ANTHROPOMETRIC AND BIO-MOTOR PROFILE OF MANIPUR YOUTH PLAYERS IN TEAM SPORTS

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Abstract

Anthropometric and bio-motor variables of players play important roles in the development of good skilled performers and skill executioners in any team sport, such as basketball, football, and field hockey, for example, in both on and off the court or field situations. The purpose of our study was to compare the anthropometric such as age, height, weight, BMI and bio-motor variables such as speed, flexibility, muscular endurance, and anaerobic power in youth male basketball, football, field hockey players in Manipur. Since the study’s design was cross-sectional, a total of 300 male team players (ages 14–18) were selected from different clubs and academies of basketball, football, and hockey who participated in the state level competition. The multiple comparison (Bonferroni) results revealed that: i) football players were faster than both basketball and hockey players, while hockey players were faster than basketball players; ii) both basketball and hockey players had more power than football players, with no significant difference in power observed between basketball and hockey players; iii) both football and hockey players had more flexibility than basketball players, with no significant difference in flexibility observed between football and hockey players; and iv) basketball players had more endurance than both football and hockey players, with no significant difference in endurance observed between football players and hockey players. It was concluded that anthropometric and bio-motor characteristics distinguished between young male team sports players in the three major team sports disciplines. The factors primarily in play in these distinctions across team sports, however, varied depending on which sports disciplines were being contrasted.

Keywords: Anthropometric profile, bio-motor profile, youth team sports, speed, anaerobic power, flexibility, muscular endurance

Introduction

A team sport is one in which players participate in opposing teams that either compete to win or cooperate to entertain their fans. Team members collaborate to accomplish a common objective. There are many methods to do this, one of which is to outperform the competition. In order to achieve their goals, team members set goals, make decisions, communicate, handle conflict, and solve problems in a positive, trusting environment. Examples of most popular team sports include basketball, volleyball, soccer (football), and field hockey. To be successful in team sports, members of the team must work together internally (Bouthier, et al., 1997).

The ability of human movement influenced by the condition of the organ systems in the body is referred to as bio-motor. These organ systems include the neuromuscular system, respiration, digestion, blood circulation, energy, bones, muscles, ligaments, and joints. Therefore, if a playing team wants to win a match, each player must have a good bio-motor. The basic components of bio-motor include several physical conditions such as endurance, strength, speed, coordination, and flexibility (Arias-Estero et al., 2018).

The development of bio-motor components is a combination of physical conditions, such as stamina, which is a combination of endurance and speed; agility, which is a combination of speed and flexibility; and power, which is a combination of strength and speed. Another major bio-motor component that plays a role in achieving the best performance in team sports is strength.

Therefore, the bio-motor abilities emphasized, such as speed, endurance, flexibility, coordination abilities, etc., play the predominant role in performing any sport. It is referred to as an efficient performance in such basic requirements as running, jumping, dozing, etc., with a sustained effort in a variety of situations. These skills are fundamental and easily improved with practise. These skills have an impact on how the body moves. In other words, bio-motor variables of players are important in the development of good and skilled performers and skill executioners in any team sport, such as basketball, football, and hockey, for example, on and off the court or field. Excellent skill performances at the desired level are highly dependent on the individual's level of bio-motor fitness.

The bio-motor abilities differ from sport to sport, and to develop these abilities, the sportsperson has to regularly participate in general, specific, and competitive exercise schedules that are specific to a sport. For example, when a sportsperson works against a resistance—maybe a resistance of their own body, a partner, a medicine ball and barbell, etc.—strength is developed. Each sportsperson has a unique profile in respect to different bio-motor abilities. Because there is a close relationship between skill performances and performance in terms of various motor abilities, a coach must understand both how to train them and how to determine them using various evaluative procedures. Only highly talented athletes have the various bio-motor abilities at an optimal level to perform well (Uppal, 2009).

Different measures may be taken up for enhancement of physical and physiological factors utilizing comparable anthropological scale measurements for talent scouting for selection of players of the game (Somasundaram, 1990). The coach can more successfully arrange training sessions if they are aware of how the bio-motor skills relate to total physical fitness. Hence, motor fitness is the final criterion through which all other elements of physical fitness or total fitness are seen and measured in man (Walter, 1952).

