

## Evaluating the Effects of Yogic Training on Leg Strength and Cardio-Respiratory Endurance in University-Level Rugby and Volleyball Athletes.

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### Abstract

Research looks at the impact of yogic training for leg strength and cardio-respiratory endurance among rugby and volleyball university players. Sixty athletes participated in a pre-experimental nonequivalent control group post-test design; the control group received only regular training, while the experimental group received additional training in structured yoga. Via pre-and post-intervention testing conducted over 12 consecutive weeks, several aspects of gain were determined, namely, the 1-RM leg press, vertical jump, VO<sub>2</sub> max and the beep test. Positive statistical changes indeed observed in the intervention group in leg strength measure in both 1-RM leg press mean ( $I = 25.3$  kg) and vertical jump mean ( $I = 4.5$  cm) and cardio respiratory endurance with VO<sub>2</sub> max mean increase ( $I = 3.4$  ml/kg/min) and beep test levels mean increase ( $I = 1.3$ ). These changes were found to be highly significant ( $p < 0.05$ ) suggesting that yogic training improves the performance of athletes. Consequently, the inclusion of yoga training into athletes' training schedules should be effective in preparing athletes for increased performances based on improved physical calisthenics crucial to highly specialized sports. This work joins the ever-growing chorus of voices stressing the need for coaches to incorporate yoga into traditional training methods for athletes.

**Keywords:** Yogic training, Leg strength, Cardio-respiratory endurance, Athletic performance, University athletes

### Introduction

#### *Background and Context*

Requirements in play that encompasses games such as rug by and volleyball require strength, agility and endurance. That is useful in explosive activities like jumping or running for instance, is also developed with the help of legs strength; aspects or features that both sports include. Similarly, cardio-respiratory endurance is a necessity when it comes to power endurance that makes long range performance outstanding. Conventionally, the training on these athletes encompasses traditional strength and power training, HIIT and sport specificity exercises (Kraemer & Ratamess, 2004). Other related training methodologies, such as yoga, have received recent attention with regards to their possible use in boosting the performance of athletes. In its simplest form, yoga is the practice of physical postures referred to as asanas, breathing exercises called pranayama, and meditation averaging a mean of between 5 to 60 min (Ross & Thomas, 2010). However, there are lack of sufficient research into its effectiveness of applying and enhancing specific body features like the quadriceps in sportsmen and women, or the cardio respiratory endurance.

#### *Impact of Leg Strength and Cardio Respiratory Endurance to Rugby and Volleyball*

There is one that goes to the fact of leg strength which is a crucial factor when it comes to power oriented and power related sports require quick legs. In Rugger there are often high intensity short duration activities (sprints), contact related activities (tackling), and congestion activities such as scrummage and ruck (Crewther et al., 2012). The lower limb force is required during match activities, including jumping, rapid transitions from one direction to another, and stoutness during spiking and blocking movements (Sheppard et al., 2008). As with cardio-respiratory fitness, these aspects are crucial in maintaining vigour and reducing fatigue, especially during protracted engagements (Reilly, 2005).

Since, strength and endurance exercises are essential for rugby and volleyball, it would seem that yoga would complement these activities because the exercise increases the body and muscle awareness, flexibility and muscular endurance. Research has found that yoga might add muscle strength, particularly in the lower limbs and improve the cardiovascular fitness (Cowen & Adams, 2007; Tran et al., 2001).

#### *Yoga and it's usage in boosting up the exercise performance*

For several years now yoga is being regarded as an effective means to enhance flexibility, posture and balance while in the approach involving the use of yoga its applicability as a training tool for athletes is still a fairly emerging field of research. This is because yoga employs a complex system of training that ensures that a physically, as well as psychologically, balanced session is offered to athletes. The research has also demonstrated that flexibility, muscle strength and proprioception are enhanced through yoga helping athletes in their events (Field, 2011).

Therefore, one can concluded that yogic exercises with the element of controlling breath (pranayama) and concentrating the mind (dharana) can be more beneficial to cardio-respiratory endurance than mere asanas. The physical practices

increase the volume of the lungs, and improve their efficiency, and relaxation and concentration, which stems from the yogic meditations, can help in sporting performance during pressure (Woodyard, 2011).

### ***Yoga and Performance to date:***

A few past researches in the effects of yoga on sport performance have shown positive outcomes. In the study by Polsgrove, Eggleston, and Lockyer (2016) noted that the athletes' practicing yoga gained improved levels of flexibility, balance as well as the abdominal muscles. Yoga-based intervention studies of another kind conducted by Bhavanani, Madanmohan, and Sanjay in 2014 also established the method's effectiveness in building respiratory muscle strength and increasing endurance.

