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# Effect of Strength Training on Physiological Variables in Hockey Players

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**Abstract-** This study investigates the impact of strength training on selected physiological variables in male field hockey players. A group of 30 university-level hockey players were purposely selected from the Jiwaji University Gwalior with aged range between 18 to 24 years were gone through an 8-week strength training program (thrice in a week). Physiological variables measured included muscular strength, $VO_2$ max, body composition, and anaerobic power. Pre- and post-training assessments were analyzed using paired T-tests. Results indicated significant improvements in muscular strength, $VO_2$ max, and anaerobic power, with a decrease in body fat percentage. The study concludes that strength training can be a vital component in enhancing physiological performance in hockey players.

**Keywords-** Hockey, Strength Training, Muscular Strength, VO2 max, Body Composition, Anaerobic Power.

## I. Introduction

Field hockey is a fast-paced, high-intensity intermittent team sport that demands a well-developed combination of aerobic endurance, anaerobic capacity, muscular strength, speed, agility, and coordination. Players are required to perform repeated sprints, rapid directional changes, powerful stick work, and sustained running throughout match play. These multifaceted physical demands place considerable stress on the physiological systems of athletes, making systematic physical conditioning an essential component of modern hockey training programs. Among various conditioning modalities, strength training has emerged as a cornerstone for enhancing overall athletic performance and reducing the risk of injury.

Strength training induces a range of physiological adaptations, including increased muscle cross-sectional area, improved neuromuscular coordination, enhanced force production, and greater muscular endurance. In the context of field hockey, these adaptations contribute to improved sprint acceleration, stronger tackles, more powerful shots, and greater resistance to fatigue during prolonged match play. Furthermore, structured strength training programs have been shown to positively influence key physiological variables such as maximal strength, anaerobic power, aerobic efficiency, body composition, and recovery capacity, all of which are critical determinants of competitive performance in hockey players.

Despite the growing recognition of strength training in hockey conditioning, limited empirical research has systematically examined its specific effects on physiological variables among university-level players, particularly within controlled experimental designs. University athletes represent a crucial developmental stage where targeted training interventions can significantly influence long-term performance outcomes. Therefore, the present study seeks to investigate the effect of a structured strength training program on selected physiological variables in university-level male hockey players. The findings of this study are expected to provide valuable insights for coaches, trainers, and sports scientists in designing evidence-based strength training protocols tailored to the physiological demands of competitive field hockey.

Field hockey is a high-intensity intermittent sport requiring a combination of aerobic and anaerobic endurance, strength, agility, and speed. Physiological conditioning, especially strength training, plays a crucial role in improving performance. Strength training enhances muscle hypertrophy, power output, and recovery, contributing significantly to match-play efficiency. This study aims to examine the effect of a structured strength training program on key physiological parameters in university-level male hockey players.

## II. Review of Literature

Previous studies have shown that strength training improves athletic performance in various sports. Hoff et al. (2002) reported increased $VO_2$ max and anaerobic power in soccer players following strength training. Similarly, Singh et al. (2016) demonstrated improved body composition and muscular endurance in Indian field hockey players.
Several additional studies further strengthen the evidence supporting the role of strength training in improving physiological and performance-related outcomes in team sport athletes.

Wisloff et al. (2004) demonstrated that maximal strength training significantly enhanced sprint speed, jumping ability, and running economy in elite soccer players, indicating that increased lower-body strength positively influences both explosive and endurance-based actions. Similarly, Chelly et al. (2010) reported improvements in muscular power and repeated sprint ability among handball players following an in-season strength training program.

In ice hockey, which shares comparable intermittent and high-intensity demands with field hockey, Hermassi et al. (2011) observed significant gains in anaerobic power, upper-body strength, and throwing velocity after resistance training, highlighting sport-specific transfer effects. Faigenbaum et al. (2009) also emphasized that well-designed strength training programs improve muscular endurance, body composition, and neuromuscular efficiency without negatively affecting flexibility or speed.

Furthermore, Kumar and Kumar (2018) reported enhanced agility, speed, and lean body mass in Indian collegiate athletes following an 8-week strength training intervention. Collectively, these findings reinforce the effectiveness of strength training as a vital conditioning component and underscore the necessity of sport-specific research in field hockey, thereby justifying the present investigation.

## III. Methodology

**Selection of participants**

For the further study 30 male field hockey players were selected purposely from the Jiwaji University Gwalior, aged between 18–24 years. All participants had at least 2 years of playing experience and no recent injuries.

**Training Protocol:**

Participants underwent an 8-week strength training program, 3 days a week, focusing on compound lifts (squats, deadlifts, bench press), plyometrics, and core stability exercises.

**Selection of variables:**
For the purpose of the study following independent variables selected are mentioned below:

1. Muscular Strength: Measured via 1-repetition maximum (1RM) in bench press and squats.
2. $VO_2$ Max: Estimated using the Yo-Yo Intermittent Recovery Test.
3. Anaerobic Power: Measured using the Margaria-Kalamen stair test.
4. Body Composition: Measured using skinfold calipers (Jackson-Pollock 3-site method).

**Statistical Analysis:**
Paired t-tests were used to assess pre- and post-training differences. Significance level was set at $p < 0.05$.

## IV. Results

**Table 1: Pre-Test and Post-Test Comparison of Selected Strength, Physiological, and Body Composition Variables**

| VARIABLE | PRE-TEST MEAN ± SD | POST-TEST MEAN ± SD | % CHANGE | p-VALUE |
|---|---|---|---|---|
| Bench press (kg) | 62.3 ± 6.5 | 74.1 ± 5.9 | +18.8% | <0.01 |
| Squat (kg) | 85.7 ± 7.8 | 100.2 ± 7.2 | +16.9% | <0.01 |
| VO2 max (ml/kg/min) | 52.1 ± 3.4 | 56.8 ± 3.7 | +9.0% | <0.05 |
| Anaerobic power(W) | 925.6 ± 120.3 | 1012.7 ± 118.6 | +9.4% | <0.05 |
| Body fat (%) | 14.6 ± 2.1 | 12.8 ± 1.9 | -12.3% | <0.05 |

Table 1 presents the pre-test and post-test mean values, standard deviations, percentage changes, and p-values for selected strength, physiological, and body composition variables following the training intervention.