Anthropometric and bio-motor characteristics in relation to performance in different team sports has been reported by studies in the past; basketball players (Jakovljevic, et al., 2011), Indian elite male hockey players (Koley & Vashisth, 2014), football players (Brahim, et al., 2013). The description of bio-motor and anthropometric factors that distinguish elite athletes from other sports has received a lot of attention in recent years (Smith & Thomas , 1991; Gualdi-Russo, et al., 1992; Loko, et al., 2000). It is generally known that, in addition to other aspects, anthropometric traits play a considerable effect in sport performance (Olutende, et al., 2018).

In addition to other criteria like physiological and physical fitness, psychological aspects, abilities, etc., a sportsperson's body composition and somatotype play a considerable impact in their ability to compete in sports (Olutende, et al., 2018). Different studies had supported the idea that certain physical characteristics were necessary for successful performance in certain sports (Carter & Heath, 1990).

However, few attempts have been made to identify and quantify the bio-motor variables such as speed, anaerobic power, flexibility, and muscular endurance that distinguish youth team sports players belonging to basketball, football, and hockey. This study could serve as a guide for coaches, physiotherapists, and researchers looking for a reference model for the three different team sports investigated.

From the foregoing discussion, it is imperative to analyse youth team players in Manipur belonging to three different team sports disciplines such as basketball, football, and hockey on selected bio-motor abilities such as speed, anaerobic power, flexibility, and muscular endurance.

Objectives

i. To describe the anthropological characteristics such as age, height, weight and BMI of youth players belonging to different team sports disciplines such as basketball, football, and hockey.
ii. To study the differences in bio-motor variables such as speed, anaerobic power, flexibility and muscular endurance, among youth players belonging to different team sports disciplines such as basketball, football, and hockey.

Hypothesis

H_0: With regard to bio-motor skills like speed, anaerobic power, flexibility and muscular endurance, young players who compete in diverse team sports like basketball, football, and hockey would not significantly differ from one another.

Methodology

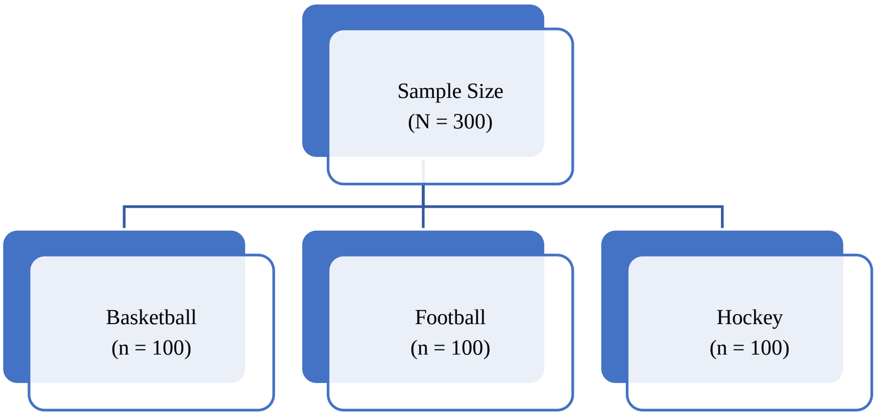
Design of the Study

The main purpose of the study was to investigate the bio-motor abilities of Manipur youth players in team sports such as basketball, football, and hockey. Therefore, the study was cross-sectional in nature.

Selection of Subjects

Since the study's design was cross-sectional, 300 players were selected from different clubs and academies of basketball, football, and hockey who participated in state level competition. The subjects ranged in age from 14 to 18 years. The players whose ages were below 14 and above 18 years of age, the female players, and those who were not willing to participate were excluded. Figure 1 shows the sample distribution according to the team sport in which the subjects participated.

Figure 1. Sample distribution according to the team sport



Criterion Measures

The criteria and measures for the administration of the selected bio-motor abilities test items were as follows:

- ***Speed:*** The ability to move rapidly or travel quickly is known as speed. Like other bio-motor skills, there are various categories of speed. It could refer to the entire body going at its top running speed, like a sprinter. It could entail the fastest possible speed, as the controlled pace used in the approach run of the jumping competitions. A 20-meter dash test was used to gauge the subjects' speed, and the results were recorded to the closest $1/100^{th}$ of a second.
- ***Anaerobic Power:*** Anaerobic power testing is the evaluation of the human capacity to perform short-term work at the highest possible rate (Inbar, 2012). The Sargent Jump test was used to gauge each subject's anaerobic capacity, and the results were measured in centimetres. The Lewis formula (Fox & Mathews , 1974) was used to translate the participants' jumping height into power.

