2020-12-15

THE RELATIONS AMONG ANTHROPOMETRIC VARIABLES WITH SHOOTING ACCURACY AND SELECTED BASIC MOTOR ABILITIES OF JUNIOR HANDBALL PLAYERS

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JULY, 2020

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A THESIS SUBMITTED TO THE SCHOOL OF GRADUATE STUDIES OF BAHIR DAR UNIVERSITY SPORT ACADEMY IN PARTIAL FULFILLMENT OF THE REQUIREMENTS FOR THE DEGREE OF MASTERS OF SCIENCE IN COACHING HANDBALL.

JULY, 2020

BAHIR DAR

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APPROVAL OF THESIS FOR DEFENSE

I, hereby certify that I have supervised, read, and evaluated this thesis titled "THE RELATIONS AMONG ANTHROPOMETRIC VARIABLES WITH SHOOTING ACCURACY AND SELECTED BASIC MOTOR ABILITES OF JUNIOUR HANDBALL PLAYERS" by Samrawit Yehyes prepared under my guidance. I recommend the thesis be submitted for oral defense.

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Approval of thesis for defense result

We hereby certify that we have examined this thesis entitled "THE RELATIONS AMONG ANTHROPOMETRIC VARIABLES WITH SHOOTING ACCURACY AND SELECTED BASIC MOTOR ABILITES OF JUNIOUR HANDBALL PLAYERS" by Samrawit Yehyes. We recommend that the thesis is approved for the Degree of Master of science in coaching Handball.

Board of Examiners

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Chair person's Name   Signature   Date

DECLARATION

I, hereby that this thesis for the partial fulfillment of the requirement for the Degree of Master of Science in Coaching Handball on the title of "THE RELATIONS AMONG ANTHROPOMETRIC VARIABLES WITH SHOOTING ACCURACY AND SELECTED BASIC MOTOR ABILITES OF JUNIOUR HANDBALL PLAYERS" is my real original work and all sources of materials used in this thesis have been acknowledged. It has not been previously conducted on the basis of award of any Degree, Diploma of any University, other Collages and other institution.

Samrawit Yehyes……………….   …………………….

Name   Signature   Date

Dedication

I dedicate this thesis manuscript to my beloved families and parents who had been besides me at everywhere, every time trough out my thesis work. As well as, my beloved friends and peoples who contribute different advice, appreciation, and moral support for conducting successful thesis and reach in this stage.

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List of abbreviations

BMI   body mass index

cm   centimeter

Kg   kilo gram

M   meter

N   number of players

Abstract

For a modern model of a handball player anthropometric variables such as height, weight, BMI, arm length and hand span are necessary for physical performance including speed and power and also skill performance of players. Such an anthropometric profile plays a supportive role in helping players perform under actual competitive conditions. The purpose of this study was to investigate the relationship of anthropometric variables with shooting accuracy and selected basic motor abilities of players. The study works out with correlational research design. Thirty three male handball players of Bahir dar and Adet handball project with the age of 17.8±1.7 and 2.18±0.68 years of playing experience were selected by comprehensive methods of sample selection as subjects of this study. Participants were measured on height, weight, BMI, arm length, hand span, shooting accuracy tests, explosive power (vertical jump power test) and speed (30m sprinting test) once. The row data collected from the study subject was analyzed by using person product correlation moment correlation coefficient and linear regression. Additionally computer software called SPSS version 23 for correlation and regression analysis were used. The results showed that between selected anthropometric variables (height, weight, arm length and hand span has strong positive correlation with shooting accuracy, speed and explosive power of handball players and it was significance at ($p \leq 0.05$). based on the finding BMI has week positive correlation with speed, and explosive power of handball players whereas it has week negative correlation with shooting accuracy of handball players and it was insignificant at ($p > 0.05$). Based on the above findings it can be concluded that anthropometric variables has positive correlation with speed, power and shooting accuracy except BMI. The result shows that on the result height is the most dominant anthropometric variable for speed performance of handball players, Therefore, considering anthropometric variables is suggested to handball coaches for improving physical fitness performances and shooting accuracy of players.

Key words: anthropometric variables, junior, shooting accuracy, basic motor abilities

CHAPTER ONE

INTRODUCTION

1.1 Background of the Study

The Handball game has gained a vast popularity all over the world. It is a contact sport where jumping, running, and arm throwing are prominent features of performance. It is a fast and exciting game played by two teams of seven players with pass, receive, throwing, dribbling, feinting and shooting the ball with different physical performance requirements and psychological readiness with the object of scoring more goals.

Handball players selected and pass through different training protocols to improve technical, tactical, Psychological, and physical qualities at different training seasons and the selection will include anthropometric qualities. And on different training season, training emphasizes on improvement in physical fitness, whereas during the in-season period, the emphasis is on making tactical and technical improvements while maintaining physical fitness.

Anthropometry is the science of measuring human body and its parts. It aids the study of human body evaluation and variation. The study of human physical measurements, anthropometry, has a wide application in the field of sports and selective diagnostics are considered for different game or sport. Handball performance is influenced by age, anthropometric characteristics, technical skills, tactical skills and physical abilities (Mehrezet. al, 2019).The body parameters such as height, arm length and leg length provide considerable advantage to many games and sports (Leppik,2005). Various Anthropometrical variables have been studied for its influence on players' performance. Such studies help coaches in selecting players, providing training to different levels of players.

Height is measure of vertical distance how tall someone it is one of the most important and useful Anthropometric parameter that determine the physical identity of an individual. The determination of height is a major step in the identification of talent in sport activities. Taller players will perform better in game actions such as throwing the ball at the goal which is an

offensive maneuver or attempting to stop a throw performed by the opposing team of defensive act (Ronnie& Gal, 2018).In adult team handball back players are taller in comparisons with wing players which help when shooting from distance. In wing position taller body height is less important to successful performance (Matthys,et al,2011)Goalkeepers may need to possess a large body height and relatively long limbs to cover bigger goal area and for ball saving movements.

Weight is an important parameter for any sportsman during movements like handball and other ball games. When mean body mass was measured in players playing different position it was reported that line players were heavier than goalkeepers, back players, and wing players (Ronnie &Gal, 2018). Back players have greater body mass than wing players. For wing players which rarely engage in physical contact with the opposing defender body weight is less important (Matthys,et al 2011). On the pivot position strong upper body and large total body mass may be needed to engage in physical contact.

Body Mass Index (BMI) is an easily-administered and inexpensive tool to monitor weight status. It helps to evaluate player's body weight for a given height, and thus, contribute to weight control .Nikolaidis and Ingebrigtsen, (2013) investigated the effect of BMI on physical fitness of Handball players and they found a negative correlation between BMI and performance-related physiological characteristics. It means that the excess of body mass could negatively affect the performance in Handball players.

Arm length is measured from the acromion process above the shoulder joint to the tip of the middle finger in the side view. Earlier studies confirmed that speed of movement with ball, in ball pass and ball manipulation ability to be important specific abilities for success in playing Handball. It involves different types of throws and passes. More specifically, the arm length and height with outstretched hands are probably the most important in ball throw. The longer arms span enables effective manipulation of the ball. (Mathavan, 2012) conducted a study on Relationship between upper body Anthropometric parameters and throwing performance of Handball players. The study revealed that the arm length did not show any significant influence on throwing performance.

Hand span is a measure of distance from the tip of the thumb to the tip of the little finger with the hand fully extended. As is known, the hand size can make a difference in sports involving throwing or catching. Since Handball is sport requiring these two acts, it could be a determining variable. Apart from improving grip, hand span helps to score the goal with accuracy and force (Amlet.al, 1997)

Handball technical skill abilities including passing, receiving, dribbling and shooting performances can be directly affected by anthropometric characteristics of players. Shooting is considered as one of the most important technical skills in competitive team hand ball as it is a major determinant of all actions taken by the players (Zapartidis et.al, 2009) its efficiency depends largely on the accuracy and speed of a throw (Gorostiaga et al., 2004).

In handball, as in other team sports, shooting a ball at the goal is the end of an offensive phase. Success or failure depends on whether a team attains its ultimate aim, that of scoring a goal. It is the key to winning or losing matches (Carmenet.al, 2017). Different studies investigate the relationship of anthropometric variables with skill performance (Visnapuuetal, 2009) investigated that anthropometric parameters (height, arm length, hand span) were significantly associated with scores ability. Handball is one of the sports games with the highest physical demands. The categories of movement specific to the handball game including: jumping, sprinting, throwing, blocking and pushing (Cristian et.al, 2016) are common activities.

Sprints for short distances are fundamental in team Handball during a fast break or while returning to defiance after a ball loss. Speed is one of the essential components in hand ball to shoot and to travel from one corner to the other corner of the playing court. It also depends on reaction time which a players move to score to the opponents and in the same way the player is reacting on the return from the opponent court. Speed directly influences the capacity of hand ball player to exert the maximum force in the shortest possible time (Bhupinder, 2013)

Tanwar(2013) Investigates that speed has a great significant contribution to improve the playing ability the results of the study refers that player to move quickly and to perform shooting, defending, dribbling, throwing and other activities speed is necessary. Power is a capacity to release the maximum force in shortest time quickly. Vertical jump power is the ability of players

to reach maximum height as possible and it is basic fitness ability of players during jump shoot and defensive movement.

Handball player make a powerful shooting or power of legs when jumping towards for an attack and also available to clear the court from the back rear court. The power is also known as strength ability of the player is during the use of power in shooting, throwing & passing (Tanwar, 2013). Players with better height can have longer arm length and hand span that helps them to generate powerful shoots during attack.

