

# Regional Comparison Of Selected Anthropometric Variables And Motor Fitness Performance In Competitive Male Taekwondo Athletes Of Uttar Pradesh And Delhi

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## Abstract

Taekwondo is a high-intensity Olympic combat sport in which success depends not only on technical and tactical proficiency but also on specific anthropometric characteristics and motor fitness capacities. Variables such as body height, limb segment lengths and body composition influence reach, kicking mechanics, balance, and movement efficiency, while motor fitness components such as speed, agility and muscular endurance determine the athlete's ability to execute repeated high-intensity actions during competition. Previous studies have demonstrated that elite combat sport athletes possess distinct anthropometric and fitness profiles, however, most available evidence is derived from international or elite cohorts, with limited regional-level data from India. In particular, there is a lack of comparative research examining whether athletes from different Indian regions differ in their physical structure and functional performance. Uttar Pradesh and Delhi represent two important talent-producing regions with potentially different genetic, nutritional and training environments. The present study therefore aimed to compare selected anthropometric variables and motor fitness performance between national-level male Taekwondo athletes from Uttar Pradesh and Delhi. It was hypothesized that significant regional differences would exist in selected anthropometric variables and motor fitness performance.

**Material and Methods:** Sixty-four national-level male Taekwondo athletes (Uttar Pradesh = 32; Delhi = 32), aged 18–25 years, participated voluntarily. Anthropometric measurements included body weight, height, body mass index, upper arm length, lower arm length, hand length, upper leg length, lower leg length and foot length, assessed according to ISAK guidelines. Motor fitness was assessed using the 50 m sprint (speed), shuttle run (10×2; agility) and pull-ups (upper-body muscular endurance). Independent sample t-tests were used for group comparisons and Cohen's d was calculated to determine effect sizes.

**Results:** Significant differences were observed for height ( $p < 0.001$ ), upper arm length ( $p < 0.001$ ), lower arm length ( $p < 0.001$ ), hand length ( $p = 0.010$ ), upper leg length ( $p < 0.001$ ), lower leg length ( $p = 0.001$ ) and foot length ( $p = 0.001$ ). No significant differences were found for body weight ( $p = 0.740$ ), body mass index ( $p = 0.112$ ), 50 m sprint ( $p = 0.460$ ), shuttle run ( $p = 0.260$ ) or pull-ups ( $p = 0.200$ ).

**Conclusions:** National-level Taekwondo athletes from Uttar Pradesh exhibited greater body height and longer limb segment dimensions than their counterparts from Delhi, whereas motor fitness performance did not differ significantly between the two regions. These findings indicate that regional variation exists primarily in anthropometric characteristics rather than in functional performance at the national competitive level. Future research should examine how these structural differences interact with biomechanical, technical and training variables to influence competitive success.

**Keywords:** Combat sports, Limb segment length, Physical profiling, Athletic performance, Regional variation, Talent identification,

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## Introduction

Taekwondo is a high-intensity Olympic combat sport that requires athletes to possess a combination of speed, agility, power, balance, flexibility and muscular endurance to perform effectively in competition. Success in Taekwondo is not determined by skill alone, physical structure and functional fitness play a crucial role in executing rapid kicks, maintaining stability and sustaining performance throughout bouts. Therefore, understanding the physical characteristics associated

with high-level Taekwondo performance is essential for athletes, coaches and sports scientists.

Anthropometric variables such as weight, height, body mass, limb lengths, limb girths and skinfold thickness provide important information about an athlete's body

composition and structural build. Similarly, motor fitness components such as speed, agility, strength and endurance reflect the athlete's functional capacity to meet the physiological and biomechanical demands of the sport. Previous studies have demonstrated that elite combat sport athletes tend to display distinct

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anthropometric profiles and superior motor fitness levels compared to non-elite athletes. However, the majority of existing research has focused on international or elite populations, with limited evidence available at the regional level in India.

In particular, there is a lack of comparative data examining how Taekwondo athletes from different regions within India differ in terms of their anthropometric characteristics and motor fitness performance. Uttar Pradesh and Delhi represent two important sporting regions with different training environments, talent development systems and socio-cultural contexts. Yet, no systematic study has directly compared Taekwondo athletes from these regions using standardized anthropometric and motor fitness assessments. This gap in knowledge limits the ability of coaches and sports authorities to develop region-specific training strategies and talent identification models.

