EVALUATION OF PHYSIOLOGICAL CHARACTERISTICS IN TALENT IDENTIFICATION AMONG SOCCER PLAYERS IN THE INDIAN STATE OF MANIPUR

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KEYWORDS

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ABSTRACT

Background: Physiological characteristics offer a potent approach to understanding the underpinnings of human behaviour and provide information about the internal state of an individual. It involves the function of the circulatory, respiratory, and related systems during the activity. Some physiological characteristics, such as pulse rate, force vital capacity, slow vital capacity, maximum voluntary ventilation, aerobic capacity, and anaerobic capacity, have long been allied with accomplishment in certain sports. The main objective was to study how the physiological characteristics are assessed among soccer players in talent identification in Manipur. The minor objectives were to 1) assess the global physiological characteristics of soccer players; 2) investigate the influence of age on the physiological characteristics of soccer players; and 3) to develop a norm and grading scale for talent identification in physiological characteristics among soccer players. Method: The subjects were a group of soccer players in Manipur (N = 45) who regularly attend morning practise programmes organised by various clubs and academies affiliated to the All Manipur Football Association (AMFA). A simple random sampling technique was used to select the subjects. The age of the subjects ranged between 12 and 16 years. Descriptive statistics such as mean and standard deviation and inferential statistics such as one-way ANOVA were used as statistical techniques for data analysis. Data was collected during January and February 2023. Results: The results indicate the good global physiological condition of the players and the age of the players has nothing to do with all the selected physiological conditions of the players except Slow Vital Capacity. Conclusion: The study is significant because it can help certain people such as coaches, physiotherapy and athletes in intermittent team sports such as soccer to improve physiological functions. In addition, this study can also increase the knowledge of coaches and athletes, and show them how important it is to have efficient physiological conditions to improve their performances in their sport..

1.1 Introduction

Evaluation of physiological characteristics forms an important part of the science-based talent identification process among soccer players at an early age (Le Gall et al., 2010, Dodd, & Newans, 2018). Williams and Reilly (2000) define talent identification (TI) as the process of recognising current participants with the potential to become elite players (Williams & Reilly, 2000). Talent identification (TI) is big business (Wolstencroft, 2002) with the facilities and players being the main assets (Dodd & Newans, 2018). Sport scientists, researchers, and physical educationists are attempting to find a way to identify the best in sports (Wolstencroft, 2002). Club's officials are also cognizant of the significance of identifying talented youth soccer players at early ages (11 to 16 years old) and integrating them into their academies or youth teams (Dodd & Newans, 2018). This is true in the case of small clubs because early talent identification allows them to develop these players into elite soccer players. High transfer fees and high players' wages factors are also being attributed for the importance of early identification and selection especially for small clubs and academies because they could not afford these costs and have the risk of being financially crippled in comparison to larger clubs with large financial backers (Dodd & Newans, 2018). Dodd and Newans (2018) further added that if they had identified players at an early age, players could be brought into their clubs' playing system, with the concept of these players developing into top class soccer players (Dodd & Newans, 2018).

Soccer is considered as the most widely practiced worldwide sport, and efficient organization of the team is essential for optimal development of the abilities of every player (Gil et al. 2007), the control of the opponent, and the successful resolution of a match have received reasonable attention in the literature (Silva et al. 2010; Vescovi et al. 2011; Williams & Reilly 2000). In order to enthuse more competitiveness and qualitative improvement in the sport the promotion and relegation structure is prevalent in soccer leagues throughout the world, making the industry the most pressurized out of all sports (Dodd & Newans, 2018).

Sports talents can be identified in two ways: traditional TI and science-based TI. The former is categorised as *"natural selection"* (e.g., Bompa, 1994, 1999) and identification is usually aimed at individuals already in a sport (Wolstencroft, 2002) and has been linked to a coach or talent scout's subjective, preconceived image of the ideal player (Williams & Reilly, 2000). Whereas the latter was introduced by many Eastern European countries in the late 1960's and 1970's, which was based on scientific theory and evidence (Bompa, 1999) due to certain flaws in the previous process of TI. For instance, many argued that an individual's involvement in a particular sport may have resulted purely from peer or parental pressure, proximity of facilities, or of the sport's popularity in that geographical area, and it would be coincidental for an individual who chooses a sport in this way to excel (Wolstencroft, 2002). Therefore, performance progression in the activity would be gradual for the majority of those who had not *"happened upon"* their perfect match since training would be required to help them overcome intrinsic weaknesses (Wolstencroft, 2002). Another argument against the traditional approach to TI is its failure to consider the potential or developmental processes of young players (Dodd & Newans, 2018). Young players mature physically at differing rates, which plays a large part in talent identification programmes (Dodd & Newans, 2018). Maturation is dependent upon the timing and tempo of its process and has been shown to determine player selection into talent identification pathways due to the anthropometrical, aerobic, and anaerobic power advantages accompanying more mature players (Meylan et al., 2010).

Furthermore, individuals' physiological characteristics vary greatly based on the particular sport they play. Matching players with their best sport and preparing an athlete for success in his or her chosen sport both need careful evaluation of the qualities necessary for success in each sport. Intermittent team sports such as soccer tend to require their athletes to be physiologically fit in terms of pulse rate, force vital capacity, slow vital capacity, maximum voluntary ventilation, aerobic capacity, and anaerobic capacity. Therefore, soccer players must be trained in a variety of fitness disciplines due to the physiological demands of soccer (Svensson & Drust 2005), including aerobic capacity, aerobic power, speed, speed endurance, strength, power, and agility (Sayers, Sayers & Binkley 2008; Walker & Turner 2009; da Silva, Guglielmo & Bishop 2010; Yilmaz 2014). To that end, it becomes crucial for a team's success to be able to assess and find individuals that have these physiological traits.

In various team sports, coaches have utilised anthropometric and physiological traits to identify and recruit outstanding players, categorise starters vs. nonstarters, and stratify athletes by level of play (Houston & Green, 1976; Keogh, Weber & Dalton, 2003; Leone, Lariviere & Comtois, 2002). The development of a physiological profile specific to a sport would help coaches choose athletes from a much larger pool who have the physiological qualities to compete at their particular level, identify an athlete's strengths and weaknesses, and enable the development of training plans tailored to individual athletes that address their limitations. Therefore, it is crucial to include physiological evaluation through the use of adequate, valid, and trustworthy physiological fitness testing. However, selecting the most effective, and most efficient TI approach is a complex task, which despite its apparently recent 'rise' to prominence, has been a concern for quite a while (Wolstencroft, 2002). At the same time in India especially in Manipur due to lack of awareness and unavailability of science-based TI tools coaches or scouts have to rely on their subjective, preconceived image of the ideal player for identification and selection of young talented individuals (Williams & Reilly, 2000). In other words, talent identification programmes in soccer typically focus on the tactical and technical aspects (Dodd & Newans, 2018). However, omitting aspects such as physiological data risks players to slip through the identification process, especially those who experience late maturation (Dodd & Newans, 2018). At the same time, it is now considered that when used in isolation, this traditional approach to TI can result in repetitive misjudgements in talent identification processes (Meylan et al., 2010) and can lack reliability (Williams & Reilly, 2000).

The present authors have attempted to concentrate on the physiological profiles of junior soccer players in Manipur in order to determine what characteristics are relevant to their age-specific development. Then, a testing battery that concentrates on these qualities will be developed. It will be suggested how to use the testing battery while discussing trends in talent identification and their practical applications.