1.2 Statements of the Problem

Identifying anthropometric characteristics that are specific to handball player is the primary activity of coaches during talent identification and players selection during screening as well as in order to provide appropriate fitness, technical and tactical training programs to their players. This is because those basic anthropometric variables (height, weight, BMI) and specific anthropometric variables (arm length and hand span) might influence performance, success in competition, training conditioning, the playing position, selection and identification of talents (Cristian, et al, 2016) and also it has its own significance effect on skill implementation and physical fitness performances of players on different position (Zapartidis et al., 2009a; and 2009b).

Anthropometric characteristics of players are determinant factors for player's technical, tactical skill implementation and team success. According to Srhoj etal (2002) in order to plan high quality sports training anthropometric measures and evaluations of player's status are needed. For an effective training process it is essential to know the current anthropometric characteristics and their effect on physical performance.

Based on the researcher current information there is no conducted research regarding to handball players anthropometric and their effect or relationship on handball shooting accuracy and selected basic motor abilities of players in our clubs and this are the gaps that needs an assessment in this area. In foreign countries many researches wear conducted on anthropometric variables and their relationship with skill performance and fitness qualities or basic motor abilities of players but not in our country so conducting this research is necessary.

The researcher didn't find any information about handball clubs players selection criteria related to their anthropometric profile, skill and basic motor abilities relationship so it needs to conduct a research. Coaches don't have any research based supportive guideline for talent identification and player's selection so to solve this problem the area needs an assessment.

Based on other foreign countries experience for the development of our country handball sport any training, tactical and technical skill implementation should be supported by researches and findings. As anthropometry is the primary and key element of talent identification and team success its relationship with handball skill performance and fitness performance should be identified.

In that case assessing the relationship of anthropometric characteristics with shooting performance and selected basic motor abilities of players is necessary this is not only for players or team success but also for the development of handball for country level and to be a good competitor with other countries and nations.

Therefore describing the relationship of selected anthropometric variables (height, weight, BMI, arm length and hand span)with shooting accuracy and selected basic motor abilities(speed and power) of team handball players is the main purpose of this study.

1.3 Objectives of the study

1.3.1 General Objective

The general objective of the study was to describe the relations anthropometric variables with shooting accuracy and selected basic motor abilities of team handball players.

1.3.2 Specific Objectives

The researcher address the following specific objectives

1. Examine the relationship between measured anthropometric variables with shooting accuracy, speed and explosive power in Bahir Dar and Adet handball project players.
2. Identify which anthropometric variable is the most dominant factor for shooting accuracy and selected basic motor abilities.

1.4 Research Questions

This study has tried to answer the following basic research questions.

1. What is the relationship between measured anthropometric variables with shooting accuracy, speed and explosive power of Bahir Dar and Adet handball project players?
2. Which anthropometric variable is the most dominant factor for shooting accuracy and selected basic motor abilities?

1.5 Significance of the study

The finding of this study expects to have the following significant contributions:

The study findings helps as an inputs in selecting potential players in Handball game by considering specific anthropometric variables for coaches and other concerned bodies and also the result provide information for developing specific screening tool for analyzing and classifying the players will be one of the important contributions of this study. Provide information for the coaches and experts on anthropometric components and their requirement for achieving better proficiency in handball game. This outcome of the results shall be helpful to Handball coaches to concentrate at the selected predicted variables of this study which have high correlation with performance, to design the training program. The result of the study helps to make it clear whether the selected predictor variables are directly or indirectly related to the criterion variables of skill performance.

1.6 Delimitation of the Study

The 'study was conduct on two selected areas. The first one is in the capital city of Amhara regional state in Bahir dar town Bahir dar handball project male players and the other is from west Gojam zone Adet handball project all meal project members will be the participants of the study. For this study among from different types of anthropometric variables, skill performances and basic motor abilities height, weight, BMI, arm length and hand spam from anthropometric variables as an independent variables and shooting accuracy, speed and explosive power as dependent variable were selected by considering their effect and necessity for players performance and also those variables were selected based on the availability of measuring

devices for the researcher during taking test measures. The study was conducted in the year of 2019-2020 G.C

1.7 Limitations of the Study

The researcher uses minimum number of participants for this type of research design this is due to the number of players in each handball clubs. Bahir dar and Adet handball projects has only 33 male players. Because of our country current situation which is covid19and financial problems the researcher was unable to move to other areas to find projects and increase the number of participants for the study and this can be considered as the challenge that may cause its own limitation on the results of this study.

Even though the researcher tries to use those materials that are standardized instruments there is limitation on the access of these instruments and the researcher used easily available instruments and consider it as alimentation.

1.8 Operational Definitions of key terms

The following words that used in this study are explained/ defined here to avoid any possible confusion in understanding them.

Anthropometry – is the science of obtaining systematic measurements of human body.

Arm length- arm length is measured from the acromion process above the shoulder joint to the tip of the middle finger in the side view.

Hand span- the distance from the tip of the thumb to the tip of the little finger in a straight line when the hand is wide open

Height- it is measure of vertical distance how tall someone is.

Junior – players age between 15-20 for this study.

Motor abilities – is the movements of running, jumping and throwing.

Power -is the ability to transfer energy explosively into force

Shooting accuracy -the final part of the action aims at scoring a goal with hands on the target area.

Speed- is the capacity to travel or move very quickly Peter J. IAAF, 2000

Weight- indicates to a person mass measured in terms of kilogram.

1.9 Organization of the study

This research has consists of five chapters. The first chapter consists of introduction (background of the study, objective of the study, statement of the problem, research question, significance, delimitation, limitation and organization of the study. The second chapter deals with a review of related literature of the study. third chapter was consists research methodology ;study design, study population, sample size and sampling technique, source of data and data collection instrument, data analysis methods and ethical considerations of the study. The fourth chapter deals with the analysis of data results, interpretation, presentation, and discussion of the study. The last chapter consist the summery, conclusion and recommendation of the study based on the results and findings.

CHAPTER TWO

REVIEW OF RELATED LITERATURE

2.1 Historical background of handball

Team handball was invented in Europe around the 1890's. In parts of Europe, it was played with 7 players per team on and indoor field. In other parts, it was played outdoors with 11 players per team. Most describe the sport as a cross between basketball, hockey, soccer, and water polo. Official rules were created and it became an Olympic event. Men's team handball made its Olympic introduction at the 1972 Olympics in Munich. Women's team handball was later added in 1976 at the Montreal Games. Handball is one of the Olympic Games team sports which require a high standard of preparation in order to play and to achieve success. In this game movement patterns are characterized as intermittent and change continuously in response to different offensive and defensive situations.

Indeed, handball is team sport that is generally played in an indoor or field and requires a high standard of aerobic and anaerobic fitness in order to complete 60 minutes of competitive play and to achieve success through an intermittent high intensity body-contact and well-coordinated activities (Buchheit et.al,2009).

Team handball is one of the fastest and the most endurance required team sports and is epitomized by special maneuvers such as jumping, shooting under the pressure, faking against hard defense players and attempting fast breaks despite all the fatigue (Bilge, 2013). It is a team sport in which main activities such as sprinting, arm throwing, hitting, blocking, jumping, and pushing involve. This Olympic team sport requires a standard of preparation in order to complete 60 minutes of competitive play and to achieve success (Cherif, et al, 2012).

Individual handball performance can be determined by different factors including coordination, strength, endurance; anthropometry, genetics, disease, injury and nutrition are among those factors and also team performance can be determined by cognition (attention, anticipation, reaction, decision making, and mental skill), social factors (coach, team leadership and group

cohesion) and also tactics which are offensive and defensive tactics are those determinant factors of team performance. In addition to this handball performance can be influenced by external factors including materials and environmental conditions.

2.2 Overviews of Anthropometry

Handball is one of the Olympic Games team sports which require a high standard of preparation in order to play and to achieve success. In this game movement patterns are characterized as intermittent and change continuously in response to different offensive and defensive situations. Team handball is one of the fastest and the most endurance required team sports and is epitomized by special maneuvers such as jumping, shooting under the pressure, faking against hard defense players and attempting fast breaks despite all the fatigue (Bilge, 2013).

It is a team sport in which main activities such as sprinting, arm throwing, hitting, blocking, jumping, and pushing involve. This Olympic team sport requires a standard of preparation in order to complete sixteen minutes of competitive play and to achieve success (Cherif, et al 2012). In the handball game, the most important factors including maximal strength levels in the shortest period of time (muscular power), handball throwing velocity, and pushing are essential to obtain high sport performance levels and to help handball players in response to different offensive and defensive situations in the game (Bobbert, & van Ingen. 1988)

Anthropometry (from Greek *anthropos*, 'human', and *metron*, 'measure') refers to the measurement of the human individual. An early tool of physical anthropology, it has been used for identification, for the purposes of understanding human physical variation, in paleoanthropology and in various attempts to correlate physical with racial and psychological traits. Anthropometry involves the systematic measurement of the physical properties of the human body, primarily dimensional descriptors of body size and shape.

Anthropometry, or anthropometrics, is the study of human body measurements. At its most basic, anthropometrics is used to help scientists and anthropologists understand physical variations among humans. Anthropometrics are useful for a wide array of applications, providing a kind of baseline for human measurement. In handball one of the criterions for selection are the

anthropometric measures of players and the second probably more important is the level of skills (Srhoj et al., 2006). By studying the differences in these measurements among humans, researchers can assess risk factors for a host of diseases.

Anthropometric factors and morphological characteristics can influence the effectiveness of such responses, as has been observed in other sports (Deng, et al. 1990). Therefore, anthropometric profiles may contribute to understanding the suitability of players for the sport of handball, particularly at a high standard of play.

The study of anthropometry has had some less-than-scientific applications throughout history. For instance, researchers in the 1800s used anthropometrics to analyze facial characteristics and head size to predict the likelihood that a person was predisposed to a life of crime when in reality; there was little scientific evidence to support this application. Anthropometric measurements relevant to human movement gained formal recognition as a discipline with the inauguration of the International Society for Advancement of Kin anthropometry in 1986(Hasan et.al, 2007).