- ***Flexibility:*** The capacity to move a joint across a wide range of motion is known as flexibility. One of the most frequent reasons for poor technique and performance is restricted flexibility. Since the muscles must work harder to overcome the opposition to an effective stride length, poor flexibility also reduces speed and endurance. A sit-and-reach test was used to gauge the subjects' flexibility, and the reading at the furthest point reached was recorded to the closest centimetre.
- ***Muscular Endurance:*** The capacity of a muscle or group of muscles to sustain repeated contractions against a force over an extended period of time is known as muscular endurance. The sit-ups test was used to assess the subjects' muscular endurance, and the reading was recorded as the number of sit-ups completed in one minute. The sit-up test evaluates the strength of the hip-flexor and abdominal muscles.

Test administration and data collection process

The test administration and data collection took place from February 2020 to April 2020 as a part of a larger study after getting written consents from the concerned authorities, parents, and the participants themselves. The test administration was organised at the participants' respective clubs' facilities by following specific test protocols. Test-retest reliability on the specific subject pool employed in the current study could not be achieved, despite the fact that the majority of the assessments given are highly standardised and widely accepted assessments. Prior to the actual data collection, all testers had rigorous training and familiarisation with proper test administration to address this potential issue. In order to prevent tester-to-tester mistakes, the same tester gave all of the tests. The participants' living situation and way of life, however, were not taken into account for this study.

Statistical Analysis

The collected data were entered into an Excel sheet, and statistical analyses were conducted using the IBM SPSS software (version 22.0; SPSS Inc., Chicago, IL, USA). The normality of statistical distribution was tested by using descriptive statistics, and ANCOVA was applied to examine differences among groups. Covariates appearing in the model were evaluated based on the age of participants, BMI, height in m, and weight in Kg. Multiple comparisons were made using the post hoc Bonferroni test. The level of significance used in the statistical analysis was 0.05.

Results

Anthropometric characteristics of team sports players

Table 1. Descriptive statistics of Age, Height, Weight and BMI of Basketball, Football and Hockey Players

Characteristics	Descriptive stats	Basketball	Football	Hockey
Age	Mean	15.76	14.99	14.83
	Std. Dev.	1.28	1.06	0.76
Height in m	Mean	1.70	1.68	1.61
	Std. Dev.	0.04	0.03	0.09
Weight in kg.	Mean	54.35	54.94	50.54
	Std. Dev.	4.37	5.02	3.41
BMI	Mean	18.85	19.32	19.58

Std. Dev.	1.33	1.68	1.99

Source: Computed from field survey data

Table 1 indicates that the mean and standard deviation of the ages of basketball, football, and hockey players were 15.76 ± 1.28, 14.99 ± 1.06, and 14.83 ± 0.76, respectively. The means and standard deviations of the heights of basketball, football, and hockey players were 1.70 ± 0.04, 1.68 ± 0.03, and 1.61 ± 0.09, respectively. Basketball, football, and hockey weights had mean and standard deviations of 54.35 ± 4.37, 54.94 ± 5.02, and 50.54 ±3.41, respectively. The mean and standard deviation of the BMI of basketball, football, and hockey players were 18.85 ± 1.33, 19.32 ± 1.68, and 19.58 ± 1.99, respectively.

