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Comparative Study of Selected Physical Fitness Variables in Junior Level Weightlifters Between the Regional Coaching Center and The National Sports Academy

Tadar Neha[1], Dr. Praloy Kanti Sarkar[*2], Dr. Shyam Sundar Rath [3]

[1]Bachelor of Science in Sports Coaching- viii, Department of Sports Coaching, National Sports University, Imphal, Manipur, India.
[2]Assistant Professor, Department of Sports Coaching, National Sports University, Imphal, Manipur, India.
[3]Associate Professor and HoD, Department of Sports Coaching, National Sports University, Imphal, Manipur, India.

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Abstract: This study compared key physical fitness parameters—including maximum strength, balance, flexibility, and explosive strength—among junior female weightlifters (aged 15–18 years) from India's Regional Coaching Centre (R.C.C.) and National Sports Academy (N.S.A.). We assessed 22 athletes (11 per institution) using standardized tests. Results showed a statistically significant advantage in maximum strength for N.S.A. athletes over their R.C.C. peers ($p < 0.001$). However, balance, flexibility, and explosive strength did not differ meaningfully between groups. These findings imply that while N.S.A.'s training environment may be particularly effective for developing strength, other fitness attributes remain comparable across both settings. The study underscores how institutional approaches shape athlete development and offers actionable insights for refining coaching methodologies and physical training programs in junior weightlifting.

Keywords: Weightlifting, Physical fitness, Maximum strength, Junior athletes, Training environment, National Sports Academy (N.S.A.), Regional Coaching Centre (R.C.C.)

INTRODUCTION

Weightlifting, commonly referred to as Olympic weightlifting, is a prestigious competitive strength sport recognized across the globe. It involves lifting a barbell loaded with weight plates from the ground to overhead in two specific styles—the snatch and the clean and jerk. The snatch is executed in one continuous motion with a wide grip, while the clean and jerk is a two-part movement involving first lifting the bar to the shoulders (clean) and then overhead (jerk). Athletes are allowed three attempts for each lift, and their best successful attempt in each is combined to determine the total score. The sport is contested across different body weight categories, which vary by gender and have evolved over time. Though the sport's official name is "weightlifting," it is often termed "Olympic weightlifting" to differentiate it from other disciplines like powerlifting and bodybuilding. Unlike other strength sports that emphasize raw strength, Olympic lifting emphasizes power, speed, flexibility, and coordination, making it a dynamic test of human performance.

Historical Background of Weightlifting

The roots of weightlifting can be traced to ancient civilizations, where lifting stones or heavy objects was a traditional way of demonstrating strength. Saint Jerome in the 4th century referenced youth in Palestine training with round stones, lifting them to various heights—movements remarkably similar to modern weightlifting techniques. The transition from ancient strength displays to a modern sport began in 19th-century Europe with the formation of strength clubs, particularly in Austria and Germany. The first World Weightlifting Championships took place in London in 1891, and the sport debuted in the modern Olympic Games in 1896. Initially, the competitions featured a mix of one- and two-handed lifts with little regulation.

The International Weightlifting Federation (IWF) was formed in 1920, leading to the standardization of lifts and equipment. By the 1928 Olympics, three two-handed lifts—the snatch, clean and jerk, and clean and press—were officially recognized. However, due to judging difficulties, the clean and press was removed in 1972. Equipment also evolved significantly, especially with the introduction of durable Eleiko bars in 1963 and bumper plates in 1967, improving both safety and performance. Women's weightlifting gained global recognition in the 1980s and was officially included in the Olympics in 2000.

Development of Weightlifting in India

In India, the sport gained momentum with the establishment of the Indian Weightlifting Federation

***Corresponding Author:** Dr. Praloy Kanti Sarkar

(IWLF) in 1935. India made its Olympic weightlifting debut in 1936, and over the years, Indian lifters began participating in international events such as the Asian Games and Commonwealth Games. Early Indian competitions included five weight categories, which were later expanded to accommodate more diverse body types. Indian women entered the international weightlifting arena in 1989, and prominent lifters like N. Kunjarani Devi and Laila Pulley earned medals in their respective categories.