Anthropometrics of all continents have participated in several major multidisciplinary studies that are being or have been conducted to assess the physical characteristics of people. Anthropometry has also had other, more sinister applications; it was incorporated by proponents of eugenics, a practice that sought to control human reproduction by limiting it to people with desirable attributes. In the modern era, anthropometrics have had more practical applications, particularly in the areas of genetic research and workplace ergonomics. Anthropometrics also provide insight into the study of human fossils and can help paleontologists better understand evolutionary processes.

Anthropometric variable are measures of the structure of human body taken at specific sites to give measures of length, girth and width (Mohammad, 2015). The field of anthropometry encompasses a variety of human body measurements. Weight, stature (standing height), body mass index (or BMI) horizontal length, skinfold thicknesses, circumferences (head, waist, limb, etc.), limb lengths, waist-to-hip ratio, body fat percentage and breadths (shoulder, wrist, etc.) are examples of anthropometric measures.(NHANES ,2009) .

2.3 Benefits of Anthropometric Variables for Handball Players

For a modern model of a handball player, the pronounced longitudinal dimensions such as stature, arm span, hand spread and length are necessary. Such an anthropometric profile plays a supportive role in helping athletes perform under actual competitive conditions (Srhoj, et al, 2002). The weight and linear measurements, i.e., body weight, standing height, total arm length, leg length, hand length and hand breadth; body diameter, i.e., elbow and shoulder diameters; skin-fold measurements, i.e., triceps, sub-scapular, thigh and sum of four skin-folds; body composition variables i.e., lean body mass and fat weight and motor fitness components i.e., speed, agility, arm and leg strength have significant correlations with skill efficiency (Kuldeep, 2013).

(Rousanoglou et.al. 2014) made a study to inspect playing level and playing position differences of Anthropometric and physical fitness characteristics in elite junior Handball players. The Anthropometric characteristics of body height, hand width, body mass, arm span, hand length, adipose tissue percentage, somatotype components and the physical fitness character of ball throwing velocity, sprinting time, standing long jump, aerobic capacity, lower back and hamstring flexibility were measured in a total of sixty Handball players of Greek Junior National Teams.

Authors found significant differences among playing levels concerning hand length, hand width, ball velocity body mass, ball velocity and standing long jump. Noteworthy differences among playing positions were found for body height arm span body mass and five m sprint time Authors concluded that Anthropometric differences among playing positions may point out the advantageous character that the respective position demands, while the absence of playing position differences in physical fitness character may specify training specificity issues that must be addressed carefully.

Basic anthropometric parameters (height, weight, circumferences, arm span) and specific anthropometric parameters (hand span, hand grip strength) might influence performance, success

in competition, training conditioning, the playing position, selection and identification of talent. Basic and specific anthropometric parameters (height, weight, BMI, arm length and hand span) might influence performance, success in competition, training conditioning, the playing position, selection and identification of talent.

2.3.1 Height

Height is one of the most important and useful Anthropometric parameter that determine the physical identity of an individual. The determination of height is a major step in the identification of talent in sport activities. Taller players will perform better in game actions such as throwing the ball at the goal which is an offensive maneuver or attempting to stop a throw performed by the opposing team of defensive act (Ronnie & Gal, 2018).The height of the individual is measured in centimeters while standing in erect position. The chin of the subject and the head was held erect.

The height was measured to the nearest centimeter   (Yobu, 1988). Human height varies greatly between individuals and across populations for a variety of complex biological, genetic, and environmental factors, among others. The average height in genetically and environmentally homogeneous populations is often proportional across a large number of individuals.

Exceptional height variation (around 20% deviation from a population's average) within such a population is sometimes due to gigantism or dwarfism, which is caused by specific genes or endocrine abnormalities (Ganong, &William., 2001). According to Justin et.al, (2013) the taller goalkeepers generated more energy in squat jump and counter movement jump performance than the shorter goalkeepers. The established correlations for the whole sample of goalkeepers found that body height had a negative impact only on the average simple reaction time. The study established that opinion of Handball experts that taller goalkeepers should be favored while selecting athletes for goalkeeping in Handball.

In adult team handball back players are taller in comparisons with wing players which help when shooting from distance. In wing position taller body height is less important to successful

performance (Matthys, et al, 2011). Goalkeepers may need to possess a large body height and relatively long limbs to cover bigger goal area and for ball saving movements.

2.3.2 Weight

Weight is an important parameter for any sportsman during movements like handball and other ball games. When mean body mass was measured in players playing different position it was reported that line players were heavier than goalkeepers, back players, and wing players (Ronnie & Gal, 2018). Back players have greater body mass than wing players. For wing players which rarely engage in physical contact with the opposing defender body weight is less important (Matthys, et al, 2011). On the pivot position strong upper body and large total body mass may be needed to engage in physical contact.

It is the total weight of body mass of a person and measured in kilograms (Kgs) (Harold, Barrow and Rosemary, 1979) According to (Massuça & Fragoso, 2011), body composition and body mass contribute among other factors to optimal exercise and performance, body mass can influence an athlete's speed, endurance, and power, strength and agility.

2.3.3 BMI

BMI is often overlooked in studies on sport populations and there are many studies on team Handball players which present data on body height and body weight. Although it is commonly used in a health-setting to classify humans as underweight, normal weight, overweight and obese, its application in sport populations has been questioned, because it is associated with fat mass, as well as with fat free mass.

Body Mass Index (BMI) is an easily-administered and inexpensive tool to monitor weight status. Although it is commonly used in a health-setting to classify humans as underweight, normal weight, overweight and obese, its application in sport populations has been questioned, because it is associated with fat mass, as well as with fat free mass. It helps to evaluate player's body weight for a given height, and thus, contribute to weight control. Nikolaidis and Ingebrigtsen (2013) investigated the effect of BMI on physical fitness of Handball players. Researcher found

a negative correlation between BMI and performance-related physiological characteristics. It means that the excess of body mass could negatively affect the performance in Handball players.

2.3.4 Arm length

Arm length is measured from the acromion process above the shoulder joint to the tip of the middle finger in the side view. The arm length is measured as the distance from the Calipers scale held by the subject tightly in his hands to the acromion process (Clarke, H. and Clarke, 1989). (Mathavan, 2012) conducted a study on Relationship between upper body Anthropometric parameters and throwing performance of Handball players. The study revealed that the forearm girth influenced the throwing performance in Handball game. But, arm length did not show any significant influence.

Earlier studies confirmed that speed of movement with ball, in ball pass and ball manipulation ability to be important specific abilities for success in playing Handball. It involves different types of throws and passes. More specifically, the arm span and height with outstretched hands are probably the most important in ball throw. The longer arms span enables effective manipulation of the ball.

2.3.5 Hand span

Hand span is the distance from the tip of the thumb to the tip of the little finger in a straight line when the hand is wide open (Clarke,H.&Clarke.DH,1987) It has been suggested that players with longer fingers and larger hand surfaces enjoy stronger grip power.

Therefore, some researchers have examined a number of factors and anthropometric variables th at explain this issue. (Fallahi, &Jadidian,2011)in handball game handling the ball (with only one hand), is particularly important so according to Fischer, et al.(2002) a higher hand span (between 24–26 cm) can helps in some handball-specific skills including shooting accuracy. Although there is evidence that the mean score of hand span in the top elite level of performance was greater.

2.4 Shooting accuracy in Handball

Shots are one of the most important elements of handball. They are vital elements that decide the scores. While shooting the muscles of the lower and upper limbs, pelvic region and trunk are extremely engaged. One can assume that shooting is performed similarly to passing, but with a stronger action of the trunk and upper limbs.

The shot power is conditioned by the distance and hand action time on a ball. The greater the distance that the hand on the ball covers in the time unit the stronger the shot will be (a ball reaches a higher velocity) performed. The names of shots have been derived from the way the players move on the court and the position of his/her body to the ground.

There are mainly two factors in shooting technique of handball, the first is speed ball velocity of shoot, and the second factor is that no clear prediction of direction to shoot for goal keeper. This approach gives a good evaluation on the kinematic structure in analyzing handball. Shooting performance of handball players can be affected by different factors. mainly two factors in shooting technique of handball the first is speed ball velocity of shoot, and the second factor is that no clear prediction of direction to shoot for goal keeper.

2.4.1 Basic Types of Shooting

Shooting is the final part of the action and it aims at scoring a goal. Technically it is similar to passing, but the action is much more forceful and fast. In handball there are two main types of shot. In handball there are two main types of shot:

2.4.1.1 Standing shot

To achieve the necessary thrust, the player takes a three steps run-up. The first step is taken right after receiving the ball. The ball is not stopped at the chest level: the player holds it with both hands and brings it towards the shooting shoulder. Then the run-up movement begins and the arm holding the ball is stretched back. The second step coincides with the throw stance and the player's left shoulder and left hip are directed into the shot direction. The arm and hand holding the ball end the throw movement during the last step. Standing shoot includes 7m shoot and 6m shoot.

2.4.1.2 Jump shot

The jump shot is one of the most important elements of handball as in the game it might be long jump/horizontal jump shot most of the time for back court players or high jump/vertical jump shoot for wing players. Motor behaviors are performed in specific conditions with the presence of players of the opposing team and while adhering to the regulations. The run-up is similar to that of the standing shot, but the last step works as a support for the jump and the shot is taken in the air. The up thrust is given by the supporting leg that pushes off, helped by the thrust of the other bending leg. During the elevation, the upper body is turned towards the shooting arm, which is in a backward position.

Jump shoot includes vertical jump shoot from the back court players including 9m shoot and long jump shots from the wing position. The goals of the run, jump, shoot are ball velocity and accuracy. Maximum ball velocity and precision is required to minimize the chance of the opponent or goal keeper intercepting the shot. In team handball, shooting to score goals is one of the most important aspects of the game.

