sprinters had the smallest waist girth (M = 68.70 cm, SD = 5.16). The ANOVA indicated a highly significant difference in waist girth among the three groups, F(2,27) = 32.232, p < 0.001.

The table below summarizes the ANOVA and Tukey HSD Post Hoc results for Waist Girth.

Table 2. Tukey HSD Post Hoc Test Result Comparison

Comparison	**Mean Difference (cm)**	**p-value**	**Significance**
200m vs 100m	+9.84	<0.001	Significant
200m vs 400m	+12.81	<0.001	Significant
100m vs 400m	Not Significant (NS)	0.196	Not Significant (NS)

Table 2 present that waist circumference of 200-meter sprinters was substantially higher than that of 100-meter sprinters (+9.84 cm, p < 0.001) and 400-meter sprinters (+12.81 cm, p < 0.001), according to Tukey HSD post-hoc analysis. There was no significant difference between the 400-meter and 100-meter groups (p = 0.196). F (2,27) = 32.232 and p<0.001 indicate that the entire ANOVA for Waist Girth was statistically significant.

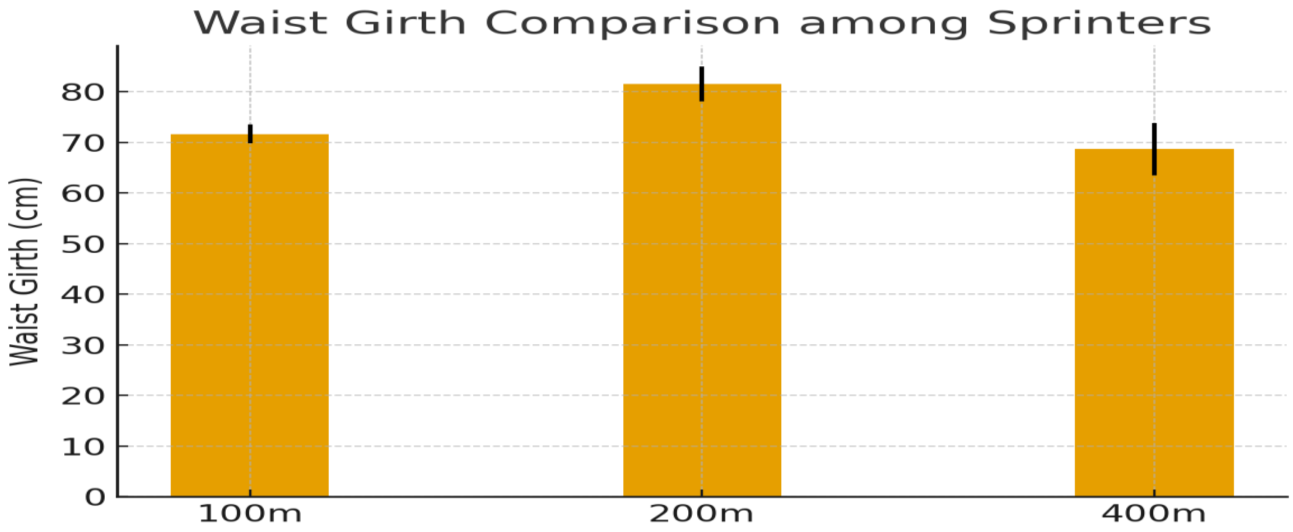

Figure 1: Mean Hip Girth (cm) Comparison across 100m, 200m, and 400m Sprinters.

Table 3. Descriptive Statistics of Hip Girth (cm) in 100m, 200m, and 400m Sprinters

Group	N	Mean	SD	SE	95% CI (Lower–Upper)	Min	Max
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
Total	30	88.47	3.21	0.59	87.27 – 89.66	81.20	95.40

Table 3 shows the descriptive statistics of hip girth across the sprinting groups. The 200m sprinters again recorded the highest hip circumference (M = 90.29 cm, SD = 2.88), followed closely by 100m sprinters (M = 89.62 cm, SD = 1.84). In contrast, 400m sprinters showed the lowest hip girth (M = 85.49 cm, SD = 2.55). ANOVA confirmed a statistically significant difference, $F(2,27) = 11.137$, $p < 0.001$.

The table below summarizes the ANOVA and Tukey HSD Post Hoc results for Hip Girth.