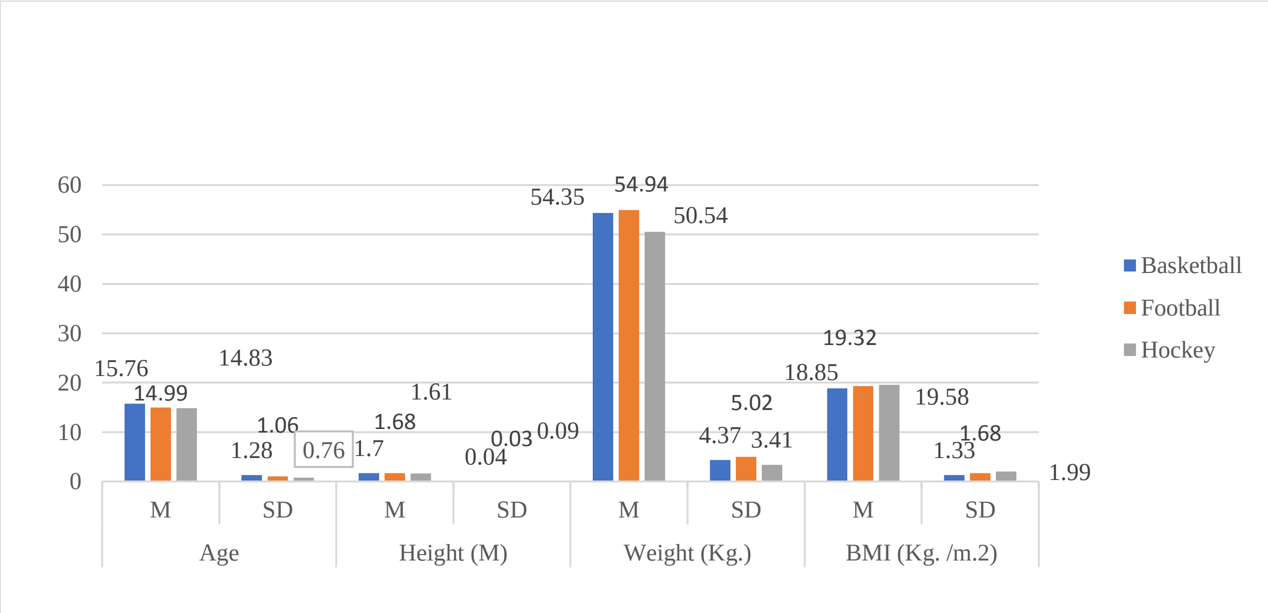


Figure 2. Age, Height, Weight, and BMI of Team Sport Players

Result of speed test (20 m dash)

Table 2. ANCOVA results for speed

Groups	*N*	*M*	*Std. Dev.*	*Adjusted M*	*Std. Error*	*F*	*Sig.*	η^2
Basketball Players	100	3.79	0.30	3.81[a]	0.03	115.018	.000	.440
Football Players	100	3.14	0.30	3.15[a]	0.03			
Hockey Players	100	3.35	0.29	3.32[a]	0.03			

Note: Covariates appearing in the model are evaluated at the following values: age of participants = 15.19, Height in m = 1.67, Weight in Kg = 53.28, BMI = 19.26. The F statistic examines the effect of participant type and is based on linearly independent pairwise comparisons of estimated marginal means.

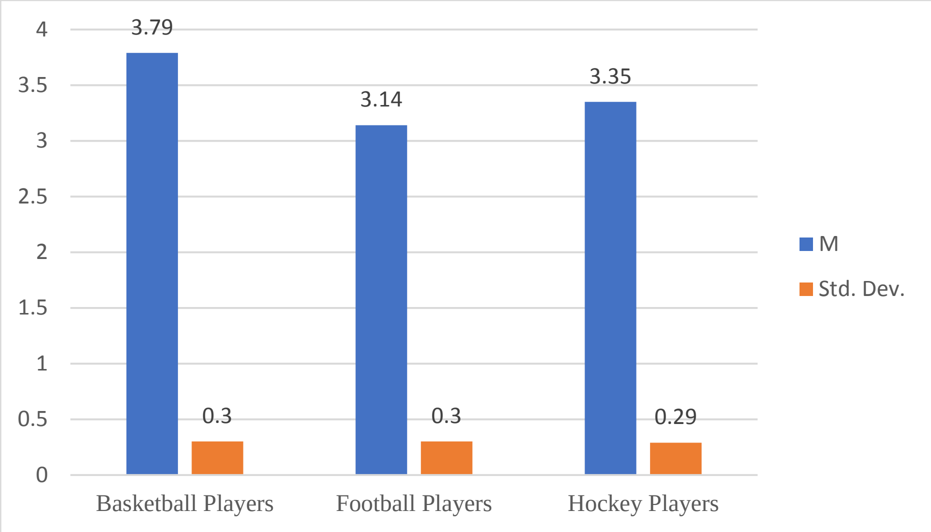


Figure 3. Mean and standard deviation value of speed among team sports

Table 3. Pairwise Comparisons (Speed)

(I) Groups	(j) Groups	M. Diff. (I-J)	Std. Error	Sig. [b]
Basketball Players	Football Players	.665*	.044	.000
	Hockey Players	.493*	.051	.000
Football Players	Basketball Players	-.665*	.044	.000
	Hockey Players	-.172*	.047	.001
Hockey Players	Basketball Players	-.493*	.051	.000
	Football Players	.172*	.047	.001

Note: Based on estimated marginal means; *. The mean difference is significant at the .05 level; Adjustment for multiple comparisons: Bonferroni.

The results in Table 2 revealed that there was an overall significant difference between the participants in speed as measured by the 20-meter dash: $F_{(2,296)} = 115.018$, $p = .000$. The null hypothesis was rejected. The results of the multiple comparison (Bonferroni) in table 3 revealed that football players were faster than both basketball and hockey players ($p = .000$), while hockey players were also faster than basketball players ($p = .000$).