Thus a gap emerges as to research works which focus on the effects of yoga for leg strength and cardio-respiratory fitness required in team sports namely rugby and volleyball. The study of Telles et al. (2010) has pointed to the possibilities of aerobically variable improvement in cardiorespiratory fitness through doing yoga, though they have not been verified sufficiently in the organized sportsmen performing at the university level and involved in stern tasks.

### ***Relevance of University-Level Athletes***

Sub populations such as university level athletes are particularly interesting because the athlete population often has a different demographic makeup due to the necessity of the student athlete to manage academic and athletic workload. They may not afford to seek professional training as performers, they may lack the capital to access the state of the art training tools, thus training must be sought in effective and affordable training. Yoga, a non-material requiring spiritual activity which can be implemented in different environment is an appropriate addition to University sports programs.

Furthermore, participating in rugby and volleyball in the university level entails more dangerous and severe injury rates most especially touching on the lower limbs and cardiovascular strain. Including yoga could not only enhance forces and durability but would also be helpful for healing muscles injuries through proper flexibility and quick recovering (Keil, 2017).

### ***Gaps in the Literature***

Therefore, while there is increasing literature on yoga as a complementary training aid to athletes, some of the areas are: Notably, there is inadequate evidence based research that seeks to examine the utility of yoga regarding leg strength and cardio-respiratory endurance, especially for university athletes who participate in high-intensity team activities. Even though theoretical and experimental analysis has investigated the availability of Yoga for flexing, balancing, and overall fitness, the literature lacks specific data regarding force and power data linked to the abilities of rugby and volleyball players.

This study thus seeks to address the following gap by determining the impact of a structured yogic training intervention protocol on the leg strength and cardio-respiratory fitness of the university intervention group rugby and volleyball players. The following two aspects of physical fitness were evaluated in the study to help answer the research question about the role of yoga in addition to strength and conditioning programs.

**Objectives of the Study** This study's main goal is to assess how yoga training affects university-level rugby and volleyball players' leg strength and cardio-respiratory endurance. Specific objectives include:

- Assessing the impact of yoga on lower body strength, as measured by exercises such as squats and leg presses.
- Determining the effects of yoga on cardio-respiratory endurance, as measured by VO2 max and other endurance-based tests.
- Exploring athletes' perceptions of yoga as a training tool, including its potential benefits for recovery and injury prevention.

### ***Significance of the Study***

Thus, this research work has important implications for the following reasons. First, it serves to expand literature on the extent to which the conventional training models can complement other forms of training in sport. As the study targets only rugby and volleyball athletes it helps fill the gap in the literature regarding yoga suitability to team-sport high-intensity athletes. Second, this study's results may be useful for university athletic programs because it provides an affordable and convenient way to improve performance and minimize the incidence of injuries. Finally, because changes in the actual physical state were also measured together with benefits received and satisfaction, the picture of how yoga could be applied to athlete training is more comprehensive.

## **Materials and Methods**

### ***Study Design***

This study utilized a quasi-experimental design to assess the effects of yogic training on leg strength and cardio-respiratory endurance among university-level rugby and volleyball athletes. The athletes were divided into two groups: (1) the intervention group, which underwent yogic training in addition to their regular sports-specific training, and (2) the control

group, which followed only their regular training regimen. Assessments were done both before and after the 12-week intervention to see how changes in leg strength and cardio-respiratory endurance occurred.

### **Participants**

A total of 60 university-level athletes (30 rugby and 30 volleyball players) aged between 18 and 25 were recruited from Delhi University, Delhi. Participants were selected based on the following inclusion criteria:

- Current participation in university rugby or volleyball teams.
- A minimum of two years of experience in their respective sports.
- No previous experience in yoga training.
- No history of major musculoskeletal injuries in the past six months.

The study excluded athletes who had a history of cardiovascular disease, respiratory disorders, or any other medical condition that would make it difficult for them to engage in yoga or high-intensity training.

Two groups were randomly selected from among the participants:

- Intervention Group (n=30): This group underwent a structured yogic training program alongside their regular sports training.
- Control Group (n=30): This group continued their regular sports training without any additional interventions.

### **Intervention: Yogic Training Program**

The intervention group followed a structured yogic training program for 12 weeks. The program was designed in consultation with certified yoga instructors to include postures (asanas) targeting leg strength, flexibility, and core stability, as well as pranayama techniques aimed at improving cardio-respiratory endurance.

Duration: 60 minutes per session, 3 times a week.