In order for a shot to be successful, it must have maximum ball velocity and precision for an element of surprise for the goalkeeper. The faster the ball is thrown at the goal the goalkeeper will have a lesser time to save the shot. In order for a throw to be successful, the highest velocity at ball release together with aiming accuracy is required therefore during the game, thus the players has to keep up with the optimal efficiency of these two factors (Zapartidis et al, 2007). Accuracy is something defined as variable. We didn't want to make it become a close-system where the subject keeps hitting at the same spot.

Thus in the analyzing performance stage, we came out with a table to judge the subject throwing effectiveness in performing the skill. Zapartidis et.al 2009) reported that players during the game are notably affected by time as aiming accuracy or ball velocity gradually decreases.

The goals of the run, jump, shoot are ball velocity and accuracy. Maximum ball velocity and precision is required to minimize the chance of the opponent or goal keeper intercepting the shot. In team handball, shooting to score goals is one of the most important aspects of the game. In order for a shot to be successful, it must have maximum ball velocity and precision for an

element of surprise for the goalkeeper (Wagner & Muller, 2008). Wagner, et al (2010) state that 67% of ball velocity at ball release was explained by the summation effects from the velocity of elbow extension and internal rotation of the shoulder. Thus we divide them into Approach, Take-off, Shoot, Land. In handball, the biomechanical principles that can be applied are use of the stretch-shortening cycle, minimization of energy used, control degrees of freedom, sequential action of muscles, minimization of inertia, impulse generation and maximizing the acceleration path.

The recruitment of each part of the body is important by allowing the development of maximal velocity of these parts. This begins from the proximal parts then to the distal parts of the body. The larger proximal joint starts the action by accelerating, thus a transfer of momentum results in a high velocity to the smaller distal joints. Each segments of the kinetic chain is linked to the stoppage of the proximal part results in the increase of angular velocity (Pori, Bon, &Sibila, 2005). When performing the shot, certain physiological characteristics are taken into considerations. Therefore, at least for some muscular groups there should be the shortest possible time between extension and contraction for muscles involved in this phase (Pori et al, 2005). Pori et al (2005) concluded that better players make use of extensors in the wrist better than worse players.

2.5 Anthropometric Variables and Shooting Performance

Body size, fat-free mass and percent of body fat seem to be important factors in physical performance, even within a rather homogeneous group of highly skilled athletes. Players with a higher skill level are taller and have a higher fat-free mass. Anthropometric characteristics such as body size, body mass, BMI, and body fat percentage, play a highly important role when discussing sport success and results (Cizmek, et al 2010, Van & Ettema, 2004 and Zapartidis, et.al 2009).

Ball throwing velocity is also an important factor in Handball (Gorostiaga et al, 2005, Granadoset.al, 2010 and Hoff & Almasbakk, 91995). This velocity depends on the player's ability to accelerate the ball with an over arm throw, the duration of the movement, which

reduces visual information for the goalkeeper, and the accuracy of the throw (Debenne, &Laffaye, 2011).

Players with larger hand can grab the ball more tightly and this fact brings probably the player in a more confident situation to shoot the ball with higher velocity. The presence of higher muscle mass reflected in handball players constitutes a significant advantage in order to confront the intense body contact during a game. Trainers should take into account some anthropometric data and particularly the hand size during handball talent selection because they tend to be a requirement for future high level performance (Carmen et.al 2013).

Throwing is considered as one of the most crucial technical skills in handball as it is a major determinant of all actions taken by the players. Throwing in handball, refers to movements in transferring the strength to hands occurred during movements of body segments and ball catching and thus releasing the ball. Previous studies show that the ball throwing velocity is the main performance factor determining the throwing movement (Zeynep, 2016)

The throwing ability is essential for the performance in handball. Data from the high level competitions have shown that the high handball players that participate in such events have become taller through the last decades. However, it is not yet clear which anthropometric parameters are correlated with the throwing ability. If a handball match is closely inspected, it is obvious that key movements in the handball matches are the ones regarding the manipulation of the ball especially throwing the ball to a team player or towards the opponent's goal. There are three factors that are important for any handball throw: the throwing technique, the timing of the consecutive movement of body segments, and the level of motor abilities (Gorostiaga et al., 2005).

The most important abilities behind throwing movements are mainly power, coordination and accuracy (Gorostiaga et al., 2005,). The level of power and precision used during a throw depends on the objective of such action. There have been studies regarding the isokinetic tests and such findings should be considered with great care due to the fact that the tests do not reflect natural movements, or more precisely the total kinetic chain created with the handball throw is excluded in such tests (Baiyos et al., 2001; Gorostiaga et al. 2005). Although special care must

be contributed to the development of technical and tactical skills, to act accordingly in any given in game situation a handball player must also be highly trained in terms of strength, power (jumping, running, throwing), both anaerobic and aerobic endurance, agility and quickness (Gorostiaga et al., 1999; Gorostiaga et al., 2005; Srhoj et al., 2006). The development of throwing power is an important issue regarding the construction of training plan and program during the pre-season and in-season periods.

Throwing of the ball is an important skill in handball and a very important aspect for success. The velocity of a handball throw is not only dependent on the muscular strength but also on other aspects such as body segments coordination and technical skills. This velocity is an important aspect for success, because the faster the ball is thrown at the goal, the less time defenders and goalkeeper have to save the shot.

(Helena, etal.2012) Longer upper extremities contribute to maximizing throwing velocity (Fleising, et.al 1999). Dimitrios, et.al (2003) showed that the throwing performance is significantly ($p<0.05$) and positively correlated with the body mass, the lean body mass, the arm span, the hand length and the width of the hand with the fingers abducted. Additionally, a significant ($p<0.05$) negative correlation was found between the throwing velocity and the ratio of the body height to the arm span.

The findings of the current study suggest that the anthropometric data and especially the size of the hand should be seriously considered when the criteria for the selection of a handball player are set. Fifty-nine volunteers were evaluated for their throwing velocity with a radar gun. The participants were asked to throw a competition handball against a target that was set 6 meters away. All subjects performed 7 maximal shots and the average was calculated. Concerning the anthropometric characteristics, the body height, the length of the upper limb segments was measured (arm, forearm and hand length, arm span and hand width with the fingers abducted), and the body mass and body obese mass as well. Furthermore, the ratio of the body height to the arm span and the lean body mass were calculated and the finding sows that there is a significance correlation.

2.6 Basic Motor Abilities

The physical demands of handball include running with and without changes of direction at speeds ranging from walking to rapid sprints, vertical jumping, various types of throwing, and direct physical contact plus an ability to make multiple sprints at high speed. Motor abilities are basic to all movements. It is considered as an individual's level of ability in a wide range of activities.

It may encompass the individual traits such as strength, endurance, power, speed, agility, balance, reaction time, and coordination traits underlying performance in many motor complexes. A combination of these factors in a coordinated and sequential manner can bring about an effective playing. Though Motor abilities important, by itself they cannot determine player's performance, but it only serves as a baseline in further improving performance (Barnes, et.al, 2007)

The motor abilities have the ability keep the individual fit and thus improve performance at work place. Several companies, identifying its importance have appointed directors of fitness in order to improve the performance of employees (Hardayal, 1991). Several qualitative and quantitative studies of top-level male handball players have demonstrated that key characteristics of the successful professional include endurance capacity, sprint performance, jumping ability, and a high throwing velocity. This is reflected in a highly developed anaerobic endurance. Aerobic endurance is less important, because there are frequent exchanges of athletes during a match.

Nevertheless, it has been hypothesized that a well-developed aerobic endurance might help recovery between frequent games during the playing season. Anthropometric and physical performance characteristics of professional handball players: influence of playing position and competitive level (Schwesig, et.al, 2017).

Motor ability, sprinting, jumping, flexibility and throwing velocity represent physical activities that are considered as important aspects of the game and contribute to the high performance of the team. Successful performance requires explosive power of the legs and arms, sprint velocity and kinesthetic feeling in ball control (Sibila, 1997). Sprinting, flexibility, motor ability,

throwing velocity and jumping ability signify physical activities are significant for team handball. The handball players are a thrower, sprinter, jumper all in one; and they should accomplish these skills with speed and precision. They frequently achieve shooting, dribbling skills and upper extremity passing, whereas wearing shoes on the flat stiff surfaces. The skills of the player need high joint accelerations from cutting maneuvers and jump landing.

2.7 Anthropometry and Basic Motor Abilities of Handball Players

One of the most fundamental steps in any multistep sport program is to evaluate the player's performance, within different areas. Nevertheless, in team sports, performance is not simple to measure and selection is known to be as a complex process (often unstructured). In fact, the literature relations to sports expertise, has tended to be mono-disciplinary.

Anthropometric parameters and physical and motor test have been identified as fundamental in order to determine the success of the performance in handball. Thus, some of the previous studies have provided the specific performance measures that could be the most useful (Alba et.al, 2018). Regarding anthropometry, some studies have demonstrated that body composition could have an influence in the game's performance, namely: higher hand size or handgrip strength involves a higher and greater control of the ball, and a higher wingspan involves a higher occupation of spaces in defensive and offensive actions

Granados et.al (2007) showed that the higher values of fat-free mass involved a higher performance, especially because of the increase in the muscular power and strength. On the other hand, some of the studies have used physical condition parameters in order to identify talents. (Srhoj et al, 2006) evaluated different basic motor skills as decisive performance factors; obtaining that the fine motor skills in the upper limbs could be essential for the performance.