A major milestone was achieved when Saikhom Mirabai Chanu won gold at the 2017 World Championships and subsequently triumphed at the 2018 Commonwealth Games. Her achievements earned her the Padma Shri and Rajiv Gandhi Khel Ratna awards. Similarly, Jeremy Lalrinnunga made history by securing a gold medal at the 2018 Youth Olympic Games. These accomplishments have cemented India's growing reputation in international weightlifting.

Rationale for the Study

Although weightlifting performance is often linked to training regimens, there is limited comparative research on the impact of different institutional training environments, particularly in India. This study aims to bridge that gap by examining physical fitness differences between junior female weightlifters trained at Regional Coaching Centers (R.C.C) and those at the National Sports Academy (N.S.A). Understanding these differences could help refine coaching methods, improve athlete development, and enhance national performance in weightlifting.

Statement of the Problem

The primary problem addressed in this study is the lack of empirical data comparing physical fitness parameters of athletes from different coaching setups. Specifically, the study investigates whether differences exist in maximum strength, balance, flexibility, and explosive strength between junior female weightlifters from R.C.C and N.S.A.

Objectives of the Study

This study is guided by the following objectives:

- To assess and compare selected physical fitness variables between R.C.C and N.S.A junior female weightlifters.
- To identify significant differences in physical performance based on training environments.
- To provide practical recommendations for training practices based on the findings.

Delimitations

- The scope of the study is restricted by the following delimitations:
- It includes only junior female weightlifters aged 15 to 18 years.
- A total of 22 athletes (11 each from R.C.C and N.S.A) participated.

The focus is limited to selected physical fitness variables: maximum strength, balance, flexibility, and explosive strength.

Limitations

This study also recognizes several limitations:

- The psychological state and mood of the participants during testing were beyond the researcher's control.
- Participant motivation levels may have varied during performance.
- Physical variations among athletes could have influenced test results.

Hypothesis

- It is hypothesized that there will be significant differences in physical fitness parameters between R.C.C and N.S.A junior female weightlifters.

Research Questions

The study seeks to answer the following questions:

- What are the differences in physical fitness parameters between R.C.C and N.S.A weightlifters?
- Are there measurable disparities in specific physical fitness variables between the two training environments?
- Which physical fitness variables show the most significant differences?
- Can these physical assessments be used for talent identification among intermediate female lifters?

Explanation of Terms

- Maximum Strength: The greatest amount of force that a muscle or group of muscles can exert in a single effort.
- Balance: The ability to maintain the body's center of gravity within its base of support.
- Flexibility: The capacity of joints and muscles to move through a full range of motion.
- Explosive Strength: The capacity to exert maximal force in minimal time, critical for powerful movements.

Significance of the Study

This study holds value for multiple stakeholders in the field of sports science and coaching. It may help athletes and coaches develop targeted training programs by identifying specific physical fitness strengths and weaknesses associated with different institutional training environments. Furthermore, it can serve as a foundational tool for performance tracking and talent identification, ultimately contributing to the enhancement of India's weightlifting success on global platforms.

METHODOLOGY

Purpose of the Study

This study was undertaken to statistically evaluate and compare the physical fitness levels of junior female weightlifters training at two different institutional

***Corresponding Author:** Dr. Praloy Kanti Sarkar

environments—Regional Coaching Centers (R.C.C) and the National Sports Academy (N.S.A) in Khuman Lampak, Imphal, Manipur. The objective was to analyze and identify significant differences in selected physical fitness parameters, namely maximum strength, balance, flexibility, and explosive strength, between these two groups. The statistical analysis was intended to validate the hypothesis that institutional training environments can influence athletic performance.

Selection of Subjects

The study focused exclusively on junior state-level female weightlifters aged between 15 to 18 years. A total of 22 participants were selected, consisting of 11 weightlifters from the R.C.C and 11 from the N.S.A. The participants were actively training at their respective centers during the time of the study, ensuring uniformity in experience and commitment to competitive weightlifting.

Selection of Physical Fitness Variables

Four key physical fitness parameters were chosen for assessment:

- Maximum Strength
- Balance
- Flexibility
- Explosive Strength

These variables were selected as they are crucial components of performance in Olympic weightlifting and are often used as benchmarks in evaluating athlete readiness and conditioning.

