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Performance predictors in weightlifting: Insights from national and state-level athletes

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Abstract

The purpose of this study was to investigate the relationship between selected motor fitness components and performance in the two-hand snatch among national and state-level male weightlifters, specifically focusing on athletes from Assam. Thirty weightlifters participated in the study, with 15 representing national-level athletes and 15 representing state-level athletes from various regions of Assam. The selected motor fitness components included explosive leg strength, abdominal strength endurance, grip strength, shoulder flexibility, and spinal flexibility. These components were measured using standardized tests with established reliability. Performance in the two-hand snatch was assessed by certified judges. Each participant performed three attempts, with the best score recorded for analysis. Pearson's product-moment correlation was used to analyze the data, with the significance level set at $p < 0.05$. Results indicated significant positive correlations between all selected motor fitness components and performance in the two-hand snatch. National-level athletes showed superior results across all variables compared to state-level athletes. These findings underscore the importance of targeted training and its role in enhancing weightlifting performance.

Keywords: Explosive leg strength, abdominal strength endurance, grip strength, shoulder flexibility, spinal flexibility, national-level weightlifters, state-level weightlifters, Assam

Introduction

The Olympic snatch, particularly the two-hand snatch, is recognized as one of the most technical and demanding lifts in weightlifting. The movement requires the barbell to be lifted from the ground to a stable overhead position in one continuous motion. The success of this lift hinges on the interplay of several motor fitness components, including explosive power, flexibility, and grip strength (Bompa & Haff, 2010) ^[5]. Weightlifting performance is a reflection of an athlete's physical and motor fitness capabilities, which form the foundation for executing technically complex lifts.

This study focuses on analyzing the relationship between motor fitness components and performance in the two-hand snatch, comparing national and state-level weightlifters from Assam to identify factors contributing to higher performance levels.

Methodology

Participants: Thirty male weightlifters, aged 18 to 26 years, participated in this study. The cohort included 15 national-level and 15 state-level athletes recruited from weightlifting clubs and associations across Assam. Selection criteria required participants to have a minimum of two years of competitive experience and active engagement in training for upcoming competitions. National-level athletes were those who had competed at recognized national events, while state-level athletes had participated in state-level competitions within Assam.

Instrumentation: The study utilized the following standardized tests to evaluate motor fitness components:

- **Explosive Leg Strength:** Assessed using the standing broad jump test, which measures the power output of the lower limbs (Fleck & Kraemer, 2015) ^[6].
- **Abdominal Strength Endurance:** Measured through the bent-knee sit-up test, a reliable indicator of core strength and endurance.
- **Grip Strength:** Evaluated using a handgrip dynamometer, widely accepted for assessing forearm and hand muscle strength (Wilmore & Costill, 2000) ^[9].

- **Shoulder Flexibility:** Measured using a static shoulder flexibility test, essential for assessing the range of motion critical in overhead lifts.
- **Spinal Flexibility:** Assessed using the sit-and-reach test, which evaluates the flexibility of the lower back and hamstrings.

Performance in the two-hand snatch was judged by certified officials according to the International Weightlifting Federation (IWF) standards. Each participant performed three attempts, with the highest successful lift recorded for analysis.

Data Analysis: Pearson's product-moment correlation was employed to determine the relationship between motor fitness components and snatch performance. Independent t-tests were used to compare national and state-level athletes. Statistical significance was set at $p < 0.05$, ensuring robust analysis of the data.

Results and Discussion

Table 1: Descriptive Statistical Analysis of selected motor fitness components

Variable	Group	N	Mean	Standard Deviation (SD)
Explosive Leg Strength	National-Level	15	2.63 m	0.12 m
	State-Level	15	2.31 m	0.15 m
Abdominal Strength	National-Level	15	50 reps	3.5 reps
	State-Level	15	44 reps	4.0 reps
Grip Strength	National-Level	15	58 kg	5.0 kg
	State-Level	15	51 kg	4.5 kg
Shoulder Flexibility	National-Level	15	37 cm	3.2 cm
	State-Level	15	31 cm	3.0 cm
Spinal Flexibility	National-Level	15	21 cm	2.5 cm
	State-Level	15	17 cm	2.8 cm

Table 1 presents the descriptive statistical analysis of selected motor fitness components among national-level and state-level athletes. The results indicate that national-level athletes demonstrated superior performance across all measured components compared to their state-level counterparts.

For explosive leg strength, the national-level group achieved a higher mean distance of 2.63 m (SD = 0.12 m), compared to 2.31 m (SD = 0.15 m) for the state-level group. In abdominal strength, the national-level athletes performed an average of 50 repetitions (SD = 3.5 reps), surpassing the state-level group's mean of 44 repetitions (SD = 4.0 reps). Similarly, grip strength was notably higher in the national-level group, with a mean of 58 kg (SD = 5.0 kg) compared to 51 kg (SD = 4.5 kg) for state-level athletes.