Table 4. Tukey HSD Post Hoc Test Results Comparison

Comparison	Mean Difference (cm)	p-value	Significance
400m vs 100m	−4.13	0.002	Significant
400m vs 200m	−4.80	<0.001	Significant
100m vs 200m	Not Significant (NS)	0.817	Not Significant (NS)

The ANOVA results for hip girth showed a statistically significant difference between the groups, with an F-statistic of $F(2,27) = 11.137$ and a p-value of $p<0.001$. This indicates that there are significant differences in hip girth among at least some of the groups being compared.

Significant variations in hip circumference between the groups were found by post-hoc analysis using Tukey's HSD test. The hip circumference of 400-meter sprinters was significantly less than that of 200-meter (M diff = −4.80 cm, p<0.001) and 100-meter (M diff = −4.13 cm, p=0.002) sprinters. On the other hand, the hip girth of the 200-meter and 100-meter groups did not differ statistically significantly (p=0.817).

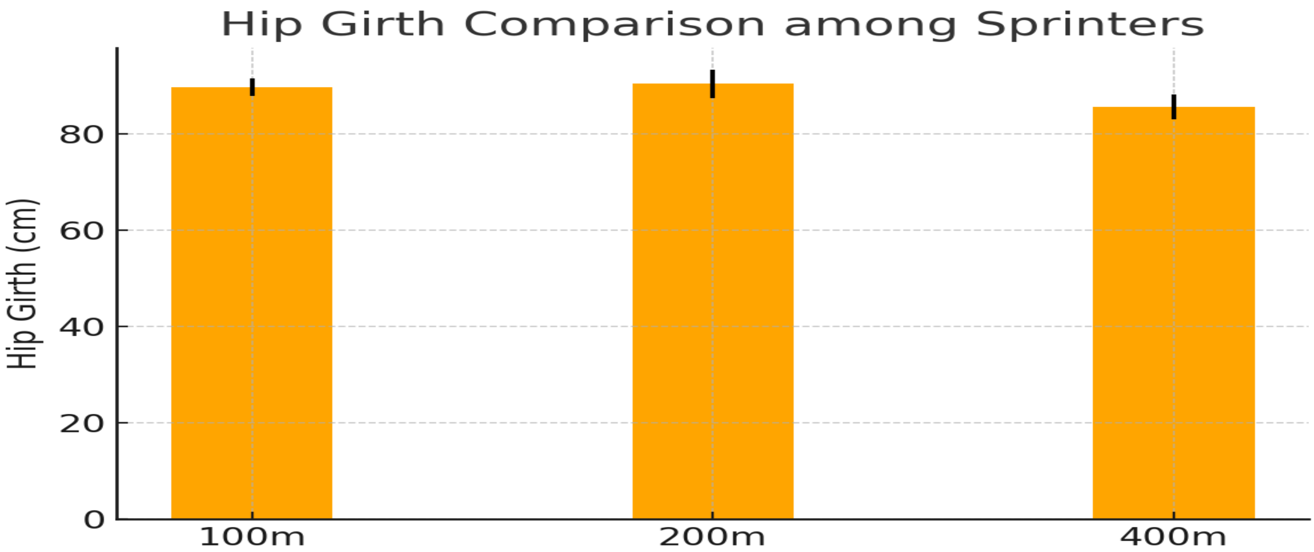

Figure 2: Mean Waist Girth (cm) Comparison across 100m, 200m, and 400m Sprinters.

Table 5. Combined Descriptive Statistics of Waist and Hip Girth (cm) in 100m, 200m, and 400m Sprinters

Group	N	Waist Mean ± SD	Waist Min–Max	Hip Mean ± SD	Hip Min–Max
100m	10	71.67 ± 1.87	67.70 – 74.00	89.62 ± 1.84	87.00 – 92.50
200m	10	81.51 ± 3.43	76.20 – 86.40	90.29 ± 2.88	86.30 – 95.40
400m	10	68.70 ± 5.16	58.50 – 76.00	85.49 ± 2.55	81.20 – 89.00
Total	**30**	**73.96 ± 6.63**	**58.50 – 86.40**	**88.47 ± 3.21**	**81.20 – 95.40**

Table 5 clearly presents that 200m sprinters possess the largest measurements in both variables. In contrast, 400m sprinters consistently exhibit smaller, leaner body compositions for both their waist and hips. The 100m sprinters generally fall between these two groups, with their hip girth measurements being much closer to those of the 200m sprinters.

