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## Strength asymmetry in wrestling: Evaluating the stance and non-stance leg in Greco-Roman and freestyle styles

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### Abstract

This study investigates the relationship between the explosive strength of the stance and non-stance leg in Greco-Roman (GR) and Freestyle (FS) wrestlers in the Indian sub- continent. Given the biomechanical differences between the two wrestling styles, stance leg strength is hypothesized to be more pronounced in GR wrestlers due to their reliance on upper-body techniques and throws. A sample of 120 wrestlers was selected; comprising individuals aged 15-25 years with a training experience of 5-10 years. Various assessments, including the Hop Test and video analysis were conducted to measure explosive strength in both, the stance and non-stance leg. Statistical analysis, including Pearson correlation and independent t-tests were applied to examine the relationship between the two variables and compare differences across wrestling styles. The findings indicate a strong correlation ( $r = 0.95$ ,  $p = 0.0000$ ) between the explosive strength of stance and non-stance legs, suggesting synchronized development of lower limb power. Additionally, GR wrestlers demonstrated significantly greater stance leg explosive strength (Mean = 185 cm, SD = 21) compared to FS wrestlers (Mean = 162 cm, SD = 19), with a t-value of 4.21 ( $p = 0.0001$ ). These results highlight the impact of wrestling-specific training methodologies on lower limb strength development. The study provides valuable insights for wrestling coaches and sports scientists, emphasizing the need for tailored strength training programs that enhance explosive performance in both wrestling styles.

**Keywords:** Explosive strength, stance leg, non-stance leg, combat sports.

### 1. Introduction

Wrestling is one of the oldest combat sports, with evidence tracing back to ancient civilizations such as Mesopotamia and Greece [6]. Among the essential physical attributes in wrestling, lower limb explosive strength plays a crucial role in executing offensive and defensive techniques [18]. Explosive strength, which refers to the ability to generate maximum force in a minimal amount of time, is critical for takedowns, stance transitions, and counterattacks [10]. Studies have shown that explosive strength is a key determinant of performance in combat sports. Explosive lower-limb power in wrestlers is directly linked to their ability to execute rapid and forceful movements [9]. Elite wrestlers exhibit significantly higher lower-limb power compared to their non-elite counterparts, emphasizing its importance in competition [17]. Kraemer *et al.* (2001) also highlights that strength training targeting the lower limbs can lead to significant improvements in wrestling performance [12]. Research by Adam *et al.* (2018) found that wrestlers with greater stance leg strength execute more effective attacks due to their ability to generate high levels of force in a short period. Additionally, dynamic explosive strength contributes to enhanced agility, a key attribute for wrestling success [7]. Greco-Roman wrestlers rely on upper-body techniques such as throws and lifts whereas Freestyle wrestlers incorporate leg attacks, making lower-body strength more equally distributed [3]. These biomechanical differences influence the way explosive strength is developed and utilized in wrestling movements [8]. Explosive strength is crucial for powerful takedowns, defensive manoeuvres and rapid directional changes during a match [11].

A strong stance leg provides the wrestler with a stable base for initiating movements, executing attacks, and resisting opponent pressure [1]. Explosive power in combat sports directly correlates with competitive success, particularly in dynamic and strength-dependent sports like wrestling [5]. Lower-limb explosive strength is a predictor of performance efficiency in elite-



level wrestlers<sup>[13]</sup>. Moreover, studies indicate that lower limb explosive strength contributes to balance and agility, key attributes for successful wrestling performance<sup>[14]</sup>. Explosive power enhances an athlete's ability to generate force quickly which is vital for executing high-speed takedowns<sup>[4]</sup>. Lower limb strength also plays a key role in injury prevention. Athletes with higher explosive strength demonstrate better neuromuscular control, reducing the risk of knee and ankle injuries<sup>[16]</sup>. Training programs focused on explosive power contribute to increased joint stability and lower injury rates in combat sports<sup>[2]</sup>. Thus, understanding the relationship between stance and non-stance leg strength can contribute to developing targeted strength training programs for wrestlers.

### 1.1 Objectives

The primary aim of this research, titled, Strength Asymmetry in Wrestling: Evaluating the Stance and Non-Stance Leg in Greco-Roman and Freestyle Style is to analyse and compare the role of explosive strength in the stance and non-stance legs of wrestlers. In view of the said points, the study was necessitated with following objectives:

- To analyse the correlation between the explosive strength of stance and non-stance leg.
- To compare the explosive strength of stance legs between GR and FS wrestlers.