Therefore, the present study aims to conduct a regional comparison of selected anthropometric variables and motor fitness performance in competitive male Taekwondo athletes of Uttar Pradesh and Delhi. By identifying whether significant differences exist between athletes from these two regions, the study seeks to contribute to a better understanding of how regional factors may influence physical profiles and performance-related fitness in combat sports.

#### **Purpose:**

- To assess the selected anthropometric variables of competitive male Taekwondo athletes from Uttar Pradesh and Delhi.
- To assess the motor fitness performance of competitive male Taekwondo athletes from Uttar Pradesh and Delhi.
- To compare the selected anthropometric variables and motor fitness performance of competitive male Taekwondo athletes from Uttar Pradesh and Delhi.

#### **Hypothesis**

There is a significant difference in selected anthropometric variables and motor fitness performance between national level competitive male Taekwondo athletes of Uttar Pradesh and Delhi.

#### **Participants**

A total of N = 60 national level competitive male Taekwondo athletes (30 from Uttar Pradesh and 30 from Delhi), aged between 18 and 25 years, voluntarily participated in the study. All participants had represented their respective states at the National Taekwondo Championships and had a minimum of five years of systematic training experience.

#### **Inclusion Criteria**

- Male Taekwondo athletes aged 18–25 years
- Participation at National level competitions

- Minimum 5 years of formal Taekwondo training
- Currently active in training and competition
- Free from injury or illness in the last three months

#### **Exclusion Criteria**

- History of musculoskeletal injury or surgery in the last six months
- Use of performance-enhancing drugs
- Presence of cardiovascular, metabolic, or neurological disorders

Written informed consent was obtained from all participants. Ethical approval was obtained from the Institutional Ethics Committee, and procedures followed the Declaration of Helsinki (2008 revision).

#### **Procedure**

Data were collected at approved sports training centres in Uttar Pradesh and Delhi between 7:00 and 10:00 a.m. under standardized conditions. Participants reported in light sportswear and barefoot and were instructed to avoid strenuous exercise for 24 hours prior to testing.

#### **Anthropometric Measurements**

Measurements were taken following ISAK guidelines:

- Weight (kg)- Digital weighing scale
- Height (cm) - Stadiometer
- Body Mass Index (kg/m<sup>2</sup>) - calculated
- Limb Length (cm) – Weight, Height, Body mass, Upper arm length, Lower arm length, Hand length, Upper leg length, Lower leg length, Foot length (anthropometric tape)

Each measurement was recorded twice and the mean value was used for analysis.

#### **Motor Fitness Tests**

##### **Components Tests**

- |                    |                    |
|--------------------|--------------------|
| Speed-             | 50 m sprint        |
| Agility-           | Shuttle run (10*2) |
| Muscular Strength- | Pull-ups           |

Standard warm-up was provided before testing and adequate rest was given between trials.

#### **Statistical Analysis**

Data were analyzed using **SPSS version 26.0**

- Descriptive statistics (Mean ± SD) were computed for all variables.
- Independent sample **t-tests** were used to compare anthropometric and motor fitness variables between Uttar Pradesh and Delhi.
- Effect size (Cohen's d) was calculated for each comparison.

The level of statistical significance was set at **p ≤ 0.05** and exact p-values were reported up to three decimal places.

Each statistical test corresponded directly to the stated hypothesis and objectives.

**Table 1. Anthropometric Comparison of Uttar Pradesh and Delhi National Level Taekwondo Athletes**

Regional Comparison Of Selected Anthropometric Variables And Motor Fitness Performance In Competitive Male Taekwondo Athletes Of Uttar Pradesh And Delhi

Variable	Uttar Pradesh National (n=32) (Mean ± SD)	Delhi National (n=32) (Mean ± SD)	t-value	p-value	Cohen's d
Weight	71.56±13.89	70.44±12.61	0.33	0.74	0.084
Height	179.42±5.68	172.74±8.63	3.55	<0.001	0.91
Body mass	22.08±3.24	23.79±4.96	-1.59	0.11	0.41
Upper arm length	33.42±1.45	30.62±1.89	6.33	<0.001	1.66
Lower arm length	26.17±1.28	24.51±1.66	4.26	<0.001	1.12
Hand length	21.38±1.49	20.33±1.61	2.60	0.01	0.68
Upper leg length	46.77±1.68	44.71±2.35	3.88	<0.001	1.01
Lower leg length	41.43±2.01	39.38±2.78	3.27	<0.001	0.85
Foot length	30.38±1.75	28.77±1.99	3.33	<0.001	0.86