Result of anaerobic power test

Table 4. ANCOVA results for anaerobic power

Groups	*N*	*M*	*Std. Dev.*	*Adjusted M*	*Std. Error*	*F*	*Sig.*	η^2
Basketball Players	100	1376.56	229.59	1304.73[a]	22.70	12.142	.000	.077
Football Players	100	1205.13	261.01	1172.13[a]	21.43			
Hockey Players	100	1197.20	227.88	1302.04[a]	23.57			

Note: Covariates appearing in the model are evaluated at the following values: age of participants = 15.1933, Height in m = 1.67, Weight in Kg = 53.28, BMI = 19. 26. The F tests the effect of types of participants. The F statistic examines the effect of participant type and is based on linearly independent pairwise comparisons of estimated marginal means.

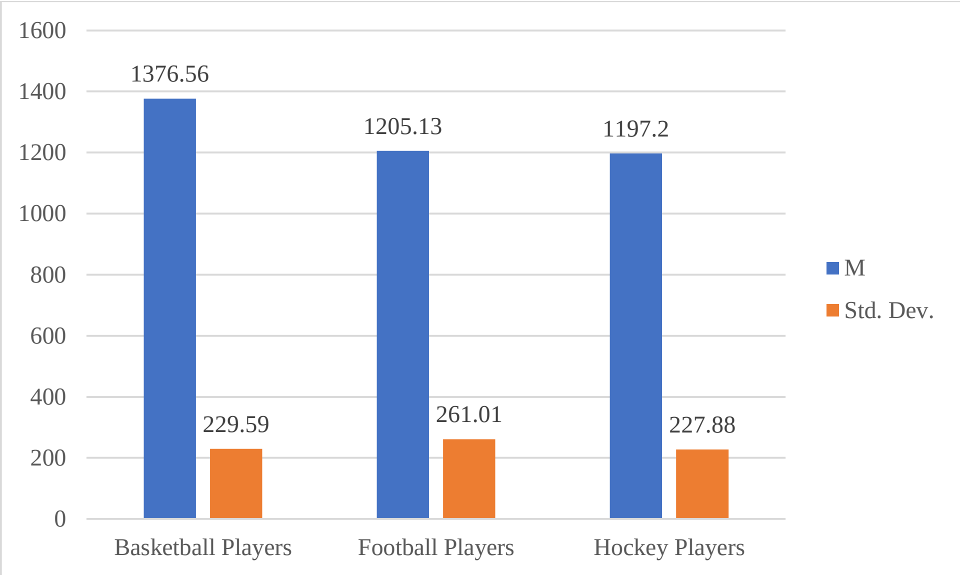


Figure 4. Mean and standard deviation value of anaerobic power among team sports

Table 5. Pairwise Comparisons (Anaerobic power)

(I) Groups	(j) Groups	M. Diff. (I-J)	Std. Error	Sig. [b]
Basketball Players	Football Players	132.60*	31.11	.000
	Hockey Players	2.69	35.45	1.000
Football Players	Basketball Players	-132.60*	31.11	.000
	Hockey Players	-129.91*	32.99	.000
Hockey Players	Basketball Players	-2.69	35.45	1.000
	Football Players	129.91*	32.99	.000

Note: Based on estimated marginal means; *. The mean difference is significant at the .05 level; and Adjustment for multiple comparisons: Bonferroni.

Table 4 shows that there was a significant difference in anaerobic power between the participants: $F_{(2,296)} = 12.142$, p =.000. The null hypothesis was rejected. The results of the multiple comparison (Bonferroni) in table 5 revealed that both basketball players and hockey players had more power than football players (p =.000), and no significant difference between basketball players and hockey players in power (p = 1.000).

Result of the flexibility test (sit and reach test)

Table 6: ANCOVA results for flexibility

Groups	*N*	*M*	*Std. Dev.*	*Adjusted M*	*Std. Error*	*F*	*Sig.*	η^2
Basketball Players	100	20.65	3.44	19.70[a]	0.64	214.692	.000	.594
Football Players	100	36.26	6.69	36.34[a]	0.61			
Hockey Players	100	35.97	7.07	36.84[a]	0.67			

Note: Covariates appearing in the model are evaluated at the following values: age of participants = 15.1933, Height in m = 1.6668, Weight in Kg = 53.28, BMI = 19.2551, The F statistic examines the effect of participant type and is based on linearly independent pairwise comparisons of estimated marginal means.