## 2. Methodology

### 2.1 Research Design

This study employs a quantitative, cross-sectional comparative research design to assess the explosive strength differences in the stance and non-stance leg of Greco- Roman (GR) and Freestyle (FS) wrestlers. The research includes statistical analysis to examine correlations and differences between the two wrestling styles.

### 2.2 Study population

A total of 120 male national level wrestlers (n = 52 Greco-Roman, n = 68 Freestyle) participated in the study with age ranges from 15-25 years (mean 20.3±3.1) and training age ranges from 5-10 years (mean 7.4±2.1) with height ranges from 160-184 cm (mean 175.2±5.6) and weight ranges from 48-96 kg (mean 75.8±6.9)

### 2.3 Variables of the Study

**Independent Variable:** Wrestling style (Greco-Roman vs. Freestyle)

## 3.2 Comparison of Explosive Strength

**Table 2:** Correlation of Stance and Non-Stance leg explosive strength

Variable	Mean ± SD (cm)	Correlation (r)	p-value
Stance leg strength	173±20	0.95	0.0000
Non-stance leg strength	168±21		

**Interpretation:** The high correlation coefficient ( $r = 0.95$ ,  $p = 0.0000$ ) suggests a strong positive relationship between stance and non-stance leg explosive strength. This indicates

## Dependent Variables

- Explosive strength of stance leg (cm)
- Explosive strength of non-stance leg (cm)
- Correlation between stance and non-stance leg strength

### 2.4 Data Collection Tools and Procedures Hop Test for Explosive Strength Assessment

The Hop Test was used to measure explosive strength in the lower limbs. Each participant performed three hop jumps on both stance and non-stance legs. Maximum distance (in cm) a wrestler can cover in a single jump best of three was recorded. All tests were conducted under standardized conditions on a non-slip wrestling mat and video analysis was used for accuracy.

### 2.5 Statistical Analysis

- Descriptive statistics (mean ± SD) were used to summarize demographic and performance data. Independent t-tests compared stance and non-stance leg strength between Greco-Roman and Freestyle wrestlers. Pearson correlation analysis examined the relationship between stance and non-stance leg strength. Effect size (Cohen's d) was calculated to determine the magnitude of strength differences and p-value of  $\leq 0.05$  was considered statistically significant.

### 2.6 Research hypothesis

- There is a statistically significant correlation between the explosive strength of the stance and non-stance leg, indicating a balanced development of lower limb power in wrestlers.
- Greco-Roman wrestlers exhibit significantly greater stance leg explosive strength than Freestyle wrestlers.

## 3. Results

### 3.1 Descriptive Statistics

**Table 1:** Mean and Standard Deviation of Participant Characteristics

Variable	Mean	SD
Height	175	±5.6
Weight (kg)	75.8	±6.9
Training Age (years)	7.4	±2.1
Chronological Age (years)	20.3	±3.1

that wrestlers with stronger stance legs also tend to have stronger non- stance legs, reinforcing the importance of balanced lower-limb strength development in wrestling.

**Table 3:** Comparison of Stance Leg Explosive Strength of GR and FS wrestlers

Wrestling Style	Stance Leg Strength (Mean ± SD, cm)	t-value	p-value	Effect size (cohen's d)
Greco-Roman (GR)	185 ± 21	4.21	0.0001	0.98
Freestyle (FS)	162 ± 19	3.89	0.0003	0.85

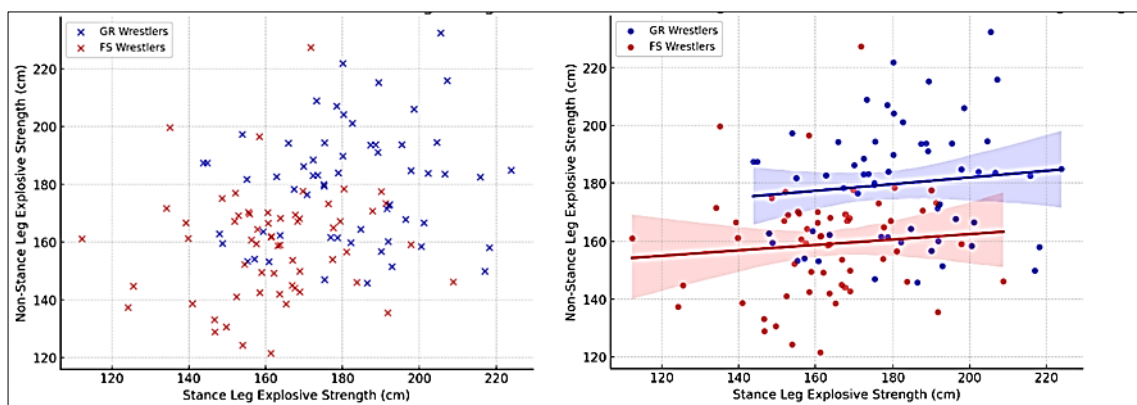
**Interpretation:** The results show that Greco-Roman wrestlers have significantly higher stance leg explosive strength (185 ± 21 cm) compared to Freestyle wrestlers (162

