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**Muhammad Shahidul Islam**

Research Scholar, Exercise and  
Sports Physiology Laboratory,  
Department of Physical  
Education, Visva-Bharati,  
West Bengal, India

## Relationship of abdominal muscle endurance with selected anthropometric measurements in soccer players

**Muhammad Shahidul Islam**

### Abstract

A physically fit soccer player complies to run on the field in different direction. Sometimes he/she change direction suddenly according to necessity on the match. Top level soccer performance depends on several factors and physical fitness one of them. Strong abdominal muscles affect the changing direction of movement as the main foundations of long duration work based on the muscle endurance. The present study finds out the relationship between abdominal muscle endurance with selected anthropometric measurements in soccer players. The study is confined to 30 male university level soccer players who had played minimum at inter department football competition. One minute sit-up test was used for measuring abdominal muscle endurance. To measure the selected anthropometric status sagittal abdominal diameter, body mass index and waist to hip ratio was used. The mean, standard deviation and co-efficient of correlation was designed for presenting the data statistically. The results indicates a significant relationship between abdominal endurance and selected independent variable- sagittal abdominal diameter and moderate level relationship between abdominal endurance and selected independent variable-body mass index while in case of waist to hip ratio no significant relationship were found. Therefore, present study highlights the relationship between abdominal endurance and selected anthropometric measurements.

**Keywords:** Abdominal muscle endurance, body mass index, sagittal abdominal diameter, sit-up, soccer, waist to hip ratio

### 1. Introduction

Soccer is a game where player has to run by intermittent nature. The movement pattern of soccer is so diverse that player fitness takes crucial part for match fluidity. The entire sports move originates from strong abdominal muscles. Additionally, abdominal muscle endurance and strength is one of the main foundations to keeping pristine through the long duration work (Callahan, 2017) [6]. Soccer specific skills and great techniques are very necessary to dominate the competitive soccer match (Menexism, 2015) [10]. First of all, it is important to understand that change of direction (agility) in game situations includes cognitive and physical components. The former includes tactical understanding, anticipation and visual reaction, while the latter involves strength and agility. Sometimes, athlete can compensate for a disadvantage in one component with an advantage in another. However, various physical tests and anthropometric measurements are necessary to scout fit athletes. All these movements (physical tests) originate from core musculature. Therefore abdominal muscle endurance may affect the overall movement pattern of soccer match and also slowing down the action. A sit-up test specifically measure abdominal muscle endurance ("Abdominal Sit-Up Endurance Tests," n.d.) [1].

In recent years sports scientist consciously used various anthropometric test (Mills *et al.*, 2017) [11]. Sagittal abdominal diameter (SAD) (Vidigal *et al.*, 2014) [7], body mass index (BMI) and waist to hip ratio (WHR) is important anthropometric tests to measure athlete's abdominal characteristics. Visceral fat is a type of body fat that's stored within the abdominal cavity (Gotter, 2017) [9]. Previous research (Barreira *et al.*, 2012) [2]; (Bi *et al.*, 2016) [3] has shown that visceral fat is more strongly correlated to cardiovascular disease (Sagittal Diameter, n.d.) [14]. Anthropometric measurements have been widely used for evaluation of visceral adipose tissue, highlighting the waist circumference (WC) and the sagittal abdominal diameter (SAD). Since, computerized topography (CT) and magnetic resonance imaging (MRI) are costly,

### Correspondence

**Muhammad Shahidul Islam**

Research Scholar, Exercise and  
Sports Physiology Laboratory,  
Department of Physical  
Education, Visva-Bharati,  
West Bengal, India

not easily accessible to measure visceral and subcutaneous adipose tissue. Researcher Zamboni and others showed that the usefulness of Sagittal Abdominal Diameter (SAD) by anthropometry to predict visceral fat and its very high inter- and intra-observer precision. The researchers also found SAD as cheap and highly precise method to evaluate visceral adipose tissue (Zamboni *et al.*, 1998) [17]. On the other hand body mass index is a very useful index to know the individual's fatness (Nuttall, 2015) [12].

Likewise according to Burgess (2017) [4], "the waist-to-hip ratio (WHR) is a quick measure of fat distribution that may help indicate a person's overall health. People who carry more weight around their middle than their hips may be at a higher risk of developing certain health conditions" (Waist-to-hip ratio, para.1).

## 2. Aim of the study

The aim of this study was to analyze the relationship between abdominal muscle endurance (Sit-up test) and selected anthropometric tests (sagittal abdominal diameter, body mass index and waist to hip ratio) of soccer players.

## 3. Methods

### 3.1 Selection of participants

The participants for this study were selected from Banaras Hindu University soccer players. Total 30 male participants were selected and age ranged between 18-25 years. The purposive sampling technique was used to select the participants.

### 3.2 Selection of variables

Keeping the feasibility criterion in mind, the current research scholar was selected the following variables for the present study.

#### 3.2.1 Independent variables

1. Sagittal Abdominal Diameter (SAD),
2. Body Mass Index (BMI),
3. Waist to Hip ratio (WHR),

#### 3.2.2 Dependent variable

1. Abdominal Endurance

### 3.3 Criterion Measures

The Criterion Measures that was used in this study for the purpose of collecting necessary data is presented in the table 1.

**Table 1:** Tools selected to administrate the tests

Name of Test	Purpose	Unit
Sagittal Abdominal Diameter Test	To measure the central abdominal obesity	CM (centimeter)
Body Mass Index	To estimate BMI	Kg/M <sup>2</sup>
Waist to Hip Ratio Test	To measure the abdominal health and body shape	CM (centimeter)
Bent-Knee Sit-ups Test	To measure the abdominal endurance	Total number of sit-ups/min.