1.2 The objectives

The objectives were 1) to assess global physiological characteristics of the soccer players; 2) to study the influence of age on the physiological characteristics of soccer players; and 3) to develop a norm and grading scale for talent identification in physiological characteristics among soccer players.

1.3 Hypothesis of the Study

- **Predictive hypothesis:** The overall physiological characteristics of the soccer players would be good.

- **Testing hypothesis:** H_0: Age of the soccer players will not influence the physiological characteristics such as pulse rate, force vital capacity, slow vital capacity, maximum voluntary ventilation, aerobic capacity and anaerobic capacity, in contrast to alternative hypothesis H_a stated as, age of the soccer players will influence the physiological characteristics such as pulse rate, force vital capacity, slow vital capacity, maximum voluntary ventilation, aerobic capacity and anaerobic capacity.

1.4 Materials and methods

1.4.1 Selection of subject

The study involved 45 junior male soccer players from the Indian state of Manipur as the participants (mean ± SD: age 15.75 ± 0.72 years, height 160.50 ± 1.50 cm, weight 55.62 ± 1.36kg, BMI 21.60 ± 0.53). These players were randomly chosen from a group of junior soccer players of various soccer clubs and academies affiliated with the All Manipur Football Association (AMFA), such as: the Kangchup Road Young Physical & Sports Association (KRYPHSA); Th. Birachandra Singh Football Academy (TBSFA); Eroisemba Youth Development Club (EYDC); and Community Development Society (CDS). The subjects were informed about the purpose of the study and they volunteered to participate. The age of each subject was calculated from the date of birth as recorded in his birth-certificate submitted to the club/academy. Inclusion and exclusion criteria are given below.

- Only male soccer players aged 11 to 16 were recruited, and their female counterparts were left out.

- The soccer players whose ages were below 11 and above 16 were excluded.

- Those who were not willing to participate in the study were left out and those who volunteered to participate were included.

1.4.2 Selection of variables

A thorough literature search was done to determine the physiological characteristics of soccer players needed to compete at the highest level. Additionally, a review of the techniques for testing these qualities was done. The following dependent variables were selected: pulse rate, force vital capacity, slow vital capacity, maximum voluntary ventilation, aerobic capacity, and anaerobic capacity. The age of the subject has been considered as an independent variable in the study.

1.4.3 Criterion Measures

- ***Pulse Rate:*** The pulse rate of the subjects was measured by the palpatory method (pulse rate count) and was recorded in the number of pulses per minute. This measure was chosen to test whether the subject's heart function was more efficient and whether they had better cardiovascular fitness. Pulse rate measures have received growing interest in recent decades and are considered potentially useful within multivariate response monitoring, as they provide non-invasive and time-efficient insights into the status of the autonomic nervous system (ANS) and aerobic fitness (Schneider et al., 2018). Although pulse rate is one of the most common physiological variables used to determine exercise internal training load, the use of heart rate (HR) monitoring is not standardized in soccer (Dellal et al., 2012).

- ***Force Vital Capacity (FVC):*** The force vital capacity (FVC) of subjects was measured using the Spiro Tech software device and was used and recorded in litres. FVC is used to evaluate a subject's lung function. The forced vital capacity test is when the subject exhales as hard and fast as possible. It is equivalent to the quantity of inspiratory reserve volume, tidal volume, and expiratory reserve volume (Akbarnia et al., 2015). It measures clinically requested spirometers, either wet or dry (Kumar, 2016). Its combination with other physiological measurements can help to diagnose the underlying lung disease (Seikel et al., 2015). To the best of our knowledge, currently available studies in talent identification literature do not focus on FVC as an evaluation tool of soccer players' physiological attributes.

- ***Slow Vital Capacity (SVC):*** A Spiro Tech software instrument assessed a subject's slow vital capacity (SVC). The measurement was made in litres. The participant exhales slowly during the slow vital capacity test, which is somewhat similar to the forced vital capacity test. In this instance, the person inhales fully before gradually exhaling every last bit of air from his or her lungs. The test is then run backward, and the subject gradually inspires till the maximum point. A FVC manoeuvre or a slow vital capacity (SVC) manoeuvre can be used in order to determine vital capacity (VC) (Barros, Pires & Raposo, 2013). The difference between SVC and FVC (SVC-FVC) is essentially nil in healthy persons; however, in the presence of airway obstruction, these changes can become noticeable and are mostly associated with the presence of lung hyperinflation (Constán et al., 2005).

- ***Maximal Voluntary Ventilation:*** A Spiro Tech software equipment was used to assess the individuals' maximum voluntary ventilation (MVV), which was measured in litres. The volume of air that a person may take and subsequently exhale in a 12- to 15-second period while making their highest voluntary effort is known as the maximal voluntary ventilation (MVV) (Neder et al., 1999). This manoeuvre is used to assess maximal ventilator capacity (Colwell and Bhatia, 2017) and respiratory muscle endurance. It also provides information on how the inspiratory pump and chest wall work.

- ***Aerobic Capacity:*** Cooper's 12-minute run-walk test was used to measure aerobic capacity, and the distance covered in metres was recorded. In mL/kg/min, the aerobic capacity (VO2 max) was measured. In the Cooper 12-minute run-walk test, the subject must run or walk as far as they can in 12 minutes. The goal of the test is to determine the individual's greatest distance travelled throughout the 12-minute session (Cooper, 1968). Numerous coaches and trainers use it to assess cardiovascular fitness and monitor fitness progress over time.

- ***Anaerobic Power:*** Anaerobic power is determined using the Sargent-Lewis Nomogram. Watts are the units used to measure anaerobic power. Dr. Dudley Allen Sargent created the Sargent Jump Test (Sargent 1921), commonly referred to as the vertical jump test (1849–1924). Power units may be converted from vertical leap height. For instance, methods that calculate power from data of vertical jumps have been created. A frequently used formula is the Lewis formula, often known as the Nomogram (Fox & Mathews, 1974).

1.4.3 Test administration

The test administration was done during January and February 2023 after getting written consent from the participants themselves and a go-ahead notice from the clubs and academies administrators at the respective clubs and academies facilities during their normal morning practise and training routine.

1.5 Analysis and interpretation

To analyse the data on talent identification on selected physiological characteristics among team junior male soccer players, frequency, percentages, mean, median, standard deviation, one-way ANOVA test was employed. The level of significance was set at 0.05. The results of the data analysis have been presented as follows.

1.5.1 The Global physiological characteristics of soccer players in Manipur

Table 1: Global physiological characteristics of soccer players in Manipur

Grade	*Frequency*	*Percentages*
Excellent	0	00%
Good	25	56%
Average	09	20%
Satisfactory	10	22%
Poor	01	2%
Total	***45***	***100%***

The global physiological characteristics refers to the overall physiological characteristics of soccer players. Table 1 reveals the global physiological characteristics of soccer players in Manipur as Excellent 0%, Good 55.55%, Average 20.00%, Satisfactory 22.00%, and Poor 2.22%. The maximum number of soccer players in Manipur falls under the category of good physiological characteristics. The results indicate the good global physiological condition of the players.