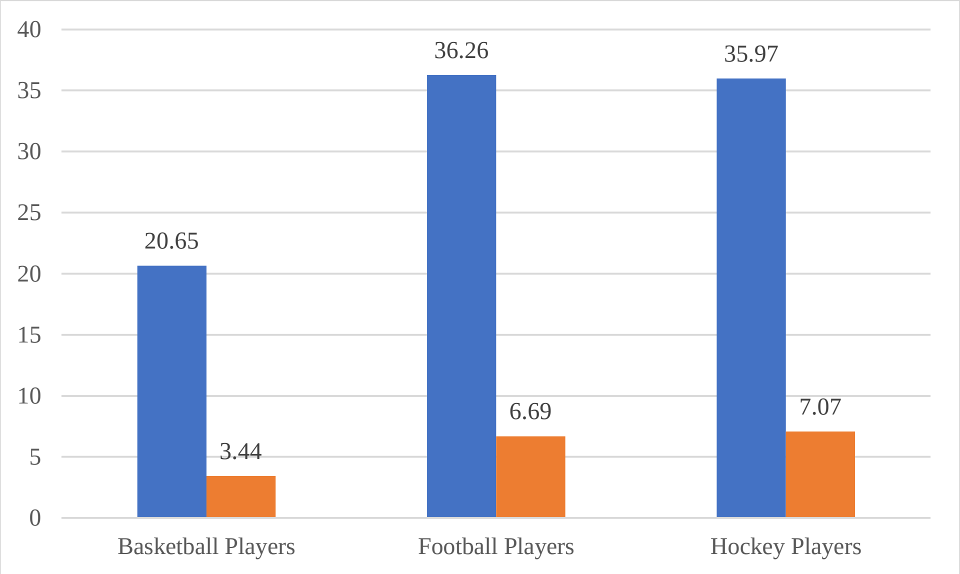


Figure 5. Mean and standard deviation value of flexibility among team sports

Table 7. Pairwise Comparisons (flexibility)

(I) Groups	(j) Groups	M. Diff. (I-J)	Std. Error	Sig. [b]
Basketball Players	Football Players	-16.65*	0.88	.000
	Hockey Players	-17.15*	1.01	.000
Football Players	Basketball Players	16.65*	0.88	.000
	Hockey Players	-0.50	0.94	1.000
Hockey Players	Basketball Players	17.15*	1.01	.000
	Football Players	0.50	0.94	1.000

Note: Based on estimated marginal means; *. The mean difference is significant at the .05 level; and Adjustment for multiple comparisons: Bonferroni.

Table 6 shows that there was a significant difference in flexibility between the participants: $F_{(2,296)} = 214.692$, p =.000. The null hypothesis was rejected. The results of the multiple comparison (Bonferroni) in table 7 revealed that both football (p =.000) and hockey players (p =.000) had more flexibility than basketball players, and no significant difference had been observed between football and hockey players (p = 1.000).

Result of the muscular endurance (sit ups test)

Table 8. ANCOVA results for Muscular Endurance

Groups	*N*	*M*	*Std. Dev.*	*Adjusted M*	*Std. Error*	*F*	*Sig.*	η^2
Basketball Players	100	43.63	4.68	43.18[a]	0.87	15.021	.000	.093
Football Players	100	38.54	9.32	38.74[a]	0.82			
Hockey Players	100	35.63	8.91	35.88[a]	0.90			

Note: Covariates appearing in the model are evaluated at the following values: age of participants = 15.1933, Height in m = 1.6668, Weight in Kg = 53.2767, BMI = 19.2551. The F statistic examines the effect of participant type and is based on linearly independent pairwise comparisons of estimated marginal means.