Regarding flexibility, national-level athletes exhibited greater shoulder flexibility, with a mean of 37 cm (SD = 3.2 cm), in contrast to the state-level group's 31 cm (SD = 3.0 cm). Additionally, spinal flexibility was superior in the national-level group, averaging 21 cm (SD = 2.5 cm), while the state-level athletes recorded a mean of 17 cm (SD = 2.8 cm). These findings highlight the enhanced motor fitness capabilities of national-level athletes in all evaluated components.

Table 2: Independent t-Test Comparison between National and State Level Weight Lifters

Variable	National-Level Mean	State-Level Mean	t-value	p-value
Explosive Leg Strength	2.63 m	2.31 m	3.45	<0.05
Abdominal Strength	50 reps	44 reps	4.15	<0.05
Grip Strength	58 kg	51 kg	3.88	<0.05
Shoulder Flexibility	37 cm	31 cm	4.02	<0.05
Spinal Flexibility	21 cm	17 cm	4.50	<0.05

The table summarizes the results of an independent t-test conducted to compare the physical performance of national-level and state-level athletes across various variables. The analysis provides the mean scores for each variable, along with the t-values and p-values, indicating the statistical significance of the differences observed.

For Explosive Leg Strength, national-level athletes exhibited a significantly higher mean of 2.63 meters compared to 2.31 meters for state-level athletes. The t-value of 3.45 and p-value of <0.05 confirm a statistically significant difference, indicating superior leg power among national-level athletes.

In Abdominal Strength, national-level athletes demonstrated greater endurance with a mean of 50 repetitions compared to 44 repetitions for state-level athletes. The t-value of 4.15 and p-value of <0.05 highlight this as a significant difference.

For Grip Strength, the mean score for national-level athletes was 58 kg, significantly higher than the 51 kg mean for state-level athletes. The t-value of 3.88 and p-value of <0.05 indicate that national-level athletes possess stronger grip strength.

In terms of Shoulder Flexibility, national-level athletes had a mean score of 37 cm, compared to 31 cm for state-level athletes. The t-value of 4.02 and p-value of <0.05 confirm a significant difference, suggesting better shoulder flexibility in the national-level group.

Lastly, for Spinal Flexibility, national-level athletes recorded a mean of 21 cm, while state-level athletes achieved 17 cm. The t-value of 4.50 and p-value of <0.05 indicate a highly significant difference, emphasizing greater spinal flexibility among national-level athletes.

Correlation Table: Coefficient of Correlation between Dependent Variable (Two Hand Snatch Performance) and Independent Variables

Table 3: Coefficient of Correlation between Dependent Variable (Two Hand Snatch Performance) and Independent Variables

Variable	Correlation Coefficient (r)	Significance (p-value)
Explosive Leg Strength	0.53	<0.05
Abdominal Strength	0.81	<0.05
Grip Strength	0.49	<0.05
Shoulder Flexibility	0.43	<0.05
Spinal Flexibility	0.85	<0.05

Correlation Analysis: Explosive leg strength demonstrated a moderate positive correlation ($r = 0.53$, $p < 0.05$) with snatch performance, emphasizing the role of lower-limb power in the initial pull phase of the lift. Abdominal strength endurance showed a strong correlation ($r = 0.81$, $p < 0.05$), highlighting its importance in maintaining core stability during the overhead position. Grip strength ($r = 0.49$,

$p < 0.05$) and shoulder flexibility ($r = 0.43$, $p < 0.05$) were also significantly correlated, indicating their relevance in securing and stabilizing the barbell. Spinal flexibility emerged as the most critical component ($r = 0.85$, $p < 0.05$), underscoring the necessity of lumbar mobility for achieving optimal lifting mechanics.

Discussion: National-level athletes consistently outperformed state-level athletes across all variables, reflecting the impact of advanced training programs, better recovery practices, and experience in high-pressure competitions. Flexibility, particularly in the spine and shoulders, played a crucial role in differentiating performance levels. The ability to achieve a stable overhead position without compromising balance or technique was significantly influenced by these flexibility measures (Siff, 2004). Core strength also emerged as a decisive factor, as it supports spinal alignment and contributes to the overall lifting posture.

Conclusion

This study concludes that motor fitness components, including explosive leg strength, abdominal strength endurance, grip strength, shoulder flexibility, and spinal flexibility, are significantly associated with performance in the two-hand snatch. National-level athletes exhibited superior performance across all variables, highlighting the influence of specialized training and competition exposure. Coaches and trainers are encouraged to prioritize flexibility and core stability training, particularly for state-level athletes aspiring to compete at higher levels. These findings reinforce the need for a holistic approach to training, integrating strength, flexibility, and technical skill development.

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