Performances on the 30-m sprint test, the standing vertical jump, the right handgrip strength, the sit-ups test, stature, and the ability of a player to vary their actions appear to be the strongest predictors of success in team-handball. According to (Juan, et al, 2016), anthropometric and physical performance characteristics are considered fundamental for talent identification. This study expanded on these ideas and tried to determine which anthropometric and physical

performance variables, by means of discriminatory analysis, were most significant at the time of selecting male and female handball players; this follows the trend of research established by other academics and practitioners

The handball players are a thrower, sprinter, jumper all in one; and they should accomplish these skills with speed and precision. They frequently achieve shooting, dribbling skills and upper extremity passing, whereas wearing shoes on the flat stiff surfaces. The skills of the player need high joint accelerations from cutting maneuvers and jump landing. The two selected motor abilities of handball players for the study are the most important and most of the time used by players during competitions almost the whole time of the competitions are seed (for movements of players especially during fast break and transition period from defense to offense and vice versa) and explosive power especially while shooting from back court and wing position.

2.8 Anthropometric Variables and Speed

Speed is the ability to move the body or a part of the body as rapidly as possible from one point to another. It is the rate of movement, or the amount of time it takes for a body or object to travel between two points. Speed is obviously extremely important in all forms of racing, but also in team and goal related sports when someone has the chance to 'runaway' from the opposition. One of the major requirements in many sports is speed.

In sports such as sprinting, soccer, cycling, hockey, fencing, games and many other team sports, speed is a major factor determining the overall outcome. In fact, all skill-related components contribute to speed. Speed requires the expenditure of a large amount of energy in a short period. It is an important factor in almost all court and field games. It can make the difference in whether a performer is able to gain an advantage over his opponent. In games like basketball, football, hockey, and team hand ball both acceleration speed and running speed are basic to success (Jensen & Fisher, 1979).

Performing sports skills economically with ease, correct positioning of body levers and good neuro-muscular coordination will result in efficient use of energy and a higher speed of the movement. In addition to relaxation ability, joint flexibility is an important ingredient for

performing movements with high amplitude (e.g. long stride in running) which in many sports is essential to execute optimum range of movement for maximum speed. Speed is determined not only by mobility and well synchronized neuromuscular response but also by the frequency of the precise nervous impulses and strong concentration. This is because quick, explosive movements depend on a high level of power. Willpower and strong concentration are very important factors in achieving high speed. Exercises of will must be included in the training process to achieve a high level of speed.

Fast movements are performed by recruiting the fast twitch fibers, and because of their function and metabolic qualities these fibers constitute the most favorable preconditions for speed performances; for instance, successful sprinters have more than 60 percent fast twitch fibers, as a result of their genetic aptitude. Whereas has stated that speed is the result of both positive and negative forces. Muscular contractions are positive forces, while air or water resistance, gravity, friction, and inertia are some examples of negative forces. Increases in speed can result from decreasing the influence of the negative forces, or both. This illustrates the importance of individualizing training on the basis of the sport or event (deVries1974).

2.8.1 Speed for handball

The development of higher movement speed and faster action play has more recently used also been encouraged by the IHF through its rule revisions. Training activities taking into account these new developments will therefore include the following aspects in the future:

- To execute fast throw-off
- Improve feinting performance
- greater demands made on legwork to support flexible defense action,
- speed-driven application of attack techniques and
- improvements in switching from defense to attack and from attack to defense

2.9 Anthropometric variables and power

Jumping is an organism's pushing the surface of leaning and leaving the ground vertically or horizontally and suspending in the air for a short time. Jumping is dependent on the power of leg

muscles, their explosive power, the flexibility of muscles involved in jumping, and on the technique of jumping (Halter, & hızlanmaya, 2006) jump movement is dependent on the speed of muscle contraction, and the development of muscle strength. The expression and development of power is an important perspective from sports performance and lifestyle as well. Power is produced when the same amount of work is completed in a shorter period of time, or when a greater amount of work is performed during the same period of time.

Power is defined as the amount of work performed per unit of time. Power is an element of skill related fitness that is needed to excel in athletic performance. Increased strength does not always translate into increased power. (www.livestrong.com). Power training programs are now considered an integral part of athlete preparation. There are a number of areas of research that provide support for this. Physical capacities that can be developed through power training have been shown to differentiate the performance levels of athletes (Fry & Kraemer, 1991)

The use of leg power training designed to increase underlying leg power and leg strength qualities in elite athletes in an attempt to improve athletic performance is common. Although the extent to which qualities of leg power and leg strength are important to sports performance may vary depending on the activity, the associations between these qualities and performance have been well documented in the literature. An increasing number of training studies with high-performance athletes are attempting to address questions concerning the role of power training for improving athlete performance (Michael et.al, 2012).

It is a capacity to release the maximum force in shortest time quickly. A power player is not only strong but generates the force quickly. Another level of evidence for the benefits of strength training on performance is looking at correlation studies. Although the relative influence that leg strength and arm power have on performance depends on the requirements of the particular sport, a large body of evidence supports a positive benefit. Researches existed showing strong relationships Strength Training for Athletes between physical capacities that can be developed using strength training and sport-specific skills such as speed and agility (Stone, et al, 2003)

Successful sporting performance at elite levels of competition often depends heavily on the explosive leg power of the athletes involved. Many team sports also require high levels of

explosive power, such as Basketball, Volleyball, Netball and the Rugby and Football codes for success at elite levels of competition. Explosive power comes from the development of speed strength and pure strength. Power represents the amount of work a muscle or muscle group can produce per unit of time. Until recent years power as it relates to sports performance has been the subject of limited research, but in the last decade or so researchers has realized the importance of training for power in a wide variety of sporting activities (Clutch et al, 1983).

Vertical and horizontal jumping, in its many different forms, requires high levels of explosive muscular power. Note power as the equivalent of explosive strength. Power is the equivalent of explosive strength (Paavolaienen et al, 1999) suggested that muscle power is the ability of neuromuscular system to produce power during maximal exercise when glycolytic and oxidative energy production is high and muscle contractility may be limited. Vertical jumps are the jumps made in a vertical plane. What is essential here is to gain height from the ground. The direction is upward primarily. For instance, jumps over a hurdle or a box (Goktape, et.al, 2016). Even though jumping, sprint and agility are versatile abilities

2.9.1 Power for handball

The power is also known as strength ability of the player is during the use of power in shooting, throwing and passing. Power help players during

- Upper limb power helps during attacking maneuver which is at the time of shooting powerfully that is unable to control the ball by opponent defenders.
- Explosive power of lower limbs that helps during jumping movement help players to jump powerfully from the backcourt position and from wing position for shooting.

CHAPTER THREE

RESEARCH METHODS

3.1 Research Approach

In order to conduct the study, quantitative research approach were used to collect and analyze the data. In the study, the anthropometric measurements of the participants such as height, weight, BMI, arm length and hand span, and shooting accuracy, and selected basic motor abilities were measured through reliable measurements.

3.2 Design of the study

The study was focus on describing the relationship of anthropometric characteristics with shooting accuracy and selected basic motor abilities of team handball players. To conduct this research the researcher was used correlational research design which is a type of research design that the investigator measures the outcome and seeks to describe a certain relationships between two or more variables. Simply it examines whether an increase or decrease in one variable corresponds to an increase or decrease in another variable. Findings from this study enable researchers to determine whether or not the degree to which-two variables change together.

3.3 Study population, Sample size and Sampling method

The population of the study includes men handball players from Bahir Dar handball project and from Adet handball project. All members of the two project handball players were participants of kthe study. The sample size of the study was from both selected handball projects (from Bahir Dar handball project 13 players and from Adet handball project 20 players) totally from the two projects 33 member players are subjects of the study. Non probability sampling method which is purposive method of sample selection was used to select Bahir Dar handball project and Adet handball project out of other handball projects based on their availability for the researcher and by comprehensive method of sample selection all member players of the project are participants on this study because of their small number of players in each team.

3.4 Source of data

The primary source of data by field test measurement which are testing and measuring of selected anthropometric variables motor ability variables and shooting accuracy performances tests are sources of data.

3.5 Data gathering tools and procedures

To collect relevant data for the study different types of data collection instruments will be used depends on their test procedure for anthropometric characteristics, shooting accuracy and basic motor abilities regarding to the relationship of anthropometric characteristics with shooting performance and selected basic motor abilities of team handball players. The researcher will collect quantitative data through the appropriate anthropometric variable test measures basic motor ability tests and shooting accuracy tests.

Five anthropometric variables were measured for each subject height, weight, BMI, arm length and hand span. These specific features were selected because they influence on motor abilities (passing, catching and ball throwing) and help players to performance. All length characteristics were measured in meter and centimeter and mass characteristics were measured in kg. BMI was computed as a ratio of body mass to the squared standing body height ($kg/m2$).

3.5.1 Data gathering tools and procedures for Anthropometric variables

3.5.1.1 Data gathering tools and procedures for height
Procedure

Players were asked to stand with both feet without shoes and it measures from big toe to their hair it measured with steel measuring tape and expressed in m (Zhang, 2010).

3.5.1.2 Data gathering tools and procedures for weight
Procedure

The participant stood on the center of the scale without support and with the weight distributed evenly on the two feet. It was measured with portable weight scale and expressed in kg (Zhang, 2010)

3k.5.1.3 Data gathering tools and procedures for BMI

Procedure

By calculating height (that measured by steel measuring tape and expressed in m) and weight (measured by portable weight scale) and calculate by weight/ (height) 2expressed in kg/m2

3.5.1.4 Data gathering tools and procedures for arm length

Procedure

Participants were asked to stand vertically and extend their arm towards the ground and it measures from the acromion process above the shoulder joint to the tip of the middle finger in the side view and it measured with steel measuring tape and expressed in cm.

3.5.1.5 Data gathering tools and procedures for hand span

Procedure

the players were asked to extend their hand fully and its measure were taken from the tip of the thumb to the tip of the little finger with the hand fully extended and measured with steel measuring tape expressed in cm.