± 19 cm).The t-test results ( $t = 4.21$ ,  $p = 0.0001$ ) indicate that this difference is statistically significant, confirming that stance leg strength is more developed in Greco-Roman



wrestlers, likely due to the greater emphasis on upper-body throws and a stable base. The effect size (Cohen's  $d = 0.98$ )

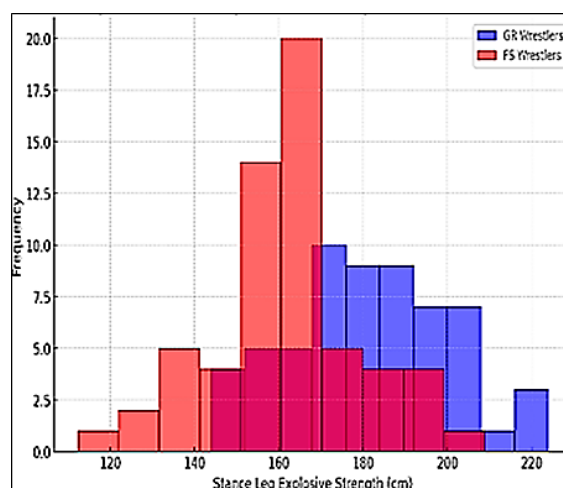
is large, indicating a strong practical difference between the two wrestling styles in terms of stance leg strength.



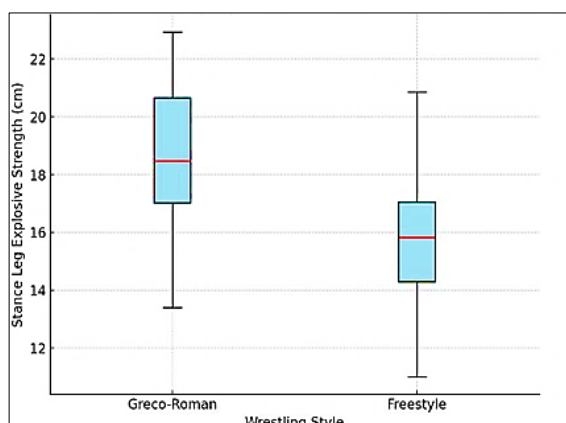
**Fig 1:** Scatter Plot of Stance vs, Non-Stance Leg Strength and Scatter Plot with Regression Line: Stance vs, Non-Stance Leg Strength

The scatter plot 1 shows relationship between stance leg strength and non-stance leg strength in Greco-Roman and Freestyle wrestlers. Greco-Roman wrestlers (blue) show higher values for both stance and non-stance leg strength. Freestyle wrestlers (red) exhibit lower values, with a different distribution pattern. The clustering of points suggests a strong correlation between stance and non-stance leg strength, supporting the study's hypothesis. Scatter plot 2 shows the relationship between stance leg strength and non-stance leg

strength in both wrestling styles. The blue regression line (Greco-Roman wrestlers) suggests a strong positive correlation, indicating that as stance leg strength increases, non-stance leg strength also increases. The red regression line (Freestyle wrestlers) shows a similar trend but at a lower range of values. These results reinforce the study's findings that both legs develop in coordination, with Greco-Roman wrestlers generally exhibiting higher explosive strength.



**Fig 2:** Histogram of Stance Leg Explosive Strength for GR and FS Wrestlers



**Fig 3:** Box Plot of Stance Leg Explosive Strength in GR and FS Wrestlers The histogram comparing the stance leg explosive strength distributions for Greco-Roman and Freestyle wrestlers. Greco-Roman wrestlers (blue) show a higher concentration of values ( $185 \pm 21$  cm) whereas Freestyle wrestlers (red) have a lower stance leg strength distribution ( $162 \pm 19$  cm). The spread of data highlights the variability in explosive strength within each wrestling style.