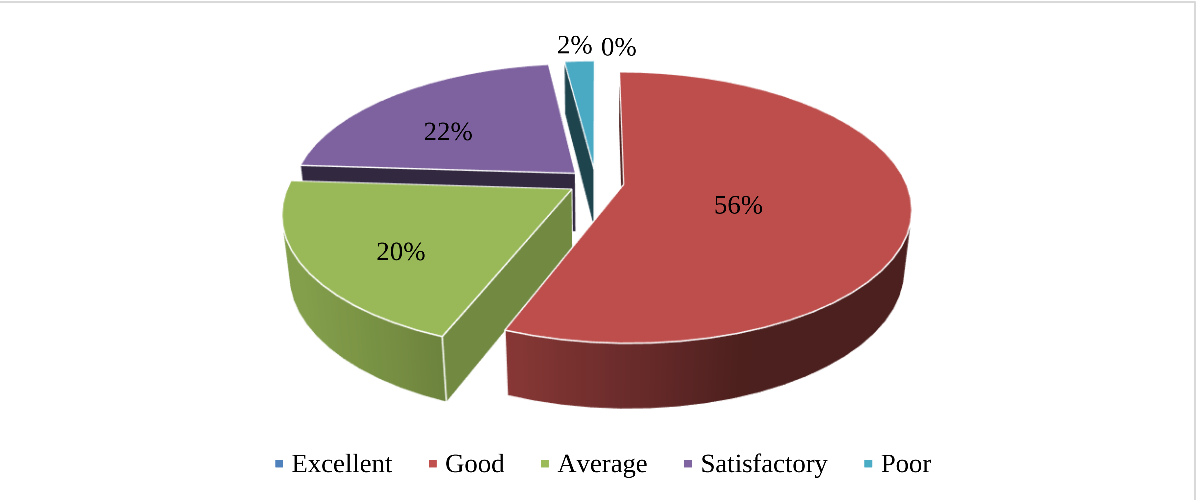

Figure 1: Pie Chart showing the global physiological characteristics of soccer players

1.5.2 Pulse rate variations according to age

Table 2: Descriptive statistics and ANOVA results (Pulse Rate)

Variable	*N*	*M*	*SD*	*F*	p-value
Below -13	13	79.38	8.21		
13-14 yrs.	13	78.77	11.10	0.044	0.957
Above 14	19	78.11	15.56		

*Significance at 0.05

Source: Computed from field data

Table 2 shows the mean and standard deviation values obtained in pulse rate by different age group such as below-13, 13-14, and above-14 years as (*M* = 79.38, *SD* = 8.21), (*M* = 78.77, *SD* =11.10), and (*M* = 78.11, *SD* = 15.56). The ANOVA results revealed the mean difference in pulse rate between the different age groups was insignificant; $F_{(2, 42)} = 0.044$, $p = 0.957$. The null hypothesis was retained. Age of the soccer players had nothing to do with their pulse rate.

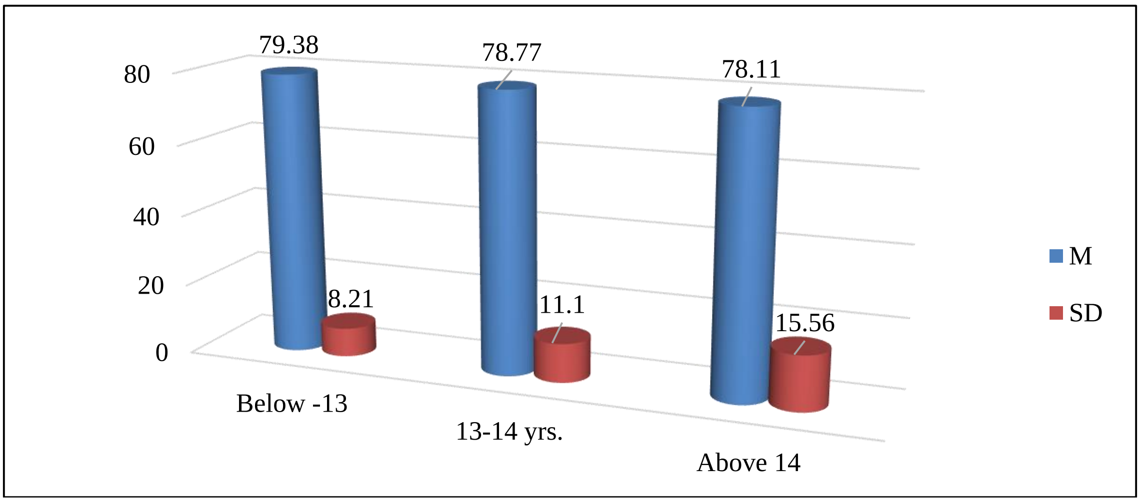

Figure 2: Pulse rate variations of soccer players according to age groups

1.5.3 Force vital capacity variations according to age

Table 3: Descriptive statistics and ANOVA results (Force Vital Capacity)

Variable	*N*	*M*	*SD*	*F*	p-value
Below -13	13	93.57	3.96		
13-14 yrs.	13	94.62	4.27	0.428	0.655
Above 14	19	94.78	2.98		

*Significance at 0.05

Source: Computed from field data

Table 3 shows the mean and standard deviation values obtained in force vital capacity by different age group such as below-13, 13-14, and above-14 years as (*M* = 93.57, *SD* = 3.96), (*M* = 94.62, *SD* = 4.27), and (*M* = 94.78, *SD* = 2.98). The ANOVA results revealed the mean difference in force vital capacity between the different age groups was insignificant; $F_{(2,42)} = 0.428$, $p = 0.655$. The null hypothesis was retained. Age of the soccer players had nothing to do with force vital capacity.

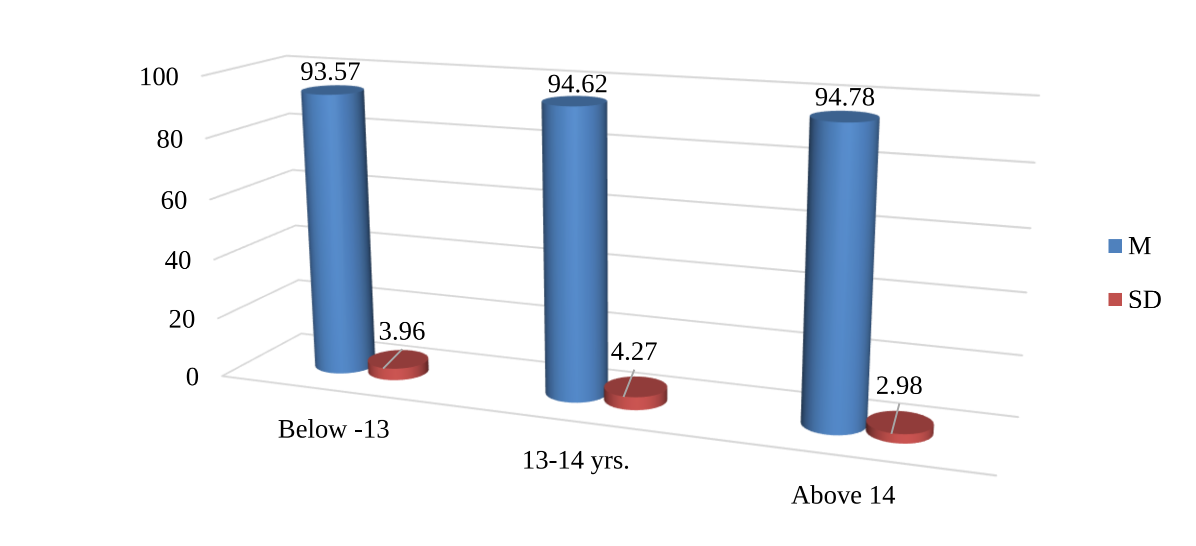

Figure 3: Force vital capacity variations of soccer players according to age groups