Tools and Tests for Data Collection

Each physical fitness component was assessed using a standardized test recognized for its reliability and validity in sports science research.

Maximum Strength – One Repetition Maximum (1-RM) Bench Press Test

The 1-RM bench press test was administered to measure the subject's maximal strength output of the chest and upper body muscles. Participants underwent a proper warm-up followed by incremental lifts. If the subject successfully lifted the weight using correct form, the load was increased by 5–10% after a 2-minute rest. If unsuccessful, the load was decreased by 2.5–5% after a longer rest. The highest weight lifted successfully with proper technique was recorded as the 1-RM score.

Balance – Flamingo Balance Test

The flamingo balance test was used to assess the participant's ability to maintain balance on a single leg. Subjects stood on a beam without shoes, balancing on one leg while the other leg was flexed at the knee and held close to the buttocks. The stopwatch was started as the examiner let go of the subject's hand. Each loss of balance or fall was counted within 60 seconds. If a subject recorded more than 15 falls within the first 30 seconds, the test was terminated and scored zero. The total number of falls was used as the test score.

Flexibility – Stand and Reach Test

This test measured the flexibility of the lower back and hamstrings. Participants stood barefoot with feet slightly apart and knees straight on a raised platform. They then bent forward slowly without jerking, stretching their arms towards the toes. The farthest point reached by the fingertips was measured using a measuring scale affixed to a flex box. If the participant extended beyond the toes, a positive score was recorded; otherwise, a negative score was given.

Explosive Strength – Countermovement Jump (CMJ) Using Force Plate

Explosive strength was evaluated using the countermovement jump. Participants stood with their feet shoulder-width apart and arms at their sides. After a quick downward movement into a squat, they jumped upward explosively, keeping their posture streamlined. The jump was repeated three times, and the best performance was recorded. The average of the three jump heights, measured using a force plate, was used to calculate the final score for explosive strength.

Data Collection and Statistical Analysis

Once all tests were completed, scores for each fitness variable were recorded for both groups. The collected data were statistically analyzed using IBM SPSS Statistics Version 27. The Shapiro-Wilk test was applied to assess the normal distribution of data across all variables—maximum strength, balance, flexibility, and explosive strength. The results indicated that the data were normally distributed, thereby justifying the use of parametric statistical methods.

To compare the physical fitness parameters between R.C.C and N.S.A athletes, an Independent Samples t-Test was conducted for each variable. This test was selected to determine whether there were statistically significant differences in mean scores between the two groups. A significance level of $p < 0.05$ was used as the threshold for determining meaningful differences between the training centers.

Analysis and results

The Shapiro Wilk test was conducted to report the normal distribution of data. The variables, maximum Strength N.S.A p=.318 and RCC p=.137, total balance N.S.A p=.403 and R.C.C p=.578, stand and reach N.S.A p=.516 and R.C.C p=.110, explosive strength test R.C.C p=.717 and N.S.A p=.202

***Corresponding Author:** Dr. Praloy Kanti Sarkar

Table 1: Descriptive statistics

Subscales	Group	N	Mean	Std. Deviation	Std. Error Mean
Strength	NSA	11	45.91	6.65	1.97
	RCC	11	32.27	5.49	1.65
Total Balance	NSA	11	9.82	5.91	1.78
	RCC	11	7.64	4.73	1.42
Stand and Reach	NSA	11	18.90	4.36	1.31
	RCC	11	19.97	5.34	1.61
Lower body explosive strength	NSA	11	.25	.48	.01
	RCC	11	.24	.03	.01

The Table 1 shows the descriptive statistics of the defined subscales. The mean and standard deviation of the subscales are reported in the table. In maximum strength it was observed that R.C.C (32.27 ± 5.49) scored less than N.S.A (45.91 ± 6.65). N.S.A (9.82 ± 5.91) scored higher than R.C.C (7.64 ± 4.73) in total balance subscale. For Stand and Reach test, R.C.C (19.97 ± 5.34) scored higher than N.S.A (18.90 ± 4.36). In lower body explosive strength subscale, R.C.C (.24 ± .03) scored less than N.S.A (.25 ±.48).