#### 4. Discussion

The results of this study emphasize the importance of explosive strength in both stance and non-stance legs for wrestling performance. The findings revealed that Greco-Roman (GR) wrestlers exhibit significantly greater stance leg explosive strength than Freestyle (FS) wrestlers, which can be attributed to the biomechanical and technical differences in the two wrestling styles. Additionally, the high correlation between stance and non-stance leg strength ( $r = 0.95$ ,  $p = 0.0000$ ) supports previous studies that suggest balanced lower-limb strength is vital for athletic performance (Garay *et al.*, 2020) <sup>[9]</sup>. Komi *et al.* (2003) <sup>[20]</sup> emphasized neuromuscular adaptations during strength training that lead to proportional strength gains in both limbs, even with unilateral training. Haff and Triplett *et al.* (2015) <sup>[21]</sup> highlight the role of coordinated muscle activation patterns in explosive movements, suggesting that training one leg can benefit the other. Suchomel *et al.* (2016) <sup>[22]</sup> suggested that bilateral force development is crucial for maximizing athletic performance, particularly in sports involving rapid changes in direction and force application, such as wrestling. The strong correlation found in this study ( $r = 0.95$ ) further confirms the interdependence of stance and non-stance leg power, as previously reported by Garay *et al.* (2020) <sup>[9]</sup> emphasizing that balanced lower-limb strength development contributes to improved mobility and adaptability in combat sports. The significant difference in stance leg strength between Greco-Roman and Freestyle wrestlers is consistent with the findings of Barbas *et al.* (2021) <sup>[3]</sup>, who highlighted that upper-body dominant sports such as Greco-Roman wrestling where techniques like throws, lifts, and clinch-based attacks require a stable and powerful base emphasize stance leg strength dominance is more pronounced than Freestyle wrestling. . Ulupinar *et al.* (2021) <sup>[19]</sup> examined performance differences between GR and FS wrestlers. The study found that GR wrestlers exhibited greater isometric strength and muscle power compared to FS wrestlers. Gierczuk *et al.* (2020) <sup>[10]</sup> found that Greco-Roman wrestlers rely more on stance leg explosive strength, as their sport requires strong posterior chain activation for overhead lifts and suplexes. Similarly, Franchini *et al.* (2011) <sup>[8]</sup> concluded that stance leg power plays a vital role in wrestling techniques that require upper-body dominance, such as clinches, throws, and lifts. For Freestyle wrestlers, the study findings suggest that a more symmetrical strength profile between the stance and non-stance legs is beneficial due to the nature of leg-based takedowns. Mirzaei *et al.* (2011) <sup>[17]</sup> findings supports that FS wrestlers require balanced lower-limb power for executing fast lateral movements and defending against opponents' attacks. In contrast, Freestyle wrestlers need a more balanced strength distribution between both legs, as leg-based takedowns and rapid directional changes require agility and explosive power from both lower limbs (Franchini *et al.*, 2011) <sup>[8]</sup>. The findings of this study indicate that stance leg explosive strength is a key performance determinant in Greco-Roman wrestling, while non-stance leg strength plays a greater role in agility and lateral movement in Freestyle wrestling. Bompa and Buzzichelli *et al.* (2019) <sup>[4]</sup> have demonstrated that stance leg power directly contributes to the ability to generate force quickly, making it critical for GR wrestlers specializing in high-amplitude throws and upper-body dominant techniques. In Freestyle wrestling, non-stance leg explosive strength is essential for rapid movement, lateral agility, and takedown attempts. He also noted that eccentric

strength in the non-stance leg enhances a wrestler's ability to regain position after a failed takedown attempt. Markovic and Mikulic *et al.* (2010) <sup>[14]</sup> found that stance leg strength enhances postural stability, allowing wrestlers to withstand attacks and counter with powerful defensive manoeuvres and athletes with well-developed non-stance leg power exhibit superior balance and quick transitions which is particularly relevant for FS wrestlers executing single-leg and double-leg takedowns. He also found that lower-limb power directly correlates with agility, meaning wrestlers with stronger non-stance legs can change direction faster and avoid being taken down. McBride *et al.* (2002) <sup>[15]</sup> Freestyle wrestlers benefit significantly from non-stance leg strength, which is associated with agility, lateral movements, and rapid directional changes. This aligns with López-Gullón *et al.* (2019) <sup>[13]</sup> who reported that wrestlers with higher non-stance leg power exhibit greater sprawling ability, a critical movement in FS wrestling for defending against opponent takedowns. Sterkowicz-Przybycień (2019) <sup>[18]</sup> found that wrestlers with greater stance leg strength exhibited higher resistance to being off-balanced, making them less vulnerable to opponent throws and sweeps. The non-stance leg plays a vital role in maintaining balance during feints, sprawls, and takedown recovery efforts. Iacono *et al.* (2015) <sup>[11]</sup> demonstrated that wrestlers with explosive non-stance leg power performed better in reactive agility tests, showing improved responsiveness in match situations. Chaabene *et al.* (2017) <sup>[5]</sup> found that strong non-stance legs help sustain movement fluidity, allowing wrestlers to transition smoothly between attacks and defences. These findings support the results of the study as a strong correlation between stance and non-stance leg in GR and FS wrestlers and GR wrestlers have more leg explosive strength than FS wrestlers.