3.5.2 Data gathering tools and procedures for shooting accuracy tests

Evaluating shooting accuracy of players
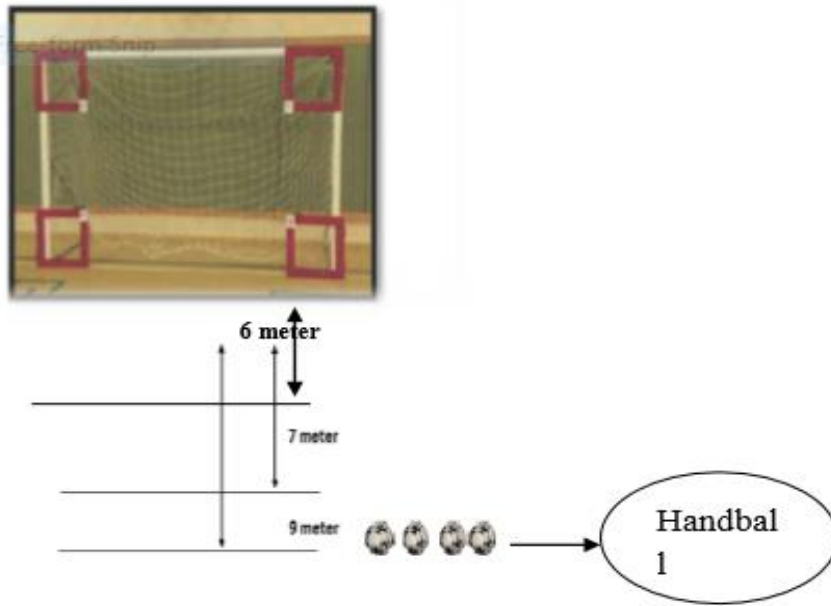
Figure 1: shooting accuracy test

Adopted from Kangane, (2005)

Objective

To assess the accuracy of handball players shoot towards the target point.

Equipment

A marked level floor or ground with a smooth surface, stopwatch, standard inflated handballs, rope, measuring tape, score recording sheets and pen are required equipment's that are used for taking shooting accuracy test.

Procedure:

Each player performed a warm-up for 10 minutes.   Goal post was divided in four parts with 50 x50 cm   on the four corners of the goal angles was designed for shooting accuracy. The score were decided for the four corners and there is not counted for the middle part of the goal post. The player, with a handball, stands behind the throwing line on the floor on the signal "go", the

player throws the ball at the target, using one-armed throw. Players attempt with total 60 shoots. 20 shots from each shoot distances: from 6m, 7m 9m meter free throw line.

 Scoring: The score is the sum of points scored on each target.

No Points will be given if

- A player touch/ cut the restraining line before release of the ball
- A player loose the control of the ball
- The ball shoots outside the target

3.5.3 Data gathering tools and procedures for selected basic motor ability test measures

3.4.3.1 Speed test

Evaluating speedby30-meter sprint test

Start   30m   End
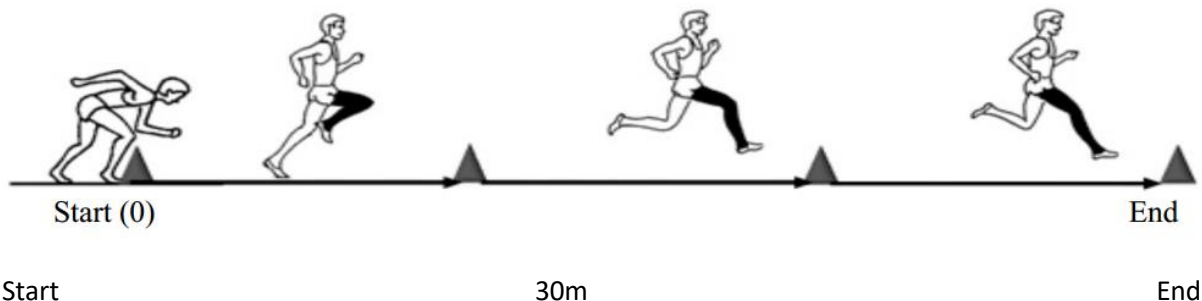
*Figure 2:*30-Meters Sprint Test

Adopted from peter JL Thompson IAAF Guide to Coach Athletics, (2000)

Objective:

 The objective of this test is to monitor the player's maximum speed

Equipment that require undertaking this test:

 Tape marker, Cones and Stopwatch to timing are used

Procedure:

Running speed test which is 30m sprint from a standing position. Players had had to run for a distance of 30m as fast as they could. Times were recorded using digital stopwatch by the investigator and the assistant

Scoring:

Two trials are allowed, and the best time is recorded.

3.5.3.2 Explosive power test

Evaluating explosive power by standing vertical jump test adopted from sergeant jump test for power
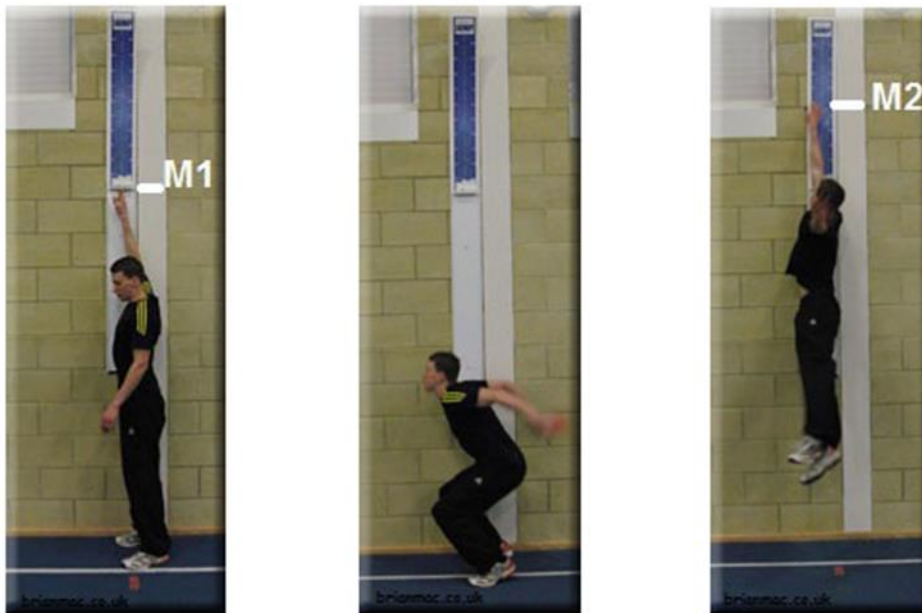
Figure 3: vertical jump power tests, (*Adopted from Sargent, 1921)*

Objective

To evaluate players standing vertical jump ability or their explosive power

Required materials to undertake this test are

Wall, Measuring tap, Chalk and Assistant

Procedures

The players

Chalks the end of his fingertips and stands side onto the wall, keeping both feet remaining on the ground, reaches up as high as possible with one hand and marks the wall with the tips of the fingers (M1) From a static position jumps as high as possible and marks the wall with the chalk on his fingertips (M2).

The coach: Measures the distance from M1 to M2. The test can be performed as many times as the athlete wishes.

3.6 Data analysis methods

After gathering all the required data the research used descriptive method of data analysis and correlational data was presented and analyzed by Pearson's product-moment coefficient of variables which is its measurement of correlation and ranges (depending on the correlation) between +1 and -1 and its indications or interpretations are considered and also linear regression were used for the analysis of collected data. In addition to this the total handball players result were expressed as mean and standard deviation and also data analyses were performed with in computer system using statistical package for social science (SPSS), version 23 to calculate the descriptions, correlations of the collected data.

3.7 Ethical considerations

This study considers the ethical issues that should be taken by the researcher during the investigation. Ethical considerations that require clarification for the coach and players including that it is not necessary to mention participants name and also researcher will not expose all of the participants in a situation where they might be at risk of harm physically, physiologically or psychologically as a result of their participation at the time of taking test measures.

Before beginning tests for the research, the researcher get permission from the coach and players and also try to give clear information about the purpose of the study, the procedures to be used during taking test measures, the potential significance for coaches and other concerned bodies in this area

CHAPTER FOUR

RESULTS AND DISCUSSIONS

4.1 Introduction

This chapter deals with the analysis and interpretations of the collected row data for all variables from selected anthropometric variables, selected physical basic motor abilities and shooting accuracy of 33 participants. The purpose of this study was to describe the correlation or relationship of anthropometric characteristics with shooting accuracy and selected basic motor abilities of handball players. The anthropometric characteristics selected for this study to correlate with shooting accuracy and selected basic motor abilities are height, weight, BMI, arm length and hand span. On the other hand shooting accuracy and selected basic motor abilities (speed and power) are variables of the study. The collected data were analyzed by using person's correlation moment.

4.2 Results of the Study

Table 1

Demographic characteristic of participants

N	Sex	Age			Playing experience (year)		
		Minimum	Maximum	Mean ± S.D	Minimum	Maximum	Mean ± S.D
33	Male	15	20	17.8±1.7	1	3	2.18±0.68

As shown from table 1 descriptive characteristic of 33 study participants the minimum age is 15 and the maximum age is 20 and its mean is 17.8. They have playing experience of minimum 1 year and maximum 3 years and its average mean is 2.18.

4.2.1 Descriptive statistics results of study variables

The following tables describe the minimum, maximum, mean and standard deviation values of all study variables for 33 participants of the study including dependent variables (shooting accuracy, speed and power) and independent variables (height, weight, BMI, arm length and hand span) of participants of the study.