1.5.4 Slow vital capacity variations of according to age

Table 4: Descriptive statistics and ANOVA results (Slow Vital Capacity)

Variable	***N***	***M***	***SD***	***F***	**p-value**
Below -13	13	3.01	0.24		
13-14 yrs.	13	3.14	0.18	4.683*	0.015
Above 14	19	3.24	0.18		

*Significance at 0.05

Source: Computed from field data

Table 4 shows the mean and standard deviation values obtained in slow vital capacity by different age group such as below-13, 13-14, and above-14 years as (*M* = 3.01, *SD* = 0.24), (*M* = 3.14, *SD* = 0.18), and (*M* = 3.24, *SD* = 0.18). The ANOVA results revealed the mean difference in slow vital capacity between the different age groups was significant; $F_{(2, 42)}$ = 4.683, *p* = 0.015. The null hypothesis was rejected and an alternative one retained. Age of the soccer players influenced their slow vital capacity. Post hoc analysis (Tukey's HSD Test) revealed that above-14 years old soccer players had better slow vital capacity than their below-13 years old counterparts (*p*=0.015).

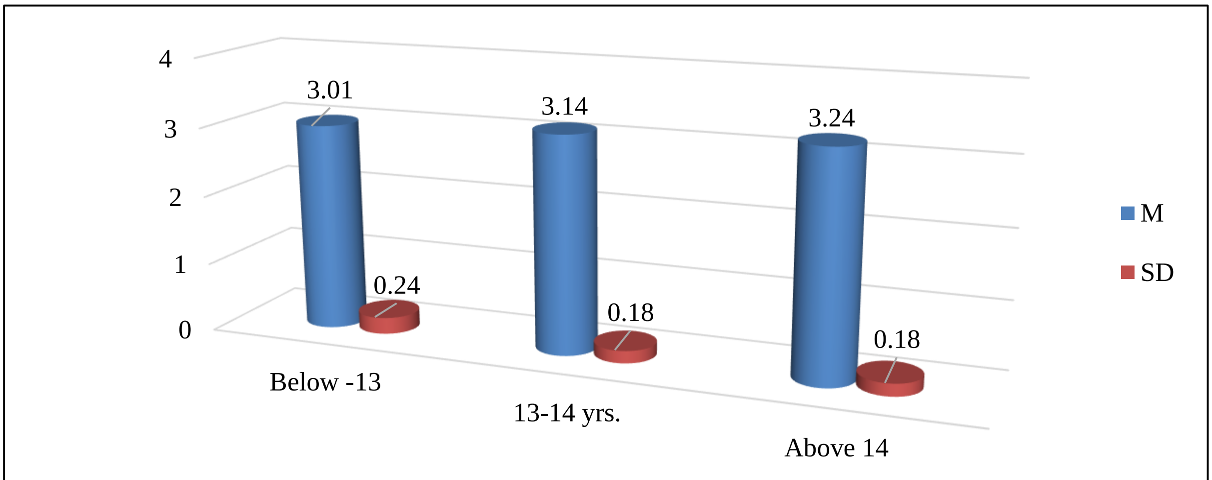

Figure 4: Slow vital capacity variations of soccer players according to age groups

1.5.5 Maximum voluntary ventilation variations according to age

Table 5: Descriptive statistics and ANOVA results (Maximum Voluntary Ventilation)

Variable	*N*	*M*	*SD*	*F*	*p-value*
Below -13	13	98.80	16.96		
13-14 yrs.	13	103.09	15.01	0.326	0.723
Above 14	19	102.55	11.02		

*Significance at 0.05

Source: Computed from field data

Table 5 shows the mean and standard deviation values obtained in maximum voluntary ventilation by different age group such as below-13, 13-14, and above-14 years as (*M* = 98.80, *SD* = 16.96), (*M* = 103.09, *SD* =15.01), and (*M* = 102.55, *SD* = 11.02). The ANOVA results revealed the mean difference in slow maximum voluntary ventilation between the different age groups was insignificant; $F_{(2, 42)} = 0.326$, $p = 0.723$. The null hypothesis was retained. Age of the soccer players had nothing to do with maximum voluntary ventilation.

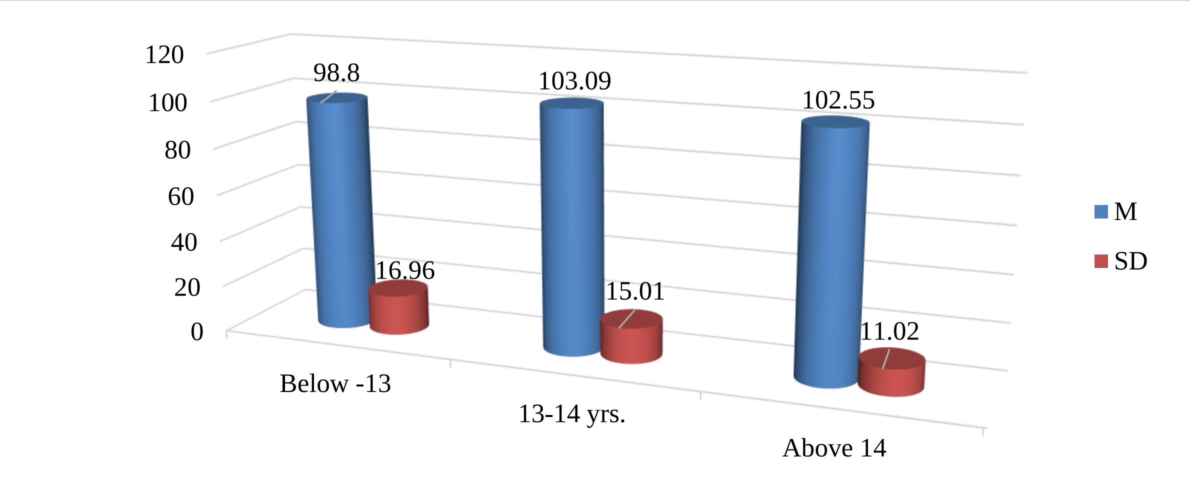

Figure 5: Maximum voluntary ventilation variations of soccer players according to age

1.5.6 Anaerobic power variations according to age

Table 6: Descriptive statistics and ANOVA results (Anaerobic power)

Variable	*N*	*M*	*SD*	*F*	*p-value*
Below -13	13	1199.27	165.84		
13-14 yrs.	13	1205.22	246.27	0.021	0.979
Above 14	19	1218.05	311.82		

*Significance at 0.05

Source: Computed from field data

Table 6 shows the mean and standard deviation values obtained in anaerobic power by different age group such as below-13, 13-14, and above-14 years as (*M* = 1199.27, *SD* = 165.84), (*M* = 1205.22, *SD* = 246.27), and (*M* = 1218.05, *SD* = 311.82). The ANOVA results revealed the mean difference in anaerobic capacity between the different age groups was insignificant; $F_{(2, 42)} = 0.021$, $p = 0.979$. The null hypothesis was retained. Age of the soccer players had nothing to do with anaerobic power.