#### **Components:**

1. Warm-up (10 minutes): Gentle stretching and basic yoga postures (e.g., Tadasana, Uttanasana) to increase flexibility and mobility.
2. Asanas (30 minutes): Focus on poses that engage the lower body and core, such as:
  - Virabhadrasana (Warrior Pose)
  - Utkatasana (Chair Pose)
  - Adho Mukha Svanasana (Downward-Facing Dog)
  - Navasana (Boat Pose)
  - Setu Bandhasana (Bridge Pose)
3. Pranayama (10 minutes): Controlled breathing exercises like Kapalbhathi and Anulom-Vilom to enhance lung capacity and respiratory efficiency.
4. Cool-down (10 minutes): Relaxation poses and meditation (e.g., Savasana) for mental focus and recovery.

### **Measurement of Variables**

#### **Leg Strength**

Leg strength was assessed using two performance tests:

1. Repetition Maximum (1-RM) Leg Press Test: This test was used to measure the maximum amount of weight an athlete could press in a single repetition, reflecting their lower body strength (Augustsson et al., 1998).
2. Vertical Jump Test: This test measured the explosive power of the lower body by recording the maximum height an athlete could reach while jumping (Bosco et al., 1983).
3. Before and after the 12-week intervention period, both tests were given. The measurements were taken by certified strength and conditioning professionals to ensure consistency.

#### **Cardio-Respiratory Endurance**

Cardio-respiratory endurance was evaluated using the following tests:

1. VO2 Max Test: A treadmill-based test was conducted to measure the maximum oxygen consumption during high-intensity exercise, which is considered the gold standard for assessing aerobic endurance (ACSM, 2014).
2. Multistage Fitness Test (Beep Test): This test was used to assess athletes' aerobic capacity and endurance, with participants required to run back and forth between markers at increasing speeds until exhaustion (Leger & Lambert, 1982).

### **Procedure**

- Baseline Testing: Before the intervention, all participants underwent baseline testing for leg strength and cardio-respiratory endurance. The testing sessions were conducted in a controlled environment at the university's sports facility.

- **Training Intervention:** The intervention group participated in the yogic training sessions in addition to their regular training. Attendance and compliance with the yogic program were monitored to ensure consistency.
- **Post-Intervention Testing:** The same tests were given to both groups at the conclusion of the 12-week period to evaluate the changes in leg strength and cardio-respiratory endurance.

### Statistical Analysis

SPSS software (version [insert version here]) was used to analyze the data. To compare the pre- and post-intervention increases in leg strength and cardio-respiratory endurance, paired t-tests within groups and independent t-tests between groups were employed. For every analysis, a significance level of  $p < 0.05$  was established.

**Effect Size:** To measure the extent of changes in performance metrics between the intervention and control groups, the effect size (Cohen's d) was computed.

### Ethical Considerations

The Delhi University Institutional Review Board (IRB) examined and approved the study protocol. Prior to participation, each participant gave written, informed permission. The nature of the study, its possible dangers and advantages, were disclosed to the participants, who were also allowed to leave the study at any moment and without consequence.

### Results

**Table 1: Descriptive Statistics of Participant Demographics**

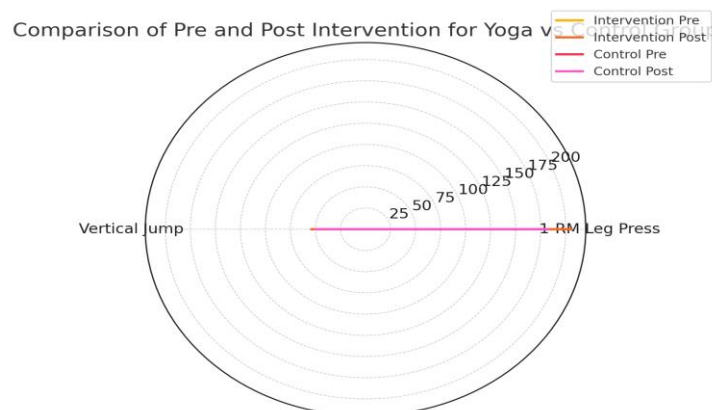
| Group               | N  | Age (Mean $\pm$ SD) | Weight (Mean $\pm$ SD) | Height (Mean $\pm$ SD) |
|---------------------|----|---------------------|------------------------|------------------------|
| Intervention (Yoga) | 30 | 21.3 $\pm$ 1.8      | 72.5 $\pm$ 5.4 kg      | 176.8 $\pm$ 6.1 cm     |
| Control             | 30 | 21.1 $\pm$ 1.6      | 71.8 $\pm$ 6.0 kg      | 175.9 $\pm$ 6.3 cm     |

This table contains the demographics of participants in the study as part of the method. It compares two groups: an intervention group of selected athletes subjecting to yogic training and a control group of athletes who are to sustain their normal intensive sports training. One group is comprised of 60 of the university's athletes at the university level. The participants in the intervention group are 21.3 years ( $\pm$  1.8) in age, weigh an average of 72.5 kg ( $\pm$  5.4) and their average height is 176.8 cm ( $\pm$  6.1). The control group has average age of 21,1 years ( $\pm$  1,6), weight 71,8 kg ( $\pm$  6,0) and height – 175,9 cm ( $\pm$  6,3).