Table 2

Descriptive statistics of anthropometric variables

Variables	N	Minimum	Maximum	Mean ± S.D
Height (m)	33	1.58	1.80	1.65±0.49
Weight(kg)	33	50.00	73.00	58.90±4.87
BMI(kg/m2)	33	18.82	24.24	21.61±1.27
Arm length(cm)	33	78.60	98.00	86.94±5.29
Hand span(cm)	33	25.30	35.00	30.25±2.54

Definition BMI=body mass index

As shown form the above table the descriptive statistics of all anthropometric variables that express in terms of its maximum, minimum, mean and standard deviation value for 33 players their height and body weight is moderate and also have normal BMI in addition to this they have an average mean of 86.94cm and 30,25cm arm length and hand span consecutively.

Table 3

Descriptive statistics of shooting accuracy

Variable	No	Minimum	Maximum	Mean ± S.D
Shooting accuracy(60 pt)	33	21	46	30.33±5.75

The above table shows that the descriptive statistics of 33 players shooting accuracy. The result shows the minimum, maximum performance and its mean and standard deviation of shooting accuracy test out of 60 points. So the average means and standard deviation of their performance is 30.33±5.75 consecutively.

Table 4

Descriptive statistics of selected basic motor abilities

Variables	N	Minimum	Maximum	Mean ± S.D
Speed (sec)	33	4.00	5.70	5.04± 0.47
Explosive power(cm)	33	32.00	45.50	39.37±2.99

The above table shows the descriptive statistics of selected motor abilities speed and power in terms of minimum, maximum, mean and standard deviation values. Based on the description player's average speed to cover 30m distance is 5.04sec and their average power is 39.37 cm.

4.2.2 Correlational results of anthropometric variables with shooting accuracy, speed and power

The following tables show that the correlation results and interpretations of the results on the study variables. The correlation of each anthropometric variable with shooting accuracy and selected basic motor abilities are presented in terms of correlation coefficient and their level of significance.

Table 5

Correlational statistics of height with shooting accuracy, speed and explosive power (N=33)

Variables	Correlation coefficient	P-value
Height and shooting accuracy	0.724	0.000
Height and speed	-0.783	0.000
Height and explosive power	0.859	0.000

Correlation is significant at $<_- 0.05$ level (2-tailed).

Table 5 shows that the correlation and significance of height with speed, shooting accuracy, and explosive power. The result shows different level of correlation and all the results are significance at less than or equal to 0.05 level of significance.

The analysis result from the above correlation table shows that the correlation of height and shooting accuracy it can be seen that the correlation coefficient(r= 0.724), indicating that height has strong positive correlation with shooting accuracy of handball players.

From the above correlation table the correlation of height and speed it can be seen that the correlation coefficient(r= -0.783), the negative correlation result is due to that speed is measured in seconds and when height increases time decrease indicates that performance increase. That is why the correlation shows negative result when time decrease speed performance increase. So the result indicating that height has strong positive correlation with speed performance of handball players

The result from the above correlation table the correlation of height and explosive power it can be seen that the correlation coefficient(r= 0.859), indicating that height has strong positive correlation with explosive power of handball players.

Table 6

Correlational statistics of weight with shooting accuracy, speed and explosive power (N=33)

Variables	Correlation coefficient	P- value
Weight and shooting accuracy	0.474	0.005
Weight and speed	-0.700	0.000
Weight and explosive power	0.709	0.000

Correlation is significant at <_ 0.05 level (2-tailed).

Table 6 shows that the correlation and significance of weight with speed, performance, shooting accuracy, speed explosive power. The result shows different level of correlation and different level of significance. The correlation of weight with shooting accuracy, speed and explosive power is significance at less than or equal to 0.05.

The above correlation analysis result shows that the correlation of weight and shooting accuracy it can be seen that the correlation coefficient(r= 0.474), indicating that weight has week positive correlation with long shooting accuracy of handball players.

The result of the above correlational indicates that correlation of weight and speed it can be seen that the correlation coefficient(r= -0.700),the negative correlation result is due to that speed measure has reverse relationship with performance and it is measured in seconds and when weight increases time decrease indicates that players performance increase. That is why the correlation shows negative result when time decrease speed performance increase. So the result indicating that weight has strong positive correlation with speed performance of handball players

From the above correlation table the correlation of weight and explosive power it can be seen that the correlation coefficient(r= 0.709), indicating that weight has strong positive correlation with vertical jump power performance of handball players.

Table 7

Correlational statistics of BMI with shooting accuracy, speed and explosive power (N=33)

Variables	Correlation coefficient	P value (Sig)
BMI and shooting accuracy	-0.117	0.515
BMI and speed	-0.186	0.299
BMI and explosive power	0.046	0.801

Definition BMI=body mass index

Table 7 shows that the correlation and significance of BMI with shooting accuracy, speed and explosive power. The result shows different level of correlation and different level of significance. The correlation of weight with shooting accuracy, speed and explosive power is insignificance at greater than 0.05.

The result indicates form the above correlation table the correlation of BMI and shooting accuracy it can be seen that the correlation coefficient(r= -0.117), indicating that BMI has week negative correlation with shooting accuracy of handball players.

Based on the above correlation table the correlation of BMI and speed it can be seen that the correlation coefficient(r= -0.186), the negative correlation result is due to that speed is measured in seconds and when BMI increases time decrease indicates that performance increase. That is why the correlation shows negative result when time decrease speed performance increase. So

the result indicating that BMI has week positive correlation with speed performance of handball players.

The above correlation table indicates that the correlation of BMI and explosive power it can be seen that the correlation coefficient($r= 0.046$), indicating that BMI has no correlation with vertical jump power of handball players.

Table 8

Correlational statistics of arm length with shooting accuracy, speed and explosive power (N=33)

Variables	Correlation coefficient	P-value (Sig)
Arm length and shooting accuracy	0.631	0.000
Arm length and speed	-0.737	0.000
Arm length and explosive power	0.825	0.000

Correlation is significant at $<\_$ 0.05 level (2-tailed).

Table 8 shows that the correlation and significance of arm length with shooting accuracy speed and explosive power. The result shows different level of correlation and all the results are significance at less than or equal to 0.05 level of significance.

Based on the above correlation table the correlation of arm length and shooting accuracy it can be seen that the correlation coefficient($r= 0.631$), indicating that arm length has strong positive correlation with shooting accuracy of handball players.

From the above correlation table the correlation of arm length and speed it can be seen that the correlation coefficient($r= -0.737$), the negative correlation result is due to that speed is measured in seconds and when arm length increases time decrease indicates that performance increase. That is why the correlation shows negative result when time decrease speed performance

increase. So the result indicating that arm length has strong positive correlation with speed performance of handball players

From the above correlation table the correlation of arm length and explosive power performance it can be seen that the correlation coefficient(r= 0.825), indicating that arm length has strong positive correlation with vertical jump power performance of handball players.

Table 9

Correlational statistics of hand span with shooting accuracy, speed and explosive power (N=33)

Variables	Correlation coefficient	P-value (Sig)
Hand span and shooting accuracy	0.656	0.000
Hand span and speed	-0.690	0.000
Hand span and explosive power	0.867	0.000

Correlation is significant at $\leq$ 0.05 level (2-tailed).

Table 9 shows the correlation and significance of hand span with shooting accuracy, speed and explosive power. The result shows different level of correlation and all the results are significance at less than or equal to 0.05 level of significance.

From the above correlation table the correlation of hand span and shooting accuracy it can be seen that the correlation coefficient(r= 0.656), indicating that hand span has strong positive correlation with shooting accuracy of handball players

Based on the above correlation table the correlation of hand span and speed it can be seen that the correlation coefficient(r= -0.690), the negative correlation result is due to that speed is measured in seconds and when hand span increases time decrease indicates that performance increase. That is why the correlation shows negative result when time decrease speed

performance increase. So the result indicating that hand span has strong positive correlation with speed performance of handball players.

The above correlation table result shows that the correlation of hand span and explosive power it can be seen that the correlation coefficient(r= 0.867), indicating that hand span has strong positive correlation with vertical jump power of handball players.

4.2.3 Regression analysis results of anthropometric variables with speed, shooting accuracy and explosive power

The following tables examine the influence of one or more independent variables (selected anthropometric variables) on a dependent variable (speed, shooting accuracy and explosive power) of handball players.

Table 10

Summary of regression prediction of speed performance with anthropometric variables

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.863[a]	.744	.697	.25780

a. Predictors: (Constant), Hand Spam, BMI, Arm Length, Height, Weight

This table provides the R and R-square values. The R value represents the simple correlation and it is 0.863 (R Column), which indicates very strong degree of correlation. The R2 value (R Square column) indicates how much of the total variation in the dependent variable, speed performance level, can be explained by the independent variable (anthropometric variables). In this case, 74.4% can be explained, which is maximum predictor.

Table 11

Coefficient of regression prediction of speed performance with anthropometric variables

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	33.668	6.356		5.297	.000
	Height	-15.623	4.189	-1.662	-3.729	.001
	Weight	.103	.045	1.073	2.273	.031
	BMI	-.352	.118	-.956	-2.981	.006
	Arm Length	-.058	.024	-.661	-2.453	.021
	Hand Span	.126	.053	.685	2.369	.025

a. Dependent Variable: Speed

The Coefficients table provides us with the necessary information to predict speed performance level from anthropometric variables as well as determine whether those anthropometric variables contributes statistically and significantly to the model by looking at the Significance column (p value) Furthermore, Linear regression equation was calculated to predict 30m sprinting test based on height, weight, BMI, arm length and hand span testing results. We can use the values in the "B" column under the "Unstandardized Coefficients" column, as shown in the above table. To represent the regression equation as players speed performance is equal to 33.668 -15.623 (height) One centimeter increases in height will increase speed performance by -15.623seconds.To represent the regression equation as players speed performance is equal to 33.668 + 0.103 (weight). One kilogram increases in weight will increase speed performance by 0.103seconds.To represent the regression equation as players speed performance is equal to 33.668-0.352(BMI) One kilogram per meter square increase in BMI will increase speed performance by0.352 seconds. To represent the regression equation as players speed performance is equal to 33.668-0.058 (arm length) One centimeter increase in arm length will decrease speed performance by-0.058 seconds. To represent the regression equation as players

speed performance is equal to 33.668 +0.126(hand span). One centimeter increase in hand span will increase speed performance by -0.126 seconds. As a result anthropometric variables of junior handball players was found to be predictor of speed performance level of those players height is the most dominant anthropometric variable.