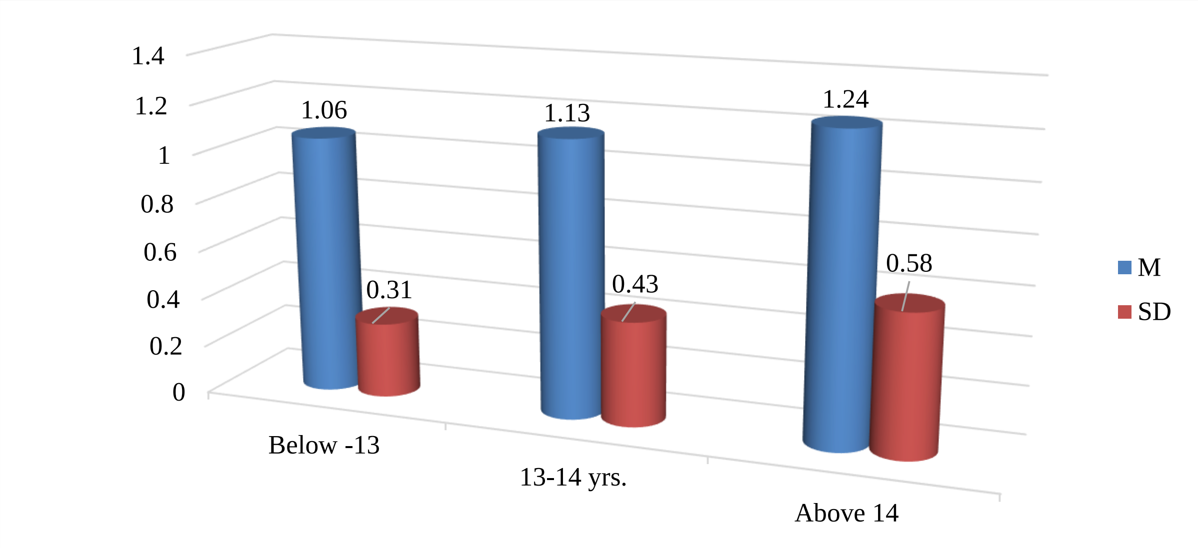

Figure 6: **Anaerobic power variations of soccer players according to age**

1.5.7 Aerobic capacity variations of soccer players according to age

Table 7: Descriptive statistics and ANOVA results (Aerobic Capacity)

Variable	*N*	*M*	*SD*	*F*	*p-value*
Below -13	13	45.38	4.47		
13-14 yrs.	13	45.59	4.35	0.524	0.596
Above 14	19	44.25	2.97		

*Significance at 0.05

Source: Computed from field data

Table 7 shows the mean and standard deviation values obtained in aerobic capacity by different age group such as below-13, 13-14, and above-14 years as ($M = 45.38$, $SD = 4.47$), ($M = 45.59$, $SD = 4.35$), and ($M = 44.25$. $SD = 2.97$). The ANOVA results revealed the mean difference in aerobic capacity between the different age groups was insignificant; $F_{(2, 42)} = 0.524$, $p = 0.596$. The null hypothesis was retained. Age of the soccer players had nothing to do with aerobic capacity.

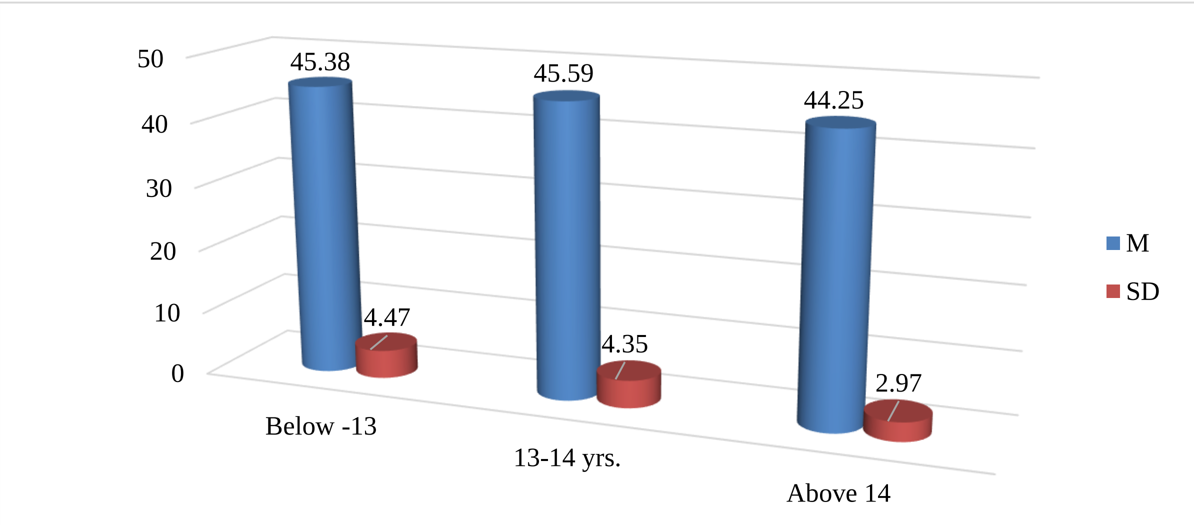

Figure 7: Aerobic capacity variations of soccer players according to age groups

1.6 Development of a grading scale for interpreting physiological conditions for male football players

All the subjects' scores on physiological tests were converted into composite scores (see table 9), having a mean value of 255.36 and a median value of 257.65 with a standard deviation of 43.74 (see table 8). Based on the percentile scores/norms found in table 9, a scale was developed to calculate the scores (physiological conditions) as shown in table 10. The global physiological condition as shown in table number 1 has been calculated based on the scale in table number 10.

Table 8: Mean, median and standard deviation values of the physiological test items and the composite scores

Test items	N	Mean	Median	St. Dev.
Pulse Rate	45	78.67	76.00	11.76
FVC	45	94.38	94.63	3.76
SVC	45	3.15	3.15	0.22
MVV	45	101.62	98.73	14.81
Aerobic capacity	45	45.43	44.27	4.13
Anaerobic power	45	1208.92	1207.62	260.96
Composite scores	***45***	***255.36***	***257.65***	***43.74***

Source: Computed from the field survey data

Table 9: The percentile scores/norms of soccer players on physiological test items and their composite scores

Percentiles	Pulse Rate	Force Vital Capacity	Slow Vital Capacity	Maximal Voluntary Ventilation	Aerobic Capacity	Anaerobic Power	Composite Scores
100	101.00	99.24	3.51	150.55	54.73	1844.25	362.64
95	99.40	99.10	3.49	133.08	53.86	1679.59	335.30
90	97.00	98.65	3.43	119.01	51.44	1530.87	309.00
85	95.10	98.54	3.40	114.01	51.26	1454.29	296.57
80	91.80	98.35	3.33	113.28	50.55	1408.36	291.33
75	87.50	97.64	3.30	112.42	48.55	1361.78	282.45
70	85.40	97.32	3.24	110.01	47.31	1338.06	279.61
65	82.00	96.99	3.20	107.02	45.88	1309.76	270.06
60	80.60	96.52	3.19	101.24	45.35	1281.37	266.55
55	77.60	94.93	3.19	99.80	44.99	1260.77	265.28
50	76.00	94.63	3.15	98.73	44.27	1207.62	257.65
45	74.70	94.25	3.11	97.77	43.80	1197.18	251.28
40	74.00	94.06	3.10	96.68	43.69	1129.14	242.88
35	72.10	92.79	3.08	95.02	42.97	1113.07	236.93
30	70.80	92.24	3.06	92.43	42.67	1093.97	235.21
25	70.00	91.57	3.02	90.02	42.22	1032.83	229.09
20	70.00	91.23	3.00	88.74	41.43	986.49	218.19
15	67.90	90.44	3.00	86.82	40.73	959.30	212.00
10	64.60	88.66	2.95	83.62	40.68	858.72	194.76
5	59.50	86.42	2.77	81.56	40.43	697.15	170.09