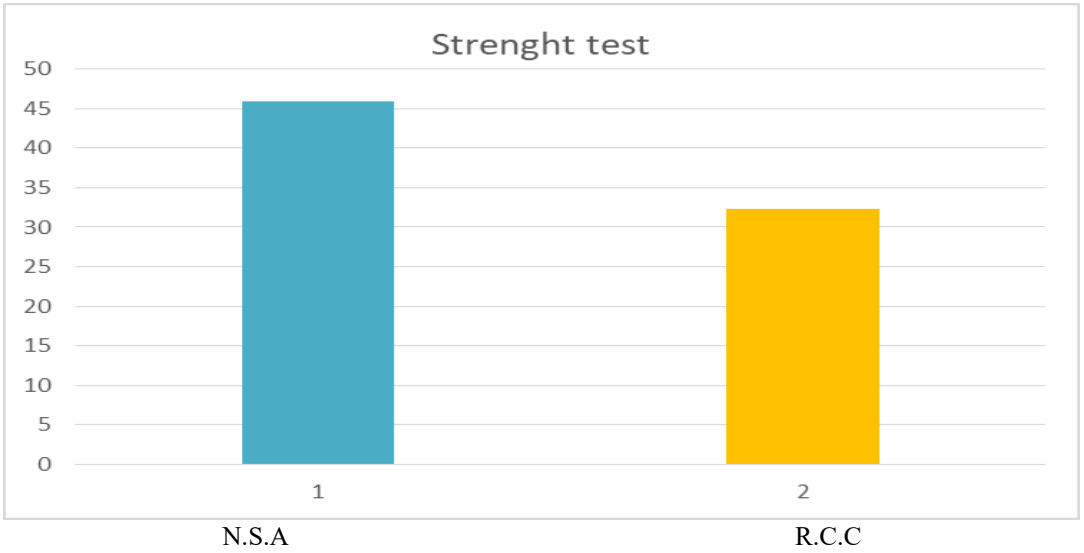

Figure 1: - The graphical representation shows that the Maximum Strength of N.S.A is 45.9 and R.C.C is 32.27 where there significant difference between the two groups.

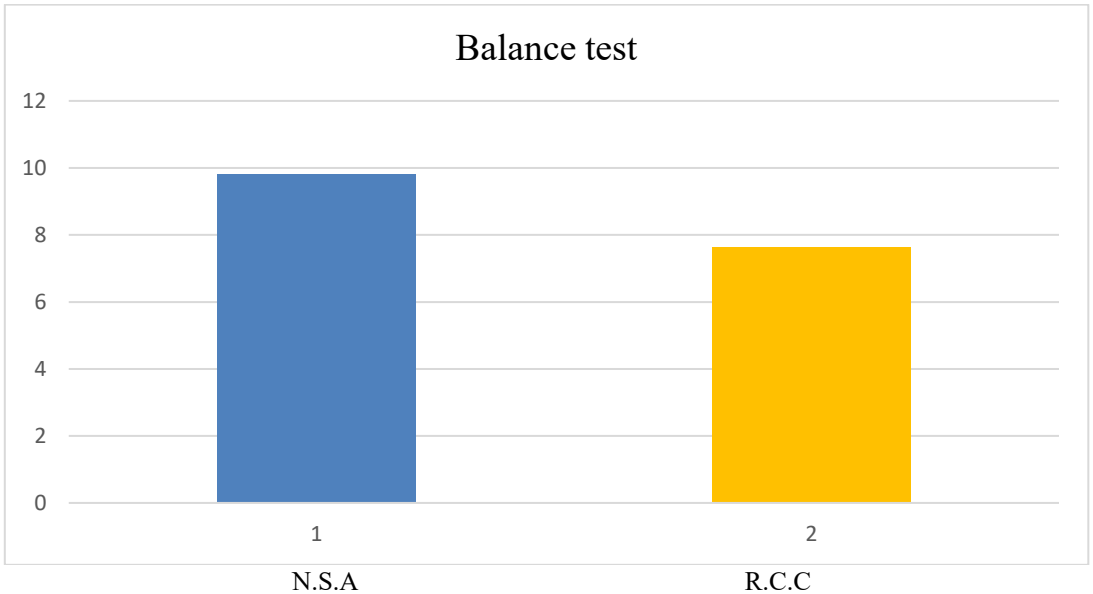

Figure 2:- The graphical representation shows that the balance test of N.S.A is 9.82 and R.C.C is 7.64 which is very nominal. Due to the time of the taken is very short period. The duration is only two weeks.