#### 5. Conclusion

This study investigated the relationship between the explosive strength of stance and non-stance legs in Greco-Roman and Freestyle wrestlers in the Indian subcontinent. The findings highlight the crucial role of lower-limb explosive strength in wrestling performance, particularly in executing takedowns, defensive manoeuvres, and rapid directional changes. The results demonstrated a significant correlation ( $r = 0.95$ ,  $p = 0.0000$ ) between stance and non-stance leg explosive strength, indicating a synchronized development of lower-limb power in competitive wrestlers. Additionally, Greco-Roman (GR) wrestlers exhibited significantly greater stance leg explosive strength (Mean = 185 cm, SD = 21) compared to Freestyle (FS) wrestlers (Mean = 162 cm, SD = 19), with a t-value of 4.21 ( $p = 0.0001$ ). These differences can be attributed to the distinct biomechanical demands of the two wrestling styles GR wrestling relies more on upper-body techniques and throws, whereas FS wrestling requires greater agility and leg-based attacks. Stance leg explosive strength is a key factor in Greco-Roman wrestling, as it provides stability and force for powerful throws and upper-body dominant techniques. A high correlation between stance and non-stance leg strength suggests that balanced lower-limb strength development is essential for optimal wrestling performance. In conclusion, this study emphasizes the importance of explosive strength in both stance and non-stance legs for wrestling performance. The findings provide scientific evidence to support wrestling-specific training adaptations, helping athletes enhance their power, agility, and defensive capabilities. By implementing



tailored strength training programs, wrestlers can maximize their competitive potential, making lower-limb power a critical determinant of success in both Greco-Roman and Freestyle wrestling.

### Practical Implications

The results of this study offer valuable insights for wrestling coaches, trainers, and sports scientists. Training programs should be designed to enhance explosive power in both legs, ensuring that wrestlers develop the necessary strength for their specific wrestling style.

- For Greco-Roman wrestlers, strength programs should emphasize single-leg stability, isometric holds, and Olympic lifting exercises to enhance stance leg dominance.
- For Freestyle wrestlers, bilateral lower-limb training, agility drills, and plyometric exercises should be prioritized to improve balance, lateral speed, and counterattack capabilities.
- A well-balanced explosive strength training program can improve not only performance but also reduce the risk of injuries, particularly in high-impact movements like takedowns and throws.

### Delimitations of The Study

- The study includes only male wrestlers, excluding gender-based differences in explosive strength analysis.
- Only wrestlers with no recent lower-limb injuries were considered to ensure the accuracy of strength assessments.
- The research does not analyse the long-term effects of specific training programs on lower-limb explosive strength development.
- The study does not explore the impact of psychological or tactical factors on explosive strength performance.

### Future Research Directions

Based on the findings of this study, future research in wrestling biomechanics and strength training should explore the following areas:

1. Longitudinal Studies on Strength Development
2. Gender-Based Differences in Explosive Strength
  - Conduct comparative studies on stance and non-stance leg strength between male and female wrestlers.
  - Examine how hormonal and physiological differences influence lower-limb power development.
3. Injury Prevention and Neuromuscular Adaptations
  - Analyse how stance leg strength contributes to injury prevention, particularly in knee and ankle stability.
  - Examine the role of non-stance leg strength in lateral quickness and counter- movements during wrestling engagements.
4. Cross-Disciplinary Research in Combat Sports
  - Compare the findings of wrestling-specific explosive strength studies with other combat sports such as judo, Brazilian jiu-jitsu, and MMA.
  - Investigate whether training methodologies in one combat sport can be effectively adapted to enhance performance in wrestling

By addressing these research gaps, future studies can provide deeper insights into strength development strategies and contribute to more effective training methodologies in wrestling.

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