The study compared selected anthropometric variables between **National level male Taekwondo athletes from Uttar Pradesh (n = 32) and Delhi (n = 32)**. The analysis was performed using **independent sample t-tests** to determine whether there were significant differences between the two groups. Cohen's d was also calculated to quantify the **effect size** of the differences. The level of significance was set at **p ≤ 0.05**, and all analyses were conducted using **SPSS version 26.0 (IBM Corp., Armonk, NY, USA)**.

- **Weight:** The mean body weight of UP athletes (71.56 ± 13.89 kg) was slightly higher than that of Delhi athletes (70.44 ± 12.61 kg), but the difference was **not statistically significant** (t = 0.33, p = 0.740). Cohen's d = 0.084 indicates a **negligible effect size**, suggesting minimal practical difference in weight between the two groups.
- **Height:** UP athletes were significantly taller (179.42 ± 5.68 cm) than Delhi athletes (172.74 ± 8.63 cm), with a **highly significant difference** (t = 3.55, p = 0.001). Cohen's d = 0.91 reflects a **large effect size**, indicating that height is a distinguishing anthropometric characteristic between the two regional groups.
- **Body Mass Index (BMI):** Delhi athletes had a higher BMI (23.79 ± 4.96) compared to UP athletes (22.08 ± 3.24), but this difference was **not statistically significant** (t = -1.59, p = 0.112). Cohen's d = 0.41 suggests a **medium effect size**, indicating a modest difference in body composition between the groups.
- **Upper Arm Length:** UP athletes had significantly longer upper arms (33.42 ± 1.45 cm) than

Delhi athletes (30.62 ± 1.89 cm), with a **highly significant difference** (t = 6.33, p < 0.001). Cohen's d = 1.66 indicates a **very large effect size**, highlighting the upper arm length as a major distinguishing factor between the regions.

- **Lower Arm Length:** UP athletes also had longer lower arms (26.17 ± 1.28 cm) than Delhi athletes (24.51 ± 1.66 cm), with the difference being **statistically significant** (t = 4.26, p < 0.001). Cohen's d = 1.12 indicates a **very large effect size**.
- **Hand Length:** The mean hand length of UP athletes (21.38 ± 1.49 cm) was greater than Delhi athletes (20.33 ± 1.61 cm), and the difference was **statistically significant** (t = 2.60, p = 0.01). Cohen's d = 0.68 represents a **medium-to-large effect size**, suggesting a meaningful regional difference.
- **Upper Leg Length:** UP athletes had significantly longer upper legs (46.77 ± 1.68 cm) than Delhi athletes (44.71 ± 2.35 cm), with t = 3.88 and p = 0.0002. Cohen's d = 1.01 indicates a **very large effect size**.
- **Lower Leg Length:** The lower leg length was significantly greater in UP athletes (41.43 ± 2.01 cm) than Delhi athletes (39.38 ± 2.78 cm) (t = 3.27, p = 0.001), with Cohen's d = 0.85 (**large effect size**).
- **Foot Length:** UP athletes had longer feet (30.38 ± 1.75 cm) compared to Delhi athletes (28.77 ± 1.99 cm), with the difference being **statistically significant** (t = 3.33, p = 0.001). Cohen's d = 0.86 (**large effect size**) highlights foot length as another distinguishing variable.

