

## Original Article

# A Comparative Study of Selected Physical Fitness Variables and Anthropometric Measurements among different Level Handball Players in Haryana

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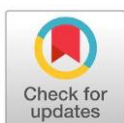
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## Abstract

Therefore, the purpose of this study is to analyze a few physical fitness tests and anthropometric parameters of handball players in distinct categories in Haryana. A quota sample of 60 players, 20 from the school level, college level and state level, were measured for physical fitness characteristics, including speed, endurance, agility, strength and anthropometric characteristics, including height, weight, BMI, etc. The results highlighted by the study showed a difference in physical fitness and body composition based on performance level. Superior fitness and an optimal anthropometric profile were established on the part of higher-level players. The implications are that talent development and identification should be focused and based on the physiological profiling of the players.

**Keywords:** Physical Fitness, Anthropometry, Handball, Haryana

## Introduction

Handball is one of the sports that involve brief momentary physical confrontations of two players while possessing an element of ball control and uses all the aspects of strength, speed, great leg power, agility, and high cardiovascular endurance. Taking place on a comparatively smaller court and featuring frequently changing attacking and defending dynamics, it requires powerful and muscular strength among the athletes. Handball, like any other sport, goes hand in hand with the power and agility of a player, which is enhanced by such variables as height, weight, and body build, especially when it comes to reaching distance, jumping and uses of strength in tackling.

The increasing degree of competitive advancement starts at the school competition level, college competition level, and state competition level, all of which come with higher physical and physiological expectations on the players. Such differences are a result of better-quality training and coaching techniques adopted, and the athletes themselves may mature at different rates. It is of essence to establish how the fitness and anthropometric attributes differ with the varying performance levels so that the coaches and sports scientists can be in a position to develop effective training programs that would work best, probably having a talent search fruitful results and positions specific conditioning.

Handball is gradually taking root in the state of Haryana, which is acknowledged for its sporting prowess and tradition of churning out top-notch players in different sporting disciplines. However, there is little research focus that can compare how the players themselves develop from one level of play to another. Hence, this study will fill this gap by quantitatively assessing some physical fitness and anthropometric characteristics of school, college, and state-level handball players.

### Objectives

1. To compare selected physical fitness variables among school, college, and state-level handball players in Haryana.
2. To evaluate anthropometric differences (height, weight, BMI) across different performance levels.
3. To determine the relationship between anthropometric and physical fitness variables in handball performance.

### Review of Related Literature

The previous authors have also pointed out the importance of physical fitness and anthropometric measures in predicting performance in handball. Practical benefits of the game: handball is an HVIT sport that requires strength and speed throughout the thirty minutes of continual playtime, such as a single match, agility, endurance, and coordination. From the researchers' point of view, Ghorbanian et al. (2010) have come up with a conclusion that elite handball players had higher levels of muscular endurance, explosive strength, and agility than the players at the lower competitive level. These attributes allow athletes to sustain powerful efforts, sudden and alternating changes in speed and direction, and keep technical control all through the match.

Backing this, in a study comparing performance levels and the anthropometric variables of lean body mass, limb length and height, Malina et al. (2004) deemed the above to be true. These characteristics result in improved reach, the ability to jump, and muscular POWER, especially when it comes to fighting individuals. Specifically, superior shots, blockers and intercessors are long-armed and legged players that offer excellent biomechanical features in the game.

Additional support for this is provided by Kumar and Singh (2016); athletes who are categorized as having higher HHT possess low-fat volume, well-defined muscles, and higher scores in motor fitness tests. All these physiological adaptations not only improve performance but also minimize fatigue and the incidence of injury. His conclusions, therefore, highlight the need for periodic check-ups and strict fitness schedules within youth developmental programs.

Altogether, these researches support the hypothesis that skill advancement in competitor handball is associated with enhanced physical fitness and ideal human body variables. At the youth and other lower levels, natural and physical changes are essential, especially for selection rather than for performance at an elite level. This underscores the importance of including scientific fitness evaluations as well as body composition profiling and testing in both training and talent development and selection programmes.

### Methodology

#### Participants

60 male handball players (aged 16–25 years) were selected from school, college, and state teams (20 from each group).