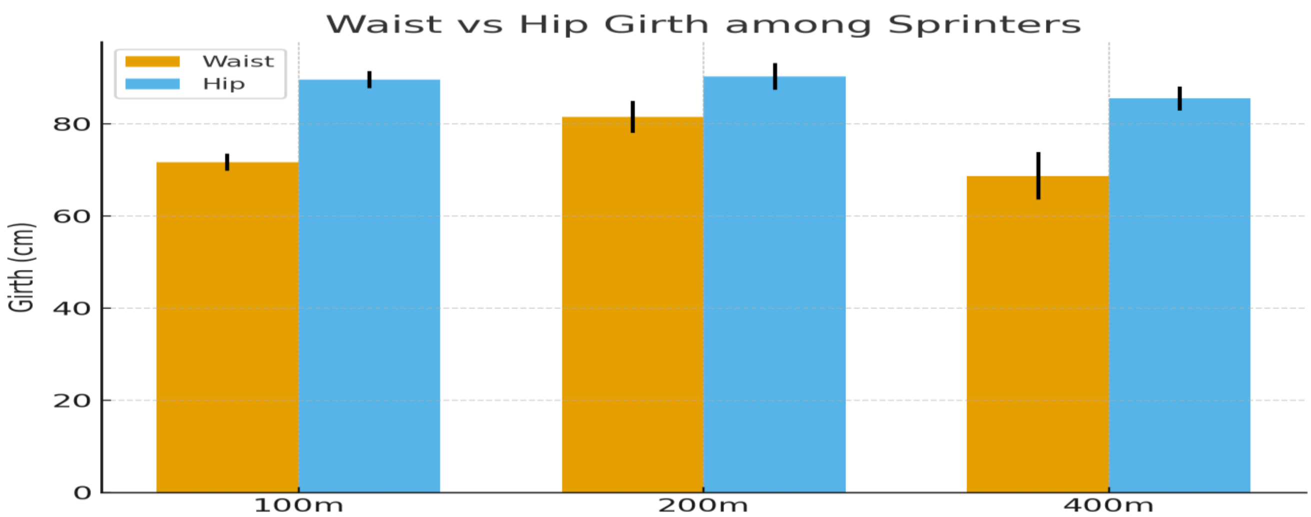

Figure 3: Waist and Hip Girth Comparison among 100m, 200m, and 400m Sprinters.

5. Discussion

The study's results strongly support the idea that each sprint distance requires a unique body shape. ANOVA confirmed significant differences in waist and hip girth, validating the hypothesis that a distinct physique is necessary for the 200-meter sprint. The post-hoc analysis highlighted that 200-meter sprinters have notably larger waists and hips, a characteristic likely developed to meet the event's dual demands for explosive power and speed endurance. This body type may enhance core stability and hip power, providing a biomechanical advantage for high-speed turns. Conversely, the 400-meter sprinters showed the smallest waist and hip measurements, which aligns with the event's focus on running efficiency and aerobic capacity. Interestingly, the 100-meter sprinters fell between the two groups, demonstrating a hip girth comparable to the 200-meter group, yet a waist girth closer to the 400-meter group. This suggests that while hip power is essential for the 100-meter race, a massive trunk isn't as critical as it is for the 200-meter event. Ultimately, the study emphasizes that these different body compositions are not accidental but are adaptive responses to the specific physical requirements of each sprint event, providing valuable insights for talent identification and training optimization in track and field.

6. Conclusion

The present study demonstrated that waist and hip anthropometry significantly differentiate sprinters across 100m, 200m, and 400m events. The findings confirm that 200-meter sprinters possess distinct morphological traits, with notably larger waist and hip circumferences compared to their counterparts. These characteristics likely reflect the hybrid physiological requirements of the 200-meter sprint, which combines explosive acceleration with speed endurance and curve-running efficiency. In contrast, 400-meter sprinters showed the leanest profiles, favouring rhythm and energy conservation, while 100-meter sprinters occupied an intermediate position, emphasizing hip-driven power without the need for a wider trunk. From a practical perspective, the results highlight the importance of waist and hip girth as event-specific anthropometric indicators in sprinting. Coaches and sports scientists can utilize these insights for talent identification, training customization, and performance optimization. By aligning athlete morphology with the specific demands of sprint distances, this research underscores the critical role of anthropometric profiling in advancing success in track and field athletics.

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