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A statistically significant improvement was observed in **maximal strength variables**. Bench press performance increased from M = 62.3 kg (SD = 6.5) in the pre-test to M = 74.1 kg (SD = 5.9) in the post-test, representing an improvement of 18.8%, which was statistically significant ($p < .01$). Similarly, squat strength showed a significant increase from M = 85.7 kg (SD = 7.8) to M = 100.2 kg (SD = 7.2), reflecting a 16.9% improvement ($p < .01$).

With regard to **aerobic and anaerobic capacity**, $VO_2$ max significantly increased from M = 52.1 $ml \cdot kg^{-1} \cdot min^{-1}$ (SD = 3.4) at pre-test to M = 56.8 $ml \cdot kg^{-1} \cdot min^{-1}$ (SD = 3.7) at post-test, indicating a 9.0% enhancement ($p < .05$). Anaerobic power also demonstrated a significant improvement, rising from M = 925.6 W (SD = 120.3) to M = 1012.7 W (SD = 118.6), which corresponds to a 9.4% increase ($p < .05$).

In terms of **body composition**, a statistically significant reduction in body fat percentage was observed. Mean body fat decreased from M = 14.6% (SD = 2.1) at pre-test to M = 12.8% (SD = 1.9) at post-test, reflecting a reduction of 12.3% ($p < .05$).

Overall, the results indicate that the training programme produced significant improvements in strength, aerobic and anaerobic performance, and body composition.

**Illustration 1**
**Comparison of Pre-Test and Post-Test Physiological and Performance Variables in Hockey Players**

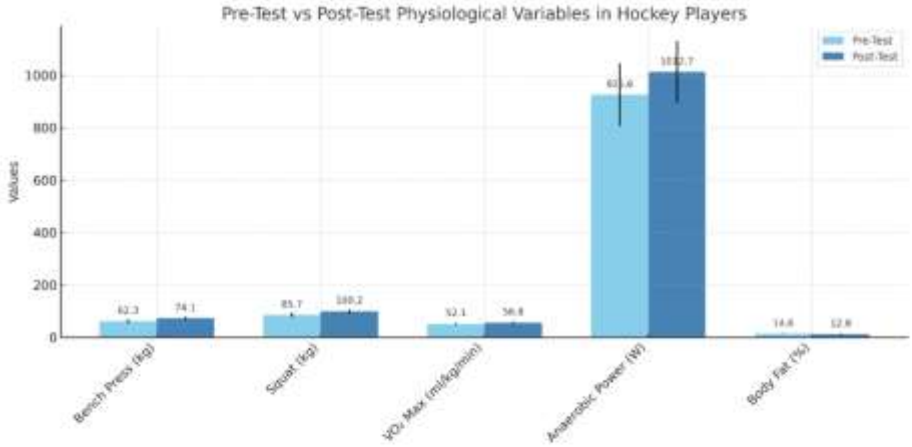


Figure 1 illustrates the comparison between pre-test and post-test mean values of selected physiological and performance variables of hockey players following the training intervention. The variables represented in the graph include bench press strength, squat strength, $VO_2$ max, anaerobic power, and body fat percentage.

## V. Discussion

The findings of the present study clearly demonstrate that an 8-week structured strength training program produces significant improvements in muscular strength, aerobic capacity, anaerobic power, and body composition among hockey players. The observed enhancement in muscular strength reflects positive neuromuscular adaptations, including increased motor unit recruitment and improved muscle fiber activation. In the context of field hockey, these adaptations are particularly important, as the sport requires repeated high-force actions such as sprinting, rapid acceleration, deceleration, tackling, and powerful stick strikes. Greater muscular strength enables players to generate higher force outputs efficiently, thereby improving performance during critical phases of match play.

The improvement in aerobic capacity, as evidenced by increased $VO_2$ max, suggests that strength training also contributes indirectly to cardiovascular efficiency. Although traditionally associated with endurance training, improvements in $VO_2$ max following strength training may be attributed to enhanced muscular efficiency, increased oxidative capacity of working muscles, and improved tolerance to high-intensity efforts. In field hockey, where players frequently alternate between intense bursts of activity and brief recovery periods, higher aerobic capacity facilitates faster recovery between sprints and sustained work rates across all four quarters of the game. Additionally, gains in anaerobic power highlight the role of strength training in improving short-duration, high-intensity performance, which is crucial for explosive movements and repeated sprint ability in hockey.

Changes in body composition, particularly the reduction in body fat percentage, further emphasize the holistic benefits of strength training. Lower body fat enhances the strength-to-weight ratio, allowing players to move more efficiently and perform agile movements with greater speed and control. Improved body composition also reduces unnecessary metabolic load, contributing to better endurance and reduced fatigue during prolonged competition. These findings are consistent with previous research conducted in various team and power-based sports, reinforcing the effectiveness of strength training as a comprehensive conditioning strategy. Collectively, the results of this study confirm that strength training is not only beneficial for increasing muscular strength but also plays a vital role in optimizing physiological efficiency and overall performance in competitive field hockey players.

## VI. Conclusion

Strength training significantly enhances physiological variables critical to field hockey performance. Incorporating such a program within the regular training routine is recommended for hockey athletes to optimize fitness and competitive advantage.

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