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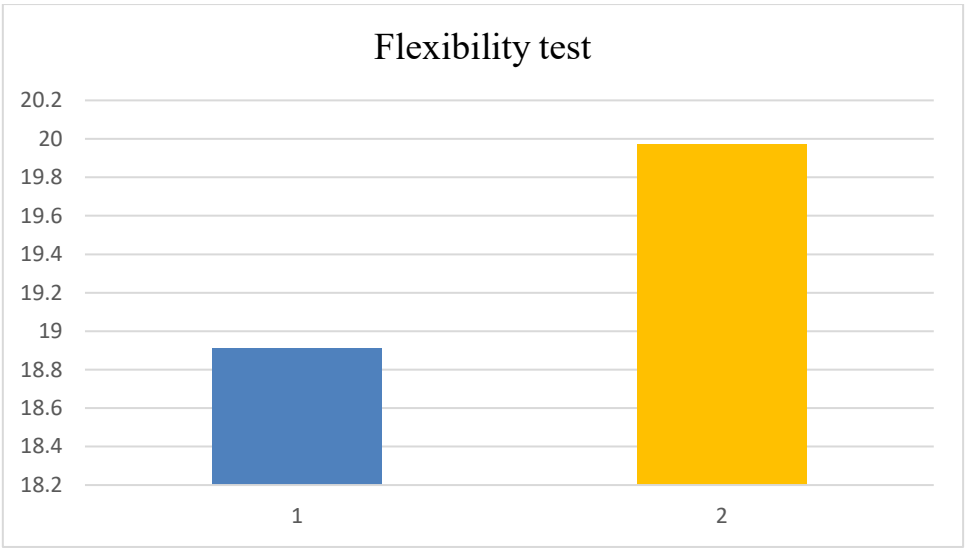

Figure 3: The graphical representation shows that the flexibility test of N.S.A is 18.9 and R.C.C is 19.97 which is very nominal. Due to the time of the taken is very short period. The duration is only two weeks.

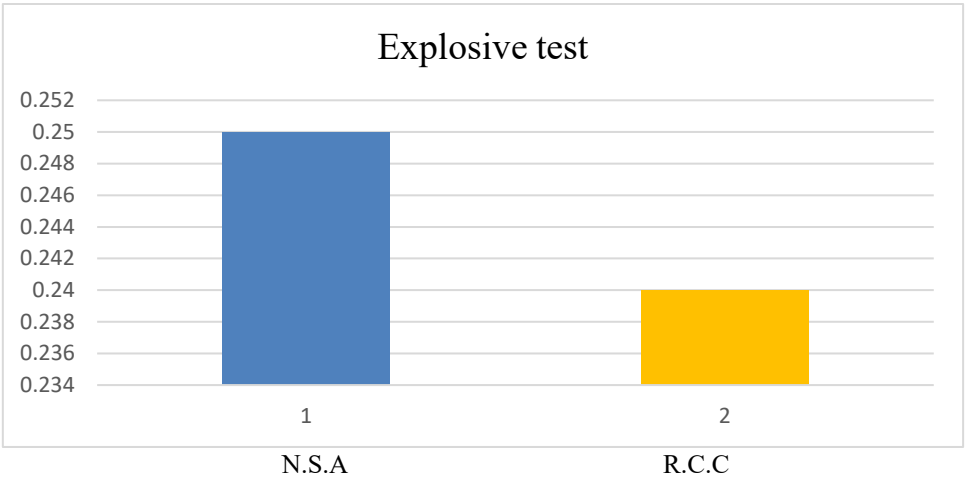

Figure 4: The graphical representation shows that the explosive strength test of N.S.A is 0.25 and R.C.C is 0.24 which is very nominal. Due to the time of the taken is very short period. The duration is only two weeks.