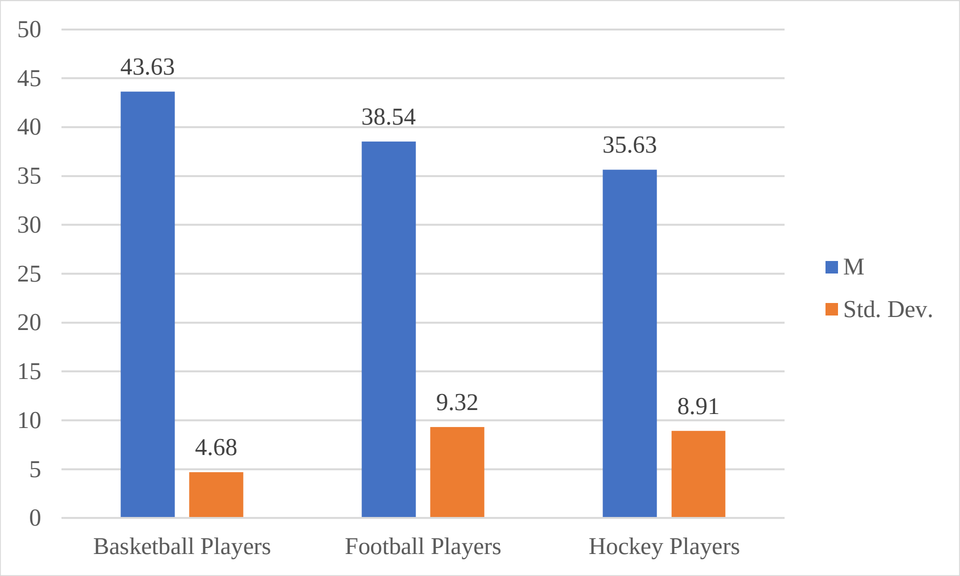


Figure 6. Mean and standard deviation value of muscular endurance among team sports

Table 9. Pairwise Comparisons (Muscular Endurance)

(I) Groups	(j) Groups	M. Diff. (I-J)	Std. Error	Sig. [b]
Basketball Players	Football Players	4.44*	1.19	.001
	Hockey Players	7.30*	1.36	.000
Football Players	Basketball Players	-4.44*	1.19	.001
	Hockey Players	2.86	1.27	.074
Hockey Players	Basketball Players	-7.30*	1.36	.000
	Football Players	-2.86	1.27	.074

Note: Based on estimated marginal means; *. The mean difference is significant at the .05 level; and Adjustment for multiple comparisons: Bonferroni.

Table 8 shows that there was a significant difference in Muscular Endurance between the participants: $F_{(2,296)} = 15.021$, p =.000. The null hypothesis was rejected. The results of the multiple comparison (Bonferroni) in Table 9 revealed that basketball players had more muscular endurance than both football (p =.001) and hockey players (p =.000), while no significant difference between football players and hockey players in endurance (p =.074).

Discussion

The purpose of our study was to compare the bio-motor abilities such as speed, anaerobic power, flexibility and muscular endurance in youth male football, field hockey, and basketball players in the Indian state of Manipur. Since the study's design was cross-sectional, a total of 300 male team players with a mean age of 15.1933, height of 1.6668, Weight of 53.2767, and BMI of 19.2551belonging to different team sports disciplines such as basketball (n =100), football (n =100), and hockey (n = 100) were selected randomly as the participants of the study.

The bio-motor variables to be analysed were: i) the speed test measured by sprint running; the data was conducted using the 20-meter sprint test; ii) the power test measured by performing a vertical jump test to determine the leg power. Jump height was converted into power by applying the Lewis formula (Fox & Mathews , 1974); iii) the flexibility test measured by the sit and reach activity; and iv) the athlete's muscular endurance test measured by a sit-up test.

The first discriminant function, which reflected variations in anthropometric and bio-motor variables between hockey players and the other groups of athletes, was shown to account for the majority of the variability between groups. The findings demonstrate that among all anthropometric characteristics, hockey players had the lowest values. This was especially true for height (1.61±0.09) and body mass (50.54±3.41). The average height of basketball players was the highest (1.70±0.04) closely followed by football players (1.68±0.03). Success at the moderate to high levels of basketball competition might depend largely on the selection of players with complementing abilities who can meet the demands of the game (Ige & Kleiner , 1998). According to studies, height can significantly contribute to success in particular sports by providing specific natural advantages (Olutende, et al., 2018). Height can be helpful for those sports where this might be a factor, but it is not always a good thing and it is not the only thing because, generally speaking, it affects the leverage between muscle volume and bone towards greater speed of movement and power, depending on overall build, fitness, and personal ability (Carter, 1984). The findings of this study also show that weight is a significant contributor to the discriminant function with hockey players scoring lowest (50.54±3.41). Recent research has shown that the key element influencing the greatest performance for elite sprinters is body mass index (BMI), which reflects greater muscle mass rather than greater adiposity (Olutende, et al., 2018). The reciprocal ponderal index (RPI) was also a significant predictor of optimal performance among track and field athletes with tall, lean body types (Watts, et al., 2011). However, a recent study by Anup, et al.(2014) confirmed a long-held theory that sprinting athletes with higher reciprocal ponderal indices should be encouraged to have an ectomorphic mesomorph body type. According to a study by Sedeaud et al. (2014), weight, height, and BMI are important factors in speed. It enables the determination of ideal body types for various track and field events. Height is not as good an indicator as BMI and body mass (Sedeaud, et al., 2014). BMI, however, is favoured as it enables the blending of both contributions (Sedeaud, et al., 2014).