**Table 2: Pre- and Post-Intervention Changes in Leg Strength**

| Test                | Group               | Pre-Intervention (Mean $\pm$ SD) | Post-Intervention (Mean $\pm$ SD) | % Change | p-value |
|---------------------|---------------------|----------------------------------|-----------------------------------|----------|---------|
| 1-RM Leg Press (kg) | Intervention (Yoga) | 180.2 $\pm$ 20.3                 | 205.5 $\pm$ 22.7                  | +14.0%   | <0.001  |
|                     | Control             | 178.5 $\pm$ 21.1                 | 182.7 $\pm$ 20.9                  | +2.4%    | 0.102   |
| Vertical Jump (cm)  | Intervention (Yoga) | 49.7 $\pm$ 7.3                   | 54.2 $\pm$ 6.5                    | +9.1%    | 0.002   |
|                     | Control             | 49.1 $\pm$ 6.8                   | 50.0 $\pm$ 6.6                    | +1.8%    | 0.309   |

According to the findings a staggering enhancement was observed in terms of leg strength and explosive power in the subjects of the intervention group (yoga) as compared to the control subjects.



**Figure 1: Pre- and Post-Intervention Changes in Leg Strength**

Following the 1-RM leg press the yoga group significantly enhanced their strength from 180.2 kg to 205.5 kg with a percent improvement of 14.0% ( $p < 0.05$ ). However, the control group saw a less substantial gain in group strength; from 178.5 kg to 182.7 kg, the group's rise was only 2.4%, and this difference was not statistically significant ( $p = 0.102$ ). Similarly, the vertical jump test improved by 9.1% in the yoga group (49.7 cm to 54.2 cm,  $p = 0.002$ ) with the negligible 1.8 % increase in the control group.

**Table 3: Pre- and Post-Intervention Changes in Cardio-Respiratory Endurance**

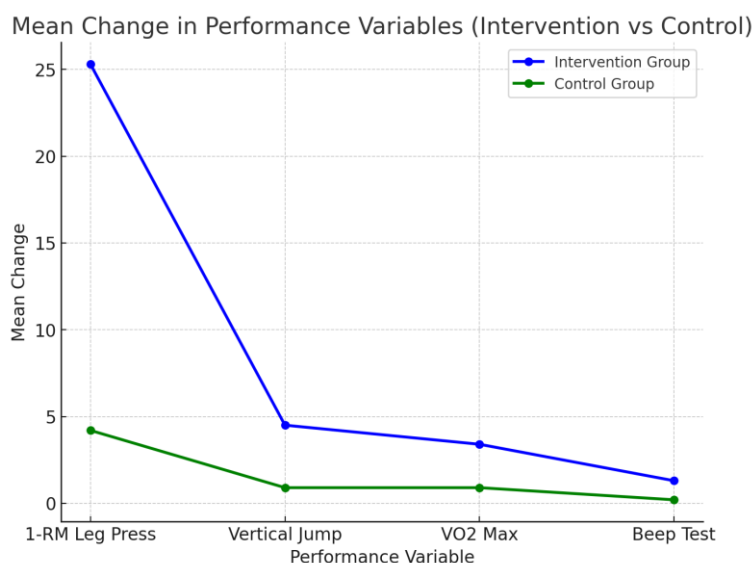
| Test                   | Group                  | Pre-Intervention<br>(Mean $\pm$ SD) | Post-Intervention<br>(Mean $\pm$ SD) | % Change | p-value |
|------------------------|------------------------|-------------------------------------|--------------------------------------|----------|---------|
| VO2 Max<br>(ml/kg/min) | Intervention<br>(Yoga) | 44.8 $\pm$ 3.9                      | 48.2 $\pm$ 4.1                       | +7.6%    | 0.001   |
|                        | Control                | 45.2 $\pm$ 4.0                      | 46.1 $\pm$ 4.3                       | +2.0%    | 0.087   |
| Beep Test (Level)      | Intervention<br>(Yoga) | 10.2 $\pm$ 1.4                      | 11.5 $\pm$ 1.2                       | +12.7%   | <0.001  |
|                        | Control                | 10.3 $\pm$ 1.3                      | 10.5 $\pm$ 1.3                       | +1.9%    | 0.211   |