Table 2: Independent t- test

Subscales	N	t	Sig.(2-tailed)
Maximum Strength test	11	5.282*	<.001
Total balance	11	.955	.351
Stand and Reach	11	-.511	.615
Lower body explosive strength	11	.835	.414

*$t_{0.05}$ (20) = 2.086

Table: 2 reports independent t test between the two groups. Maximum Strength test (t = 5.282, p<.001) reported significant difference.

DISCUSSION

At the beginning of the researcher had formulate the hypothesis that there will be significant differences in selected physical fitness variables such as Maximum strength, balance, stand and reach, lower body explosive strength between Regional Coaching Center (R.C.C) and National Sports Academy (N.S.A) weightlifters. The findings of the study were similar to the hypothesis. So, the researcher hypothesis was accepted. It was hypothesized that there will be significant difference in physical fitness variables between the weight lifting players from Regional Coaching Center (R.C.C) and National Sports Academy (N.S.A) weightlifters.

The findings from Tables 1 and 2 provide insights into the performance differences between the

***Corresponding Author:** Dr. Praloy Kanti Sarkar

two groups N.S.A and R.C.C across four physical fitness subscales: maximum strength, total balance, stand and reach, and lower body explosive strength.

1. Maximum Strength:

A significant difference was observed between the two groups ($t = 5.282$, $p < .001$). N.S.A (Mean = 45.91) significantly outperformed R.C.C (Mean = 32.27), indicating that N.S.A participants had considerably higher strength levels. This result is statistically significant, as the t-value exceeds the critical value (2.086), suggesting that the observed difference is unlikely due to chance.

2. Total Balance:

Although N.S.A had a higher mean score (9.82) compared to R.C.C (7.64), the difference was not statistically significant ($t = 0.955$, $p = .351$). This implies that both groups performed similarly in balance ability, and the slight difference may be due to natural variation rather than a real effect.

3. Stand and Reach:

R.C.C scored slightly higher (19.97) than N.S.A (18.90), but the t-test ($t = -0.511$, $p = .615$) shows no significant difference. This suggests flexibility levels between the groups were comparable.

4. Explosive Strength:

The mean scores were very close (N.S.A = .25, R.C.C = .24), and the statistical test ($t = 0.835$, $p = .414$) indicated no significant difference. This shows both groups had similar levels of lower body explosive power.

CONCLUSION

This study aims to compare selected physical fitness variables among junior state-level weightlifters from two organizations: the National Sports Academy (N.S.A) and the Regional Coaching Centre (R.C.C). The focus is on understanding how these athletes differ in terms of their physical fitness, which can impact their performance in weightlifting. The comparative study highlighted significant differences in physical fitness variables among junior state-level weightlifters from N.S.A and R.C.C. These findings suggest that training approaches, coaching styles, and environmental factors play a crucial role in developing specific physical attributes essential for successful weightlifting. Recommendations for future training programs include adopting best practices from both institutions to enhance overall athlete performance. This research can inform coaches and trainers about effective training strategies tailored to improve the physical fitness of weightlifters at the junior level. Further studies are suggested to explore long-term impacts of different training methodologies on performance outcomes.

The analysis revealed a statistically significant difference in strength between the N.S.A and R.C.C groups, with N.S.A showing superior performance. However, no significant differences were found between the groups in total balance, stand and reach, or lower body explosive strength, suggesting comparable abilities in these areas. Overall, the results indicate that while N.S.A participants demonstrated significantly greater strength, both groups performed similarly in other physical fitness components.

RECOMMENDATION

Based on the analysis of the data, here are some recommendations:

- Implement targeted strength training programs for the R.C.C group to improve their strength performance, as they currently lag behind the N.S.A group.
- Design and make balance-focused exercises or activities into both groups' training plans, as the N.S.A group's advantage in balance was not statistically significant.
- Flexibility and stretching routines for the N.S.A group to enhance their stand and reach scores, addressing the lower performance in this area compared to the R.C.C group.
- Assess and refine training methods for lower body explosive strength in both groups, considering that both groups showed similar performance levels. This could involve plyometric exercises or sport-specific drills.

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***Corresponding Author:** Dr. Praloy Kanti Sarkar

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***Corresponding Author:** Dr. Praloy Kanti Sarkar