Considering basketball, football, and hockey involve sprinting, the same rule of thumb may also apply. The anthropometric variables included in this study, such as age, BMI, body mass, and height, could act as confounding factors whose presence affects the variables being studied so that the results do not reflect the actual relationship (Pourhoseingholi et al., 2012). Therefore, we rely on statistical methods to adjust for potentially confounding effects, especially regression models, and these are flexible to eliminate the effects of confounders since our research design is cross-sectional. The Analysis of Covariance (ANCOVA) is a type of Analysis of Variance (ANOVA) that is used to control for potential confounding variables (Pourhoseingholi et al., 2012). The participants' living environment and way of life, however, were not taken into consideration for this study.

Our study assumed that, with regard to bio-motor skills like speed, power, endurance, and flexibility, young players who compete in diverse team sports like basketball, football, and hockey would not significantly differ from one another. In all the cases we have fail to retain the null hypothesis stated.

Our results revealed that football players were faster than both basketball and hockey players, while hockey players were faster than basketball players. Our finding is in the line with Ajayaghosh's (2017) study which revealed that football players possesing better speed than hockey players. Other study also revealed that football players having bettter speed than hockey players (Kariyawasam, et al., 2019). However, our finding is in contrast to other studies where basketball players exhibit better speed than football players (Karthi & Krishnakanthan, 2014; Srinet, 2014; Singh & Singh, 2017;) and hockey players (Karthi & Krishnakanthan, 2014).

Our results also revealed that both basketball and hockey players had more power than football players, with no significant difference in power observed between basketball and hockey players. Though, basketball and hockey players showed better explosive power than footballers, but much lower compared to most international studies (Fernandez, et al., 2014). The lower jumping power in footballers may be due to relative shortness or due to inadequate lower limb training (Kariyawasam, et al., 2019). Medicine ball throwing power was higher among basketball players, reflecting the necessity of throwing skill in basketball players compared to footballers (Kariyawasam, et al., 2019). The probable reason could be that football players and hockey players need equal levels of fitness, which are highly required while performing certain technical skills like dribbling, quick running, jump passing, and co-ordination (Singh & Singh, 2020).

The results revealed that both football and hockey players had more flexibility than basketball players, with no significant difference in flexibility observed between football and hockey players. A study by Singh and Kumar (2015) revealed no significant difference in flexibility among football and hockey players. The study attributed the reason for this finding to the nature of the football players' performances, where flexibility plays a vital role for optimum performance, similar to the hockey players. Our results were in contrast to Kant's (2017) findings, which revealed that there were significant differences among basketball and football players in backward flexibility (trunking) and right flexibility (trunking) (Kant, 2017). However, other study revealed that football players exhibit better flexibility than basketball players (Kariyawasam, et al., 2019).

The results also revealed that basketball players had more endurance than both football and hockey players, with no significant difference in endurance observed between football players and hockey players. Our findings aligned with other studies' findings (Kariyawasam, et al., 2019). Our findings partially conformed to those of Singh, et al. (2021), who found no significant differences in endurance as measured by sit-ups between football and hockey players (Singh, et al., 2021). Another study found that football players had better endurance than basketball players (Singh & Kaur, 2019); the same study also found no significant differences in endurance between football and hockey players or between hockey and basketball players (Singh & Kaur, 2019).

Conclusion

Based on these findings, it was clear that anthropometric and bio-motor characteristics distinguished between young male team sports players in the three major team sports disciplines. The factors primarily in play in these distinctions across team sports, however, varied depending on which sports disciplines were being contrasted. The study's findings could also be utilised to forecast an athlete's sport from a variety of anthropometric and bio-motor factors. This might be used to direct athletes' training toward a particular sport, but it could also be helpful for enhancing performance in weak areas. Therefore, it could be inferred that in addition to physiological traits, anthropometrical traits were one of the most important determinants in determining successful athletic performances in particular sports.

Ethical Approval

The study was approved by the Institutional Human Ethical Committee of Manipur University, Canchipur, Imphal (India) with Ref. No. MU/IHEC/2020/021 and informed consent was obtained from the participants.

Declaration of conflicting interests

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