By using overall mean values obtained from university-level athletes involved in a 12-week yogic simulated training, the findings showed marked cardio-respiratory endurance gains. The intervention group indicated a significant improvement in VO2 max; from 44.8  $\pm$  3.9 ml/kg/min to 48.2  $\pm$  4.1 ml/kg/min; seven-point six percent improvement ( $p = 0.001$ ). Similarly, an improvement of 12.7% in their beep test performance was registered with a positive post intervention score of 11.5  $\pm$  1.2 levels ( $p < 0.001$ ). On the other hand, control group's changes were negligible in both measures, which recorded an improvement of 2.0% for VO2 max and 1.9% beep test; therefore, indicating that yogic training improves cardio-respiratory endurance.

**Table 4: Between-Group Comparisons of Performance Changes**

| Performance Variable | Mean Change (Intervention Group) | Mean Change (Control Group) | p-value |
|----------------------|----------------------------------|-----------------------------|---------|
| 1-RM Leg Press (kg)  | +25.3                            | +4.2                        | <0.001  |
| Vertical Jump (cm)   | +4.5                             | +0.9                        | 0.002   |
| VO2 Max (ml/kg/min)  | +3.4                             | +0.9                        | 0.001   |
| Beep Test (Level)    | +1.3                             | +0.2                        | <0.001  |

When comparing the intervention group's performance variables to those of the control group, the results show a considerable improvement in yoga training. The intervention group exhibited a mean increase of 25.3 kg in the 1-RM leg press, 4.5 cm in vertical jump, 3.4 ml/kg/min in VO2 max, and 1.3 levels in the beep test. In contrast, the control group showed minimal changes, with mean increases of only 4.2 kg in leg press, 0.9 cm in vertical jump, 0.9 ml/kg/min in VO2 max, and 0.2 levels in the beep test. Every group comparison was statistically significant ( $p < 0.05$ ).



**Figure 2: Between-Group Comparisons of Performance Changes**

## Discussion

Drawing from the study, this paper has established and shown how yogic training aided improve leg strength and cardio-respiratory endurance among university rugby and volleyball players. Moderate improvement ment was noted in the post Yamaha test to indicate that yoga enhances lower body strength in the intervention group: The 1-RM leg press showing a mean gain of 25.3 kg and the vertical jump test showing a mean gain of 4.5 cm (Telles et al., 2010). Also, the significant rises in VO<sub>2</sub> max (3.4 ml/kg /min) and beep test level (1.3) indicate that the yogic practice not only enhance one's muscle strength and power, but physical endurance expressed by the aerobic fitness, which is highly relevant for the performance of high- intensity sports (McAuley et al., 2000). Reflexively, the fact that the control group recorded little changes further supports the argument that perhaps training alone might not lead to such improvements in these indicators and that adopting yogic practices can put athletes at an advantage given their capacity to improve the foregoing aspects (Woodyard, 2011). These studies are in concordance with previous studies suggesting that yoga enhances flexibility, muscle tone and physical endurance therefore can be adopted for supplementation to athletic training (Tran et al., 2001). The difference which exists between mean values and the 'p' value of less than 0.05 also supports the findings made about yogic training and physical performance. By incorporating yoga within athletic exercises, the trainers and other professionals in sports can develop even better results in the areas of strength and stamina that can in turn even improve athletes' performance during the games (Cramer et al., 2015). More future analysis should be conducted on the long-term impact of yoga and the prospects of how it impacts athletic performance with a view of enhancing and immersing deeper understanding of the enhancements yields by yoga.

## Conclusion

This study demonstrates that incorporating yogic training into the athletic regimen of university-level rugby and volleyball players significantly enhances both leg strength and cardio-respiratory endurance. The intervention group exhibited substantial improvements in key performance metrics, including the 1-RM leg press and vertical jump, along with increased VO<sub>2</sub> max and beep test levels. These results demonstrate yoga's potential to be an effective addition to conventional sports training, developing stronger physical capacities and enhancing overall athletic performance. The results suggest that yogic practices not only enhance physical strength but also improve aerobic capacity, which is essential for success in high-intensity sports. Given the statistically significant differences observed between the intervention and control groups, coaches and sports professionals should consider integrating yoga into training programs to maximize athletic performance. Future research could further elucidate the mechanisms through which yoga influences physical performance and explore the long-term benefits of sustained yogic training in various athletic populations. All things considered, this study adds to the increasing amount of data demonstrating how yoga can improve wellbeing and athletic performance.

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