Source: Computed from the field survey data

Table 10: Grading scale for the interpretation of physiological conditions of soccer players

Quantitative Interpretation	Qualitative Interpretation	Grade
Above 300	Very Good	A
275 to 300	Good	B
265 to 275	Average	C
225 to 265	Poor	D
Below 225	Very Poor	E

1.7 Discussion of Findings

This study hypothesised that the overall physiological conditions of junior male soccer players in Manipur would be good. It was confirmed by our results estimated through the newly established norms and sigma scale for the purpose of the study. We have included physiological variables such as pulse rate, force vital capacity, slow vital capacity, maximal voluntary ventilation, aerobic capacity and anaerobic capacity in the comprehensive physiological profiles of the junior male soccer players. However, in prior TI literature, relevant effort has been devoted to the evaluation of aerobic and anaerobic endurance, but poor attention has been paid to ventilator capacity in soccer players (Di Paco et al., 2014). Furthermore, previous research has shown that aerobic capacity and vital capacity influence each other (Goral, 2014; Mohammed et al., 2016; Mohammed, 2017) and vital capacity is the limiting factor of aerobic capacity (Grupe et al., 2012). Previous research has shown that genetic factors, ethnic characteristics, environmental pollution, physical activity, altitude, and, to a lesser extent, nutritional and socioeconomic factors all influence pulmonary function values (American Thoracic Society, 1991; Hankinson et al., 1999; Forastiere et al., 1994; MacAuley et al., 1999; Fiori et al., 2000; Harik-Khan et al., 2004; Raju et al., 2005). Generally, physically fit athletes showed better pulmonary functions relative to less fit subjects (Johnson et al., 1981; Johnson et al., 1991). Several authors have already suggested that talent identification procedures should include more representative measures (Vaeyens et al., 2008; Unnithan et al., 2012; Breitbach, Tug & Simon, 2014; Johnston et al., 2018).

The study also assumed that the physiological characteristics of the soccer players would be different based on their age differences. However, our assumption could only be confirmed in the case of slow vital capacity (SVC) and inferred that above-14-year-old soccer players had better slow vital capacity than their below 13 year-old counterparts (p = 0.015). This could be explained by the fact that we had no control over other significant variables such as the players' training regimen, environmental conditions, and dietary habits. The age difference has nothing to do with other physiological characteristics such as pulse rate, FVC, MVV, aerobic capacity, and anaerobic power of the soccer players. Determining relevant differences in performance would be challenging due to the population under study's physiological profiles being presumably homogeneous (Williams & Reilly, 2000). A prior finding by Beboucha et al. (2021) revealed that talent selection models with the single dimensions lead in general to significant predictions with the aim of an early differentiation between 11-12 years and 13 years old players (Beboucha et al., 2021). Corresponding to this talent identification problem in soccer, is the well-reported relative age effect (Helsen et al., 2005; Mujika et al., 2009). Chronologically, there seems to be a greater predominance of players born early in the selection year within youth (Helsen et al., 2005; Vaeyens et al., 2005; Williams, 2010). The relative age effect is particularly prevalent during the adolescent years (Jiminez & Pain, 2008). Cross-sectional studies carried out by Gil et al. (2007) and Carling et al. (2009) suggested that 79% and 72% of players respectively were born within the first 6 months of the selection year within elite U-14 soccer clubs. These observations provide evidence to suggest that potentially promising young players are overlooked at youth level (Campo et al., 2010). A disconnect appears to exist between the criteria used for talent identification and the applicability of this information for predicting future playing time (Unnithan et al., 2012). Unnithan et al. (2012) further speculated that match- related variables may provide a much more accurate marker of the true extent and effect of the relative age effect in soccer (Unnithan et al., 2012).

Based on these findings, the conclusion may be that these variables are not very useful for differentiating junior male soccer players' relative age effect. However, it would be incorrect to assume that these traits are unimportant for success in soccer in general (Ackerman, 2014). It is likely that the sample of academy players were exposed to the same training routine, had similar practise histories, and were (directly or indirectly) preselected on at least some of the variables in this study (Bergkamp et al., 2019). There is less volatility in the predictors and the criterion as a result of this pre-selection of athletes within a physically homogenous group of athletes. Larger effect sizes would have most certainly been discovered for at least some of these variables if the same factors were investigated in a more diverse population of soccer players (Williams & Reilly, 2000; Ackerman, 2014) (e.g., Franks et al., 1999).

Further, based on the percentile scores/norms, a composite grading scale has also been developed to measure the physiological conditions of soccer players' ages between 11 and 16 years. Beboucha et al. (2021) further argued that many talent identification models showed superiority over random predictions and were also calibrated appropriately for the U11, U12, and U13 age groups (Beboucha et al., 2021). Therefore, it is recommended that clubs and academies avoid selecting players guided by unilateral criteria favouring only physical and morphological advantages (Vandendriessche et al. 2012). Tactical, technical, and psychological qualities together with physiological capabilities manifest themselves in symbiosis during the game and should be seen in that way during selection, detection, and sporting formation processes (Jones & Drust 2007).

The study has suffered from three limitations, such as its cross-sectional nature, limited number of participants, and confinement of the study to a group of male soccer players' ages between 11 and 16 years of age. To determine whether the successful attributes shown in soccer at this age group might serve as a predictor of future playing success, future study should aim to use longitudinal studies with larger sample sizes including female players. To best identify this complicated process, further research on the underlying mechanisms influencing young soccer players' growth may benefit from the findings of this study.

1.8 Conclusion

This study examined the physiological components of talent identification in male junior soccer players, focusing on six key parameters: pulse rate, forced vital capacity, slow vital capacity, maximum voluntary ventilation, aerobic capacity, and anaerobic power. Measurements of these parameters were conducted to establish benchmarks for identifying talent in soccer. Based on the findings, normative data were developed to guide coaches in evaluating physiological traits effectively. A comprehensive and practical testing routine was proposed, integrating these tests to assess the physiological capacity of players. This routine was designed to accommodate the varying resources available to clubs and academies.

The feasibility of using a battery of tests as an evaluation tool for young soccer players was also explored. The findings of this study are particularly significant for coaches, physiotherapists, and athletes involved in intermittent team sports like soccer, as they provide insights into improving physiological functions. Additionally, this research highlights the importance of maintaining optimal physiological conditions for enhancing athletic performance. By increasing the knowledge of coaches and athletes, the study emphasizes the critical role of physical fitness in achieving success in soccer.

1.9 Ethical Approval

The study was approved by the Institutional Human Ethical Committee of Manipur University, Canchipur, Imphal, India (Reference No. MU/IHEC/2024/13). Informed consent was obtained from all participants prior to their involvement in the study.

1.10 Conflicts of interest

The authors declare that they have no conflicts of interests regarding this study.

References

Ackerman, P. L. (2014). Nonsense, common sense, and science of expert performance: Talent and individual differences. Intelligence, 45, 6–17. https://doi.org/10.1016/j.intell.2013.04.009.

Akbarnia, B. A., Yazici, M., & Thompson, G. H. (2015). The Growing Spine: Management of Spinal Disorders in Young Children. UK: Springer Shop.

American Thoracic Society (1995). Medical section of the American lung association. standardization of spirometry. 1994 update. American Journal of Respiratory of Critical Care Medicine, 152(3), 1107–1136. https://doi: 10.1164/ajrccm.152.3.7663792.