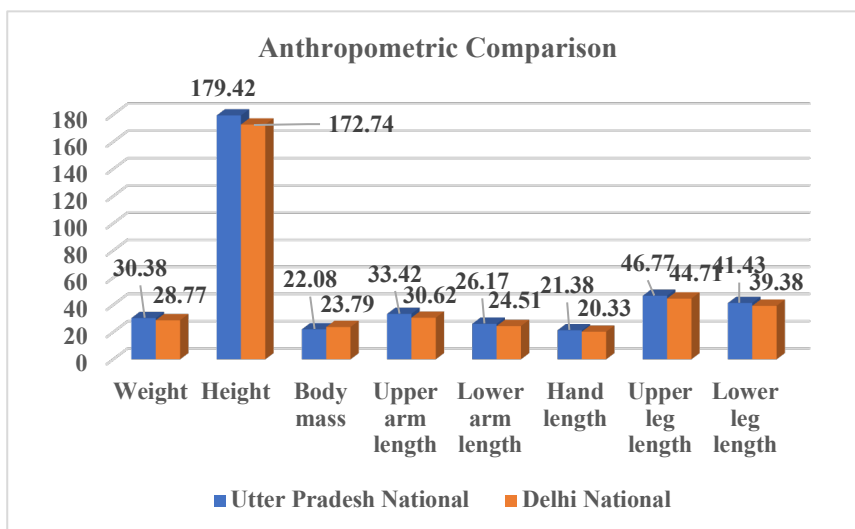


Fig. 1 Shows the Anthropometric Comparison of Uttar Pradesh and Delhi National Level Taekwondo Athletes

Table 2. Motor Fitness Comparison of Uttar Pradesh and Delhi National Level Taekwondo Athletes

Variable	Uttar Pradesh National (n=32) (Mean ± SD)	Delhi National (n=32) (Mean ± SD)	t-value	p-value	Cohen's d
50 m Sprint	6.52±0.10	6.57±0.28	-0.74	0.46	0.24
Shuttle run (10*2)	9.49±0.21	9.40±0.33	1.12	0.26	0.33
Pull-ups	20.61±1.81	21.22±2.19	-1.29	0.20	0.30

Table 2 presents the comparison of selected motor fitness variables between national-level male Taekwondo athletes from Uttar Pradesh and Delhi. The results showed **no statistically significant differences** between the two groups for any of the motor fitness variables examined.

- For the **50 m sprint**, the mean time of Uttar Pradesh athletes ( $6.52 \pm 0.10$  s) was marginally lower than that of Delhi athletes ( $6.57 \pm 0.28$  s); however, this difference was not statistically significant ( $t = -0.74$ ,  $p = 0.460$ ) and the effect size was small (Cohen's  $d = 0.24$ ), indicating a negligible practical difference in sprint performance.
- In the **shuttle run (10×2)** test, Uttar Pradesh athletes recorded a slightly higher mean time ( $9.49 \pm 0.21$  s) compared to Delhi athletes ( $9.40 \pm 0.33$  s). This difference was also not statistically significant ( $t = 1.12$ ,

$p = 0.260$ ), with a small effect size ( $d = 0.33$ ), suggesting only a minor difference in agility performance between the groups.

- For **pull-ups**, Delhi athletes showed a marginally higher mean ( $21.22 \pm 2.19$  repetitions) compared to Uttar Pradesh athletes ( $20.61 \pm 1.81$  repetitions), but the difference was not statistically significant ( $t = -1.29$ ,  $p = 0.200$ ) and the effect size was small ( $d = 0.30$ ), indicating minimal practical difference in upper-body muscular endurance.

Overall, the findings indicate that **national-level Taekwondo athletes from Uttar Pradesh and Delhi exhibit comparable motor fitness profiles**, with no statistically or practically meaningful differences observed in sprint speed, agility, or upper-body endurance.