### 3.4 Administration of Tests

#### 3.4.1 Sagittal Abdominal Diameter (SAD)

The SAD was measured with a portable abdominal caliper (sagittometer). To measure SAD place of the calipers on the individuals back at the level of the landmark and close the other caliper until it touches the individual's abdomen. The measurement is taken to the nearest 0.1 cm (Firouzi, Tucker, LeCheminant, & Bailey, 2018) [8]; (Risérus *et al.*, 2004) [13];

(Sagittal Diameter, n.d.) [14].

#### 3.4.2 Body Mass Index (BMI)

Body mass index (BMI) was calculated as the weight (in kilograms) divided by the height (in metres) squared. For example, a football player who weighs 68 kg and is 175cm tall has a BMI =  $68 / (1.75 \times 1.75) = 68 / 3.06 = 22.22 \text{ kg/m}^2$  (Vidigal *et al.*, 2014) [7]; (Firouzi *et al.*, 2018) [8]; ("Calculate Your BMI - Standard BMI Calculator," n.d.) [5].

#### 3.4.3 Waist to hip ratio (WHR)

**3.4.3.1 Waist circumference:** The subject was asked to stand erect with naked abdomen. A tape was snug around the waist of the subject at the level of the naval in front but not too tight, top of the iliac crest and the lower margin of the last palpable rib, such as the tape touches the body all around lightly, the waist circumference was measured at the end of a normal expiration (World Health Organization, 2011) [15].

**3.4.3.2 Hip Circumference:** The hip circumference was measured around the widest portion of the buttocks of soccer players (World Health Organization, 2011) [15].

**3.4.3.3 Scoring:** The calculation of the measurements of the waist girth divided by the hip girth was WHR. The score in centimeters was calculated by using the formulae.

#### 3.4.4 Sit-ups

Abdominal muscle strength and endurance is important for core stability and back support. Current researcher utilizes the one minute sit-up test as suggested by Prof. A. Yobu (Yobu, 2010) [16].

### 3.5 Statistical Procedure

Firstly to find out correlation between Independent variables (Sagittal Abdominal Diameter, Body Mass Index, Waist to Hip Ratio) and Dependent variable (Abdominal Endurance), Product moment method of correlation was used. Secondly to study the joint contribution of Independent variables (Sagittal Abdominal Diameter, Body Mass Index, Waist to Hip Ratio) and Dependent variable (Abdominal Endurance) multiple correlation was used.

## 4. Results

Current researcher revealed that the mean value and standard deviation representing all four variables i.e. Abdominal Endurance, Sagittal Abdominal Diameter, Body Mass Index, Waist to hip ratio was 37.1 ( $\pm 11.408$ ), 18.913 ( $\pm 2.705$ ), 22.383 ( $\pm 2.949$ ), 0.849 ( $\pm 0.043$ ) respectively.

**Table 2:** Correlation between Independent Variables (Sagittal Abdominal Diameter, Body Mass Index, Waist to Hip Ratio) and Dependent Variable (Abdominal Endurance)

S.N.	Independent Variables	Correlation coefficient
1.	Sagittal Abdominal Diameter	0.718*
2.	Body Mass Index	0.578*
3.	Waist to Hip Ratio	0.356

\*Significant at 0.05 level;  $r(28) = 0.361$

Table-2 clearly indicates a significant relationship between Abdominal Endurance and selected independent variables-Sagittal Abdominal Diameter and Moderate level relationship between Abdominal Endurance and selected independent variable-Body Mass Index as the correlation coefficient value were found greater than the tabulated value at 0.05 level of significance while in case of Waist to Hip Ratio no significant

relationship were found.

**Table 3:** Joint Contribution of Independent Variables (Sagittal Abdominal Diameter, Body Mass Index & Waist to Hip Ratio) in predicting Dependent Variable (Abdominal Endurance)

Criterion Variable	Independent Variables	Coefficient of Multiple correlation
Abdominal Endurance	Sagittal Abdominal Diameter	0.723*
	Body Mass Index	
	Waist to Hip Ratio	

\*Significant at 0.05 level;  $r(26) = 0.374$

Table 3 indicates that significant relationship was found between criterion variable (Abdominal Endurance) and independent variables (Sagittal Abdominal Diameter, Body Mass Index, Waist to Hip Ratio) as coefficient of multiple correlations was found 0.723 which is higher than the tabulated value.

## 5. Discussion

In the present study it was hypothesized that there may be relationship between Sagittal Abdominal Diameter, Body Mass Index, Waist to Hip Ratio and Abdominal Endurance of Banaras Hindu University soccer players, the hypothesis is partially accepted due to the reason because there was lower correlation found between Abdominal Endurance and Waist to hip ratio whereas present study indicates a higher relationship between Abdominal Endurance and selected independent variable-Sagittal Abdominal Diameter and moderate level relationship between Abdominal Endurance and selected independent variable-Body Mass Index.

## 6. Conclusions

Based on the findings and within the limitation of the study following conclusions were drawn.

- There was significant relationship found between Abdominal Endurance and Sagittal Abdominal Diameter.
- There was moderate level relationship found between Abdominal Endurance and Body Mass Index.
- There was no significant relationship found between Abdominal Endurance and Waist to Hip Ratio.

## 7. Acknowledgement

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