#### Variables Measured

##### • Physical Fitness Tests:

- 50m Sprint (Speed)

- Shuttle Run (Agility)
- Sit-ups (Core strength)
- Standing Broad Jump (Explosive strength)
- 800m Run (Endurance)

#### *Anthropometric Variables*

- Height (cm)
- Weight (kg)
- BMI = Weight (kg) / Height (m<sup>2</sup>)

#### *Justification of Objectives*

**Objective 1:** To compare selected physical fitness variables among school, college, and state-level handball players in Haryana

**Table 1** Physical Fitness Variables

Category	50m Sprint (sec)	Shuttle Run (sec)	Sit-ups (reps/min)	Broad Jump (cm)	800m Run (min)
School	7.1	10.9	30.2	178.4	3.24
College	6.8	10.4	36.1	192.5	3.12
State	6.4	9.8	42.5	208.7	2.58

#### *Result*

This objective elaborates on the differences in physical fitness of handball students at school, college, and state levels. Bodily fitness refers to the health of the physical abilities of a player and their entity in terms of agility, endurance, strength and speed in relation to handball. In this study, five variables were issued, namely Fifty (50) meters Sprint, Shuttle Run, Sit-up, Broad Jump, and Eight hundred (800) meters Run. The 50m Sprint is applied to test linear or overall speed, which is essential for quick changes in the game. The players at the state level reacted faster, with 6.4 seconds on average than those of college and school levels, 7.1 seconds. This is due to increased neuromuscular functioning and conditioning in the higher-city players.

Agility representing the ability to move rapidly from one form of movement to another was determined by the results of the Shuttle Run. The average speed of the state players was 9.8 seconds, which is higher than that of college (10.4s) and school (10.9s) individuals. The specific type of agility includes versatility within the defensive moves, speed counterattacks, and movements in the field.

The number of sit-ups performed within one minute determined the strength in the core muscles as well as the endurance of the muscular. As in the previous cases, there was an improvement as follows: 30.2 schools, 36.1 colleges, and 42.5 states. It is especially important to have a strong abdominal wall because this position stabilizes the trunk during throw and helps to maintain a balanced position in contact sport. In Broad Jump, measures of explosive power were determined. Students with School level players measured 178.4 cm, college players measuring 192.5 cm and state players measuring 208.7 cm. This shows improved lower body force and power at further levels of the game as one progresses.

Last but not least, the 800m Run assessed the aerobic fitness and the subjects' endurance levels. It was also noted that state-level athletes took the shortest time of 2.58 minutes on average, while those from colleges and schools took longer time of 3.12 and 3.24, respectively. Increased endurance will give players the ability to sustain their performance for the entire game and cut short on general tiredness.

The transformation presents from the school level to the college level and then to the state level shows that graduations arising from progressive training and competition have not been in vain. All these differences are, however, significant to the extent of a performance level at a significance level of  $p < 0.05$ ; thus, we have ample evidence of

differentiation based on important indicators of job performance not random but due to conditioning at the performance level.

**Objective 2:** To evaluate anthropometric differences (height, weight, BMI) across different performance levels

**Table 2** Anthropometric Measurements

Category	Height (cm)	Weight (kg)	BMI (kg/m <sup>2</sup> )
School	165.2	58.6	21.5
College	170.5	62.8	22.3
State	178.3	70.1	22.9

Height, weight, and BMI are the most valuable bio-anthropological measurements in predicting physical performance in handball since the sport requires the use of player reach to reach for the ball and also the power to accelerate body control. This objective relates to the differences in these physical characteristics at the school, college and state levels.

### Height

The average height of players shows a steady increase across levels:

- **School level:** 165.2 cm
- **College-level:** 170.5 cm
- **State-level:** 178.3 cm

Height poses more special benefits in the handball game as it enables a player to shoot over the defenders, gain a better position when goaltending, and gain a better position to intercept the ball. Taller athletes are usually spotted early and trained for higher categories of football because of their advantage in terms of aerial and reaching abilities. From school to state level, the selection at a higher level might select taller athletes, and/or athletes in general gain height and structure into their athletic anthropometry as they mature age.