Barros, A. R., Pires, M. B., & Raposo, N. M. (2013). Importance of slow vital capacity in the detection of airway obstruction. Jornal Brasileiro de Pneumologia: Publicacao oficial da Sociedade Brasileira de Pneumologia e Tisilogia, 39(3), 317–322. https://doi: 10.1590/S1806-37132013000300008.

Beboucha, W., Belkadi, A., Benchehida, A., & Bengoua, A. (2021). The anthropometric and physiological characteristics of young Algerian soccer players. Acta Facultatis Educationis Physicae Universitatis Comenianae, 61(1), 35–51. https://doi: 10.2478/afepuc-2021-0004.

Bergkamp, T., Niessen, A., den Hartigh, R., Frencken, W., & Meijer, R. R. (2019). Methodological issues in soccer talent identification research. Sports Medicine (Auckland, N. Z.), 49(9), 1317–1335. https://doi: 10.1007/s40279-019-01113-w.

Bompa, T. O., & Haff, G. G. (2009). Periodization: Theory and Methodology of Training. Human Kinetics.

Bompa, T. O. (1994). Theory and Methodology of Training: The Key to Athletic Training. Champaign: Human Kinetics.

Bompa, T. O. (1999). Periodization: Theory and Methodology of Training. Champaign: Human Kinetics.

Breitbach, S., Tug, S., & Simon, P. (2014). Conventional and genetic talent identification in sports: will recent developments trace talent? Sports Medicine, 44(11), 1489–1503. https://doi: 10.1007/s40279-014-0221-7.

Campo, D. G., Vicedo, J. C., Villora, S. G., & Jordan, O. R. (2010). The relative age effect in youth soccer players from Spain. Journal of Sport Science and Medicine, 9(2), 190–198.

Carling, C., Le Gall, F., Reilly, T., & Williams, A. M. (2009). Do anthropometric and fitness characteristics vary according to birth date distribution in elite youth academy soccer players? Scandinavian Journal of Medicine and Science in Sports, 19(1), 3–9. https://doi.org/10.1111/j.1600-0838.2008.00867.x.

Colwell, K. L., & Bhatia, R. (2017). Calculated versus measured MVV—surrogate marker of ventilatory CPET. Medicine and Science in Sports and Exercise. 49(10), 1987–1992. https://doi: 10.1249/MSS.0000000000001318.

Cooper, K. (1968). A means of assessing maximal oxygen intake correlation between Field and treadmill testing. Journal of American Medical Association, 203(3), 201–204. PMID: 5694044.

Da Silva, J. F., Guglielmo, L. G. A., & Bishop, D. (2010). Relationship between different measures of aerobic fitness and repeated-sprint ability in elite soccer players. The Journal of Strength & Conditioning Research. 24(8), 2115–2121. https://doi: 10.1519/JSC.0b013e3181e34794.

Daniels, J. (2013). Physiological characteristics of champion male athletes. Research Quarterly. American Alliance for Health, Physical Education and Recreation, 45(4), 342–348. https://doi:10.1080/10671315.1974.10615282.

Dellal, A., Da Silva, C., Hill-Haas, S., Wong, Del P., Natali, A., Lima, J., Filho, M., Marins, J., Garcia, E., & Chamari, K. (2012). Heart rate monitoring in soccer: Interest and limits during competitive match play and training, practical application. Journal of Strength and Conditioning Research / National Strength & Conditioning Association. 26(10), 2890–2906. https://doi: 10.1519/JSC.0b013e3182429ac7.

Di Paco, A., Catapano, G. A., Vagheggini, G., Mazzoleni, S., Micheli, M. L., & Ambrosino, N. (2014). Ventilatory response to exercise of elite soccer players. Multidisciplinary Respiratory Medicine, 9(1), 20. https://doi: 10.1186/2049-6958-9-20.

Dodd, K. & Newans, T. (2018). Talent identification for soccer: Physiological Aspects. Journal of Science and Medicine in Sport. 21(10), 1073–1078. https://doi: 10.1016/j.jsams.2018.01.009.

Fiori, G., Facchini, F., Ismagulov, O., Ismagulova, A., Tarazona-Santos, E., & Pettener, D. (2000). Lung volume, chest size, and hematological variation in low-, medium-, and high-altitude Central Asian populations. American Journal of Physical Anthropology, 113(1), 47–59. https://doi.org/10.1002/1096-8644(200009)113:1<47::AID-

AJPA5>3.0.CO;2-K.

Forastiere, F., Corbo, G. M., Pistelli, P., Michelozzi, P., Agabiti, N., Brancato, G., Ciappi, G., & Perucci, C. A. (1994). Bronchial responsiveness in children living in areas with different air pollution levels. Archives of Environmental and Occupational Health, 49, 111–118. https://doi: 10.1080/00039896.1994.9937463.

Fox, E. L. & Mathews, D. K. (1973). The Interval Training: Conditioning for Sports and General Fitness. Philadelphia PA: Saunders. p. 257–258. https://doi:10.1080/ 00221473.1973.10621921.

Franks, A. M., Williams, A. M., Reilly, T., & Nevill, A. M. (2002). Talent identification in elite youth soccer players: Physical and physiological characteristics. In T. Reilly & A. M. Williams (Eds.), Science and football IV (1st ed., pp. 6). Routledge. https://doi.org/10.4324/9781315823775.

Gil, S. M., Gil, J., Ruiz, F., Irazusta, A., & Irazusta, J. (2007). Physiological and anthropometric characteristics of young soccer players according to their playing position: relevance for the selection process. Journal of Strength and Conditioning Research, 21(2), 438–445. https://doi: 10.1519/R-19995.1.

Gil, S., Ruiz, F., Irazusta, A., Gill, J., & Irazusta, J. (2007). Selection of young soccer players in terms of anthropometric and physiological factors. Journal of Sports Medicine and Physical Fitness, 47(1), 25–32. PMID: 17369794.

Goral, K. (2014). The examination of the relationship between maximum aerobic power, forced vital capacity and body composition in soccer players. Journal of Physical Education & Sports Science, 8(2), 173–179.

Grupe, O., Kurz, D., & Teipel, J. M. (2012). Sport in the Modern World Chances and Problems. UK: Springer Publishing.

Harik-Khan, R. I., Muller, D. C., & Wise, R. A. (2004). Racial difference in lung function in African–American and White children: Effect of anthropometric, socioeconomic, nutritional and environmental factors. American Journal of Epidemiology, 160(9), 893–900. https://doi: 10.1093/aje/kwh297.

Helsen, W. F., Hodges, N. J., Van Winckel, J., & Starkes, J. L. (2000). The roles of talent, physical precocity and practice in the development of soccer expertise. Journal of Sports Sciences, 18(9), 727–736. https://doi: 10.1080/02640410050120104.

Hankinson, J. L., Odencrantz, J. R., & Fedan, K. B. (1999). Spirometric reference values from a sample of the general U.S. population. American Journal of Respiratory Critical Care Medicine, 159(1), 179–187. https://doi: 10.1164/ajrccm.159.1.9712108.

Houston, M. E., & Green, H. J. (1976). Physiological and anthropometric characteristics of elite Canadian ice hockey players. Journal of Sports

Medicine and Physical Fitness 16(2), 123–128. PMID: 966746.