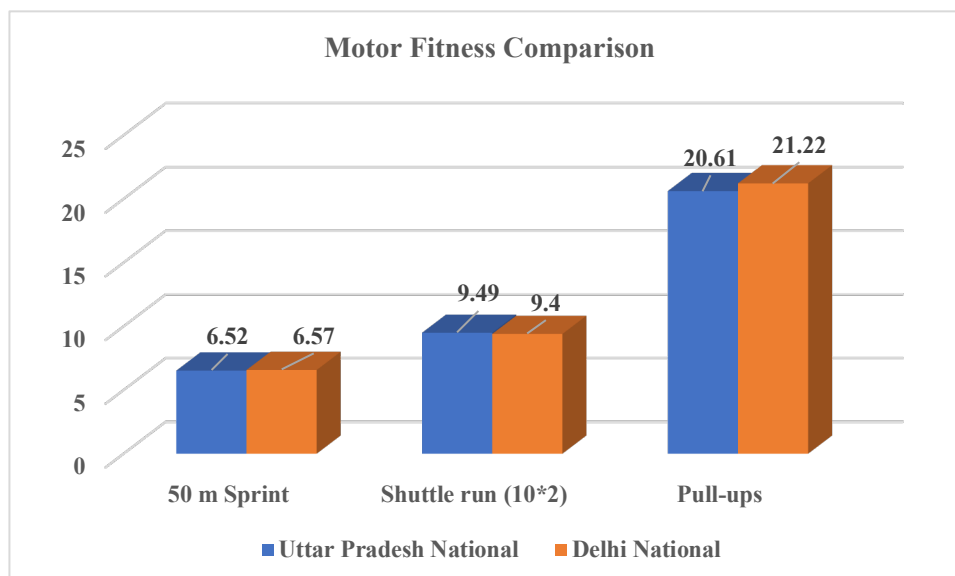


Fig. 2 Shows the Anthropometric Comparison of Uttar Pradesh and Delhi National Level Taekwondo Athletes Results

A total of 64 national-level male Taekwondo athletes participated in the study, with 32 athletes each from Uttar Pradesh and Delhi. No participants were excluded and no dropouts or complications were reported during data collection.

The comparison of selected anthropometric variables between the two groups is presented in Table 1. Independent sample t-tests indicated that several segmental length variables differed significantly between athletes from Uttar Pradesh and Delhi, whereas body mass and BMI did not show statistically significant differences.

Specifically, athletes from Uttar Pradesh were significantly taller and exhibited greater upper arm length, lower arm length, hand length, upper leg length, lower leg length and foot length compared to athletes from Delhi ( $p < 0.05$  for all). These differences were accompanied by medium to very large effect sizes, indicating that the observed differences were not only statistically significant but also practically meaningful. In contrast, body weight and body mass index did not differ significantly between the groups and the associated effect sizes were small to moderate.

The comparison of motor fitness variables is shown in Table 2. No statistically significant differences were observed between the two groups for any of the motor fitness measures ( $p > 0.05$ ). Effect size analysis further indicated that the magnitude of these differences was small, suggesting negligible practical differences in sprint speed, agility and upper-body muscular endurance between national-level athletes from Uttar Pradesh and Delhi.

Overall, the results indicate that while regional differences exist in several anthropometric dimensions, the motor fitness profiles of national-level Taekwondo athletes from Uttar Pradesh and Delhi are largely comparable.

### Discussion

The present study examined regional differences in selected anthropometric and motor fitness variables among national-level male Taekwondo athletes from Uttar Pradesh and Delhi. The findings revealed that athletes from Uttar Pradesh possessed significantly greater body height and longer limb and segmental dimensions, whereas no meaningful regional differences were observed in motor fitness performance.

The greater stature and limb lengths observed among Uttar Pradesh athletes may be attributed to genetic, nutritional, or developmental factors that influence growth patterns across populations. Similar findings have been reported in previous studies on combat sport athletes, where anthropometric characteristics such as height and limb length have been shown to vary across regions and ethnic groups and may provide biomechanical advantages in striking and reach-based sports like Taekwondo.

Despite these anthropometric differences, both groups demonstrated comparable motor fitness performance. This suggests that at the national competitive level, training adaptations, technical skills and conditioning programs may offset structural differences, leading to similar functional performance outcomes. These findings align with earlier research indicating that elite-level athletes often exhibit homogeneous fitness profiles due to standardized training loads and selection processes.

The results also imply that anthropometric advantages alone may not translate directly into superior motor performance at higher levels of competition. Instead, performance in Taekwondo is likely influenced by a combination of technical proficiency, tactical awareness, psychological readiness and training quality, in addition to physical structure.

### Highlights

- This study provides a regional comparison of anthropometric and motor fitness profiles among national-level male Taekwondo athletes from Uttar Pradesh and Delhi.
- Significant regional differences were observed in body height and limb segment lengths, with athletes from Uttar Pradesh showing greater values.
- No significant regional differences were found in motor fitness variables, including sprint speed, agility, and upper-body muscular endurance.
- The findings suggest that anthropometric advantages do not necessarily translate into superior motor fitness performance at the national competitive level.
- The study emphasizes the importance of multidimensional athlete evaluation beyond basic anthropometric and motor fitness measures.

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