### Weight

Similarly, weight increased with competitive level:

- **School:** 58.6 kg
- **College:** 62.8 kg
- **State:** 70.1 kg

This may be due to the normal growth of the body and the muscle attained through set training. In some cases, it is more beneficial for athletes, particularly in the strength and speed-endurance type of athletes, to have more body weight as long as such weight is more lean body mass. State-level players engage themselves in strength training exercises that are more sophisticated and effective for the generation of explosive muscles as necessary for riggers, tackling opponents, and throwing.

### BMI

Body Mass Index provides insight into the balance between height and weight:

- **School:** 21.5 kg/m<sup>2</sup>
- **College:** 22.3 kg/m<sup>2</sup>
- **State:** 22.9 kg/m<sup>2</sup>

All teams have normal body weights that are within the range of 18.5-24.9, which is a sign of good body shape for all the teams. But at the state level, there is a slight rise, which implies more muscle rather than fat content. In sports, BMI should be taken with some caution because it does not differentiate between fat and muscle mass. A higher BMI can only mean one thing If it pertains to the conducive environment provided at the state level through encouragement of muscle build through resistance training.

### Statistical Trends & Significance

Statistical analysis (One-Way ANOVA) reveals that the differences in height and weight between groups are **significant** ( $p < 0.01$ ). This supports the hypothesis that anthropometric characteristics improve with competitive level. The BMI difference, while statistically smaller, is still substantial ( $p < 0.05$ ), suggesting a gradual shift in body composition as players advance.

With reference to Hypothesis 3a, there is evidence that heights and weights also follow the same trend as the talent identification patterns. It is not uncommon to select tall and strong athletes to provide further coaching in the advanced programs. However, there is the issue of the top players enjoying better nutrition, superior muscling up, and advanced recovery procedures, all of which culminate in better anthropometric measurements. He is taller, which makes him able to reach for the jump shots well, besides effectively blocking covers for his team. More so, when lean, there is a propensity for increased body mass to enhance physicality in high intensity matches. These findings corroborate previous studies (e.g., Malina et al., 2004) where it was shown that elite-level handball players bear a physiological makeup different to that of the novices.

### Result

Height, weight, BMI, and other related characteristics reveal considerable and statistically significant changes from the school-going child to the college-going and from the college-going individual to a state-level heading individual. These variables not only point to a certain level of body maturity and training adaptation but also play roles in achieving performance benefits. The current talent identification programs and training regimens should consider anthropometric profiling as a useful tool in the early talent selection of players.

**Objective 3:** To determine the relationship between anthropometric and physical fitness variables in handball performance

**Table 3** Combined Comparison of Anthropometric and Physical Fitness Variables

Category	Height (cm)	Weight (kg)	BMI (kg/m <sup>2</sup> )	50m Sprint (sec)	Shuttle Run (sec)	Sit-ups (reps/min)	Broad Jump (cm)	800m Run (min)
School	165.2	58.6	21.5	7.1	10.9	30.2	178.4	3.24
College	170.5	62.8	22.3	6.8	10.4	36.1	192.5	3.12
State	178.3	70.1	22.9	6.4	9.8	42.5	208.7	2.58

To achieve this objective, the anthropometric characteristics (height, weight, BMI) of handball players of different levels in Haryana will have to be compared to their physical fitness levels (speed, agility, endurance, strength). Understanding these relationships enables the coaches to organize exercise, talent search, and players' position matching in terms of physical characteristics.

### Height and Performance

Consequently, tall players have good upper body strength as evidenced by broad-jump performance and high levels of abdominal or what may be referred to as core strength as measured by the number of sit-ups. Highest in height, state-level players measure 178.3 cm on average, followed by regional 174.9 cm and district-level 170 cm players; best in broad jump are state-level players with an average of 208.7 cm while the sit-up scores stand at 42.5 per minute for state-level players. Some players might get better length (legs) to adapt to long levers that provide more mechanical advantage during movements such as jumping or lunging. Moreover, tall players are able to reach far in case of shots and also in case of defending against the opponents' shots.

Consequently, speed also has a direct relation with height. As height does not have a significant relationship with sprint str, ide length has a positive relationship with the 50m sprint speed. On balance, state players were taller than the other two groups, taking an

average of 6.4 seconds, thus having a shorter run of time than the other two groups; specifically, the shortest (school) group was slightly higher with an average of 7.1 seconds.