Jimenez, I. P., & Pain, M. T. (2008). Relative age effect in Spanish association football: Its extent and implications for wasted potential. Journal of Sports Sciences, 26, 995–1003. https://doi.org/10.1080/02640410801910285.

Johnston, K., Wattie, N., Schorer, J., & Baker, J. (2018). Talent identification in sport: a systematic review. Sports Medicine, 48(1), 97–109. https://doi: 10.1007/s40279-017-0803-2.

Jones, S., & Drust, B. (2007). Physiological and technical demands of 4 V 4 and 8 V 8 games in elite youth soccer players. Kinesiology, 39(2), 150–156.

Keogh, J. W., Weber, C. L., & Dalton, C. T. (2003). Evaluation of anthropometric, physiological, and skill-related tests for talent identification in female field hockey. The Canadian Journal of Applied Physiology, 28(3), 397–409. https://doi: 10.1139/h03-029.

Kumar, B. U. (2016). Handbook of Mechanical Ventilation. New Delhi: The Health Sciences Publisher.

Le Gall, F., Carling, C., Williams, M., & Reilly, T. (2010). Anthropometric and fitness characteristics of international, professional and amateur male graduate soccer players from an elite youth academy. Journal of Science and Medicine in Sport, 13(1), 90–95. https://doi: 10.1016/j.jsams.2008.07.004.

Leone, M., Lariviere, G., & Comtois, A. S. (2002). Discriminant analysis of anthropometric and biomotor variables among elite adolescent female athletes in four sports. Journal of Sports Science, 20(6), 443–449. https://doi: 10.1080/02640410252925116.

MacAuley, D., McCrum, E., Evans, A., Stott, G., Boreham, C., & Trinick, T. (1999). Physical activity, physical fitness and respiratory function–exercise and respiratory function. Irish Journal of Medical Science, 168(2), 119–123. https://doi: 10.1007/BF02946480.

Mangine, R. E., Noyes, F. R., Mullen, M. P. & Barber, S. D. (1990). A physiological profile of the elite soccer athlete. Journal of Orthopedic and Sports Physical Therapy, 12, 147–152. https://doi:10.2519/JOSPT.1990.12.4.147.

Meylan, C., Cronin, J., Oliver, J., & Hughes, M. (2010). Talent identification in soccer: The role of maturity status on physical, physiological and technical characteristics. International Journal Sport Science Coach, 5(4), 571–592. https://doi.org/10.1260/1747-9541.5.4.571.

Mohammed, Z. (2017). Maximal aerobic capacity versus vital capacity which Cassel relationships determine the cardiorespiratory fitness among soccer players. Turkish Journal of Kinesiology, 3(3), 49–53.

Mohammed, Z., Abelatif, H., Mokhtar, M., & Ali, B. (2016). Height versus weight which Cassel parameter determines pulmonary functions fitness among the

Algerians soccer players. Journal of Pulmonary Medicine and Respiratory Research, 6(3), 1–3. http://dx.doi.org/10.4172/2161-105X.1000353.

Mujika, I., Vaeyens, R., Matthys, S. P., Santisteban, J., Goiriena, J., & Philippaerts, R. (2009). The relative age effect in a professional football club setting. Journal of Sports Sciences, 27(11), 1153–1158. http://doi: 10.1080/02640410903220328.

Neder, J. A., Andreoni, S., Lerario, M. C., & Nery, L. E. (1999). Reference values for lung function tests: II. Maximal respiratory pressures and voluntary ventilation. Brazil Journal of Medicine and Biological Research, 32(6), 719–727. http://doi: 10.1590/s0100-879x1999000600007.

Raju, P. S., Prasad, K. V., Ramana, Y. V., Balakrishna, N., & Murthy, K. J. (2005). Influence of socioeconomic status on lung function and prediction equations in Indian children. Pediatric Pulmonology, 39(6), 528–536. https://doi.org/10.1002/ppul.20206.

Sargent, D. A. (1921). The physical test of a man. American Physical Education Review, 26(4), 188–194. https://doi.org/10.1080/23267224.1921.10650486.

Seikel, J. A., Drumright, D. G., & King, D. W. (2015). Anatomy & Physiology for Speech, Language, and Hearing. US: Cengage Learning.

Schneider, C., Hanakam, F., Wiewelhove, T., Doweling, A., Kellmann, M., Meyer, T., Pfeiffer, M., . Ferrauti, A. (2018). Heart rate monitoring in team sports—A conceptual framework for contextualizing heart rate measures for training and recovery prescription. Frontiers in Physiology, 9, 1–19. https://doi.org/10.3389/fphys.2018. 00639.

Coelho E Silva, M. J., Figueiredo, A. J., Simoes, F., Seabra, A., Natal, A., Vaeyens, R., Philippaerts, R., Cumming, S. P., & Malina, R. M. (2010). Discrimination of u-14 soccer players by level and position. International journal of sports medicine, 31(11), 790–796. https://doi.org/10.1055/s-0030-1263139.

Svensson, M., & Drust, B. (2005). Testing soccer players. Journal of Sports Sciences. 23(6), 601–618. https://doi.org/10.1080/02640410400021294.

Unnithan, V., White, J., Georgiou, A., Iga, J., & Drust, B. (2012). Talent identification in youth soccer. Journal of Sports Sciences, 30(15), 1719–1726. https://doi: 10.1080/02640414.2012.731515.

Vaeyens, R., Philippaerts, R. M., & Malina, R. M. (2005).The relative age effect in soccer: A match related perspective. Journal of Sports Science, 23(7), 747–756. https://doi: 10.1080/02640410400022052.

Vaeyens, R., Lenoir, M., Williams, A. M., & Philippaerts, R. M. (2008). Talent identification and development programmes in sport: current models and future directions. Sports Medicine, 38(9), 703–714. https://doi: 10.2165/00007256-200838090-00001.

Vandendriessche, J. B., Vaeyens, R., Vandorpe, B., Lenoir, M., Lefevre, J., & Philippaerts, R. M. (2012). Biological maturation, morphology, fitness, and motor coordination as part of a selection strategy in the search for international youth soccer players (age 15-16 years). Journal of Sports Sciences, 30(15), 1695–1703. https://doi: 10.1080/02640414.2011.652654.

Vescovi, J. D. R., Rupf, T. D., Brown & Marques, M. C. (2011). Physical performance characteristics of high-level female soccer players 12–21 years of age. Scandinavian Journal of Medicine & Science in Sports, 21(5), 670–678. https://doi: 10.1111/j.1600-0838.2009.01081.x.

Walker, S., & Turner, A. (2009). A one-day field test battery for the assessment of aerobic capacity, anaerobic capacity, speed, and agility of soccer players. Strength & Conditioning Journal, 31(6), 52–60. https://doi: 10.1519/SSC.0b013e3181c22085.

Williams, A. M., & Reilly, T. (2000). Talent identification and development in soccer. Journal of Sports Sciences. 18(9), 657–667. https://doi.org/10.1080/02640410050120041.

Williams, J. H. (2010). Relative age effect in youth soccer: Analysis of the FIFA U-17 world cup competition. Scandinavian Journal of Medicine and Science in Sports, 20, 502–508. https://doi: 10.1111/j.1600-0838.2009.00961.x.

Wolstencroft, E. (2002). Talent Identification and Development: An Academic Review. Edinburgh: Sportscotland.

Yilmaz, G. (2014). The effects of power, speed, skill and anaerobic capacity of different training models in young male basketball players. The Anthropologist, 18(3), 877–883. https://doi:10.31901/24566802.2014/18.03.24.