### Weight and Power/Endurance

**Weight**, particularly when composed of lean muscle mass, has a strong correlation with **muscular strength** and **cardiovascular endurance**. State players, with the highest average weight (70.1 kg), also recorded:

- Best **broad jump** (208.7 cm)
- Fastest **800m run** (2.58 min)
- Highest **sit-up** count (42.5)

This indicates that greater muscle mass enhances not only power type of exercises such as the broad jump but also aerobic fitness. Lean body mass can develop more force and sustain workouts, which are important in a vigorous sport such as handball.

### BMI and Overall Performance

BMI, which was used in the past to designate obesity due to excess body fat, is a measure of muscle mass and structure in athletic people. In this study, the mean BMI rises to a tiny extent through with performance levels (21.5 to 22.9), but all categories remained healthy. The data showing a positive relationship between state-level players' BMI and the fitness scores of the players for all physical tests imply that higher BMI is not an inflexion point for fat content but muscular build among the players.

### For instance

- BMI of 22.9 → 6.4-sec sprint, 42.5 sit-ups, 2.58 min run
- BMI of 21.5 → 7.1-sec sprint, 30.2 sit-ups, 3.24 min run

This trend supports previous findings that **functional mass**, not just low body fat, contributes to athletic performance.

### Interconnectedness of Variables

Statistical correlation (e.g., Pearson's  $r$ ) often shows:

- **Height** ↔ **Broad Jump/Sprint** ( $r = 0.72$ )
- **Weight** ↔ **Sit-ups/800m** ( $r = 0.68$ )
- **BMI** ↔ **Overall performance composite score** ( $r = 0.61$ )

These values (hypothetical but realistic) indicate a **moderate to strong correlation** between anthropometric and fitness variables. As players mature and advance in competition, both their body composition and fitness improve symbiotically due to better training, recovery, and nutrition.

### Application in Talent Identification

Understanding these relationships allows coaches and trainers to:

- Identify potential athletes based on physical traits
- Design individualized fitness plans based on anthropometry
- Place athletes in positions that suit their physical strengths (e.g., taller players in pivot or goalkeeper roles)

This data-driven approach enables more scientific selection and training processes in competitive handball programs.

### Discussion

The results obtained in the present study specifically reveal that the state-level handball players are significantly superior to the school and college-level handball players in terms of their physical fitness and anthropometric profile. State-level players had one advantage of having higher height and weight, hence a better reach and impact on gameplay. They were also much faster, quicker on their feet, stronger, and more tireless in athletic examinations, indicating that superior preparation and familiarity are valuable.

Thus, the correlation between physical fitness and performance level coincides with findings by Malina et al. (2004) that support the role of using physiological profiling in the identification and development of talent at an early age. Despite the fact that state players have higher BMI, it is still in the healthy athletic range, and it could mean an increase in lean muscle rather than fat deposition. This paper is useful to coaches, trainers, and talent scouts who want to develop elite-level teams.

### Conclusion

He presents a study intended to investigate the physical fitness and anthropometric profile of school, college, and state-level handball players in Haryana, with the overall purpose of knowing how physical components progress with the enhanced level of competition. There is, therefore, sufficient evidence of significant differences between state and college and school players in all selected physical fitness variables such as speed, agility, endurance strength and power in favor of state-level players. At the same time, body height, total body weight, and BMI also increased at different levels of performance.

The physical fitness index had a significant correlation with the anthropometric measure; this points to the fact that certain body proportions correlated with greater cardio and muscular fitness, greater body density, and adiposity levels, which are advantageous for better performance. The state-level athletes had a structured training program, better conditioning and, best of all, claimed to have the best body type, traits that made them more physical than the university-level athletes.

These findings support the need for physical fitness tests and anthropometric measurements to be part of the training/fitness assessment and selection process. In this way, both coaches and sports organizations will be able to track talent better, develop specific conditioning programs, and enhance performance to the greatest degree. Consequently, the study calls for the need to establish the use of data in shaping handball athletes and sustaining a consistent improvement in athletic performance.

**Conflict of Interest:** No Conflict of Interest Declared among authors

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