Table 12

Summary of regression prediction of speed performance with anthropometric variables

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.732[a]	.536	.450	4.26566

a. Predictors: (Constant), Hand Span, BMI, Arm Length, Height, Weight

This table provides the R and R-square values. The R value represents the simple correlation and is 0.732(R Column), which indicates strong degree of correlation. The R2 value (R Square column) indicates how much of the total variation in the dependent variable, shooting accuracy performance level, can be explained by the independent variable (anthropometric variables). In this case, 53.6% can be explained, which is an optimal predictor.

Table 13

Coefficient of regression prediction of speed performance with anthropometric variables

Model		Unstandardized Coefficients		Standardized Coefficients		
		B	Std. Error	Beta	t	Sig.
1	(Constant)	-131.873	105.177		-1.254	.221
	Height	105.612	69.317	.915	1.524	.139
	Weight	-.285	.751	-.241	-.379	.707
	BMI	.282	1.954	.062	.144	.886
	Arm Length	-.045	.394	-.041	-.113	.911
	hand Span	.073	.880	.032	.083	.935

a. Dependent Variable: Shooting Accuracy

Table 14

Summary of regression prediction of speed performance with anthropometric variables

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.891[a]	.794	.756	1.48095

a. Predictors: (Constant), Hand Spam, BMI, Arm Length, Height, Weight

This table provides the R and R-square values. The R value represents the simple correlation and is 0.891 (R Column), which indicates strong degree of correlation. The R2 value (R Square column) indicates how much of the total variation in the dependent variable, explosive power level, can be explained by the independent variable (anthropometric variables). In this case, 79.4% can be explained, which is a maximum predictor.

Table 15

Coefficient of regression prediction of speed performance with anthropometric variables

Model		Unstandardized Coefficients		Standardized Coefficients		
		B	Std. Error	Beta	t	Sig.
1	(Constant)	10.913	36.515		.299	.767
	Height	3.165	24.065	.053	.131	.896
	Weight	.261	.261	.424	1.001	.326
	BMI	-.520	.678	-.221	-.767	.450
	Arm Length	.009	.137	.016	.065	.949
	hand Span	.606	.305	.514	1.983	.058

a. Dependent Variable: explosive power

4.3 Discussions of the Results

In this section the finding of the study was discussed in relation to reviews of related literature.

The purpose of this study was to investigate the relationship of anthropometric variables with shooting performance and selected basic motor abilities of handball players.

Discussions of results of height with shooting accuracy and selected motor abilities

The result also shows that height of players has a significant correlation with shooting accuracy. The result revealed that it has a significant correlation at r=0.673 for shooting accuracy and significance value which is p- value (p=0.000). Hence, (P <0.05) implies positive and significant correlation. This finding of the study is in accordance with the findings Ronnie and Gal (2018) and Raju and Satish (2016) study on relationship of shooting ability with selected physical fitness components and anthropometric measurements of men handball players in Andhra Pradesh the finding shows that there was significant relationship between height and shooting performance of players.

The finding of the study shows that there were significance correlation between height of players and their speed performance when evaluated in 30m sprinting test. The result revealed that it has a significant correlation at r=-0.783 and p=0.000). Hence, (P <0.05) implies positive and significant correlation. The reason behind this significant correlation is that players with better height have longer stride length so they can finish the given distance within a short period of time that is why the correlation shows negative result but it is positive performance. The results of this study is in line with the findings of Eshita, and, Lakhvinder,(2018) influence of height and weight on physical fitness index of amateur gymers of age 17 years the result shows that height was found to be positively and significantly correlated to the physical fitness indicators including power performance. The finding shows that height of players has a significant correlation with explosive power. The result indicates that it has a significant correlation at r=0.859 for explosive power and the significance value which is p- value is p=0.000). Hence, (P <0.05) implies positive and significant correlation of height and explosive power of players. The findings of this study is supports the findings of Eshita, and Lakhvinder, (2018)on the influence of height and weight on physical fitness index of amateur gymers of age 17 years the result shows that height was found to be positively and significantly correlated to the physical fitness indicators including power.

Discussions of results of weight with shooting accuracy and selected motor abilities

The result shows that weight of players has positive and significant correlation with shooting accuracy. The result revealed that it has a significant correlation at r= 0.470 for shooting accuracy and the significance value which is p- value p= 0.005Hence, (P <0.05) implies positive and significant correlation. This finding of the study is in accordance with the findings Raju and Satish, (2016) study on relationship of shooting ability with selected physical fitness components and anthropometric measurements of men handball players in Andhra Pradesh the finding shows that there was insignificant relationship between weight and shooting performance of players. The finding of the study shows that there were significance correlation between weight of players and their speed performance when evaluated in 30m sprinting test.

The result revealed that it has a significant correlation at r=-0.700 and p=0.000). Hence, (P <0.05) implies positive and significant correlation. The reason behind this significant correlation

for this specific finding might be all players are under normal body weight. The findings of this study is in line with the findings of Eshita and Lakhvinder (2018) influence of height and weight on physical fitness index of amateur gymers of age 17 years the result shows that weight was found to be positively and significantly correlated to the physical fitness including speed. On the other hand kuldeep singh and mange ram (2013) on Prediction of handball players playing ability on the basis of their anthropometric measurements and physical fitness components suggests that of player optimum weight helps both offensive and defensive movements it will be helpful to run fast.

The finding shows that weight of players has a significant correlation with explosive power. The result indicates that it has positive and strong significance correlation at r=0.709 for the variable the significance value which is p- value is p=0.000). Hence, (P <0.05) implies positive and significant correlation of weight and power performance of players. The findings of this study is in line with the findings of Eshita, and Lakhvinder,.(2018) influence of height and weight on physical fitness index of amateur gymers of age 17 years the result shows that weight was found to be positively and significantly correlated to the physical fitness indicators including power.

Discussions of results of BMI with shooting accuracy and selected motor abilities

The result shows that BMI of players has insignificant correlation with shooting accuracy. The result revealed that it has negative and insignificant very week correlation at r= -0.117 and its significance value which is p- value p=0.515 Hence, (P >0.05) implies negative, week and insignificant correlation. The result shows different from the finding interpretations given by Pantelis, et al, (2019) the relationship of age and BMI with Physical Fitness in Futsal Players that BMI correlated inversely with jumping ability and relative mean of power. The finding of the study shows that there were no significance correlation between BMI of players and their speed performance when evaluated in 30m sprinting test.

The result revealed that it has week and insignificant correlation at r=-0.186 and p=0.299). Hence, (P >0.05) implies positive and insignificant correlation. The finding for the correlation between weight and physical performance variables (speed and power) shows that it has no positive and week correlation but Nikolaidis and Ingebrigtsen(2013) investigated the effect of

BMI on physical fitness of Handball players and found a negative correlation. It means that the excess of body mass could negatively affect the performance in Handball player's physical performance. The result also shows that BMI of players has no significant correlation with explosive power. The result indicates that it has negative and insignificant correlation at r=0.046 the significance value which is p- value p=0.801for vertical jump and p=0.537 for long jump Hence, (P >0.05) implies positive and insignificant correlation.

Discussions of results of arm length with shooting accuracy and selected motor abilities

The result also shows that arm length of players has appositive significant correlation with shooting accuracy. The result revealed that it has a significant correlation at and r= 0.631for shooting accuracy and this variable is significance at p- value p=0.000). Hence, (P <0.05) implies positive and significant correlation. Players with longer arm length can generate more power during shooting performance the result of this study is different from the finding of Mathavan (2012)conducted a study on Relationship between upper body Anthropometric parameters and throwing performance of Handball players. The result revealed that arm length did not show any significant influence. The finding of the study shows that there were positive and significance correlation between arm length of players and their speed performance when evaluated in 30m sprinting test. The result revealed that it has a significant correlation at r=-0.737 and p=0.000). Hence, (P <0.05) implies positive and significant correlation. The reason behind this significant correlation is that players arm length is due to its proportionality with their body height. kuldeep, and Mange (2013) on Prediction of handball players playing ability on the basis of their anthropometric measurements and physical fitness components Sows that arm length is helpful to the players in catching, passing, shooting and to do defensive and offensive actions besides the opponent's difficulty. The finding shows that arm length of players has a significant correlation with explosive power. The result indicates that it has a significant correlation at r=0.825 for vertical jump power and the significance value which is p- value is p=0.000). Hence, (P <0.05) implies positive and strong significant correlation of arm length and explosive power of players.

Discussions of results of hand span with shooting accuracy and selected motor abilities

The result also shows that hand span of players have a significant correlation with shooting accuracy. The result revealed that it has a significant strong positive correlation r= 0.656 and the significance value which is p- value p=0.000). Hence, (P <0.05) implies positive and significant correlation. The finding of the study shows that there were significance correlation between hand span of players and their speed performance when evaluated in 30m sprinting test. The result revealed that it has a significant correlation at r=-0.690 and p=0.000). Hence, (P <0.05) implies positive and significant correlation.it is due to its proportionality with their height similarly handling the ball (with only one hand), is particularly important so according to Fischer, et al.(2002) a higher hand span can helps in some handball-specific skills. The finding shows that hand span of players have a significant correlation with explosive power. The result indicates that it has a significant correlation at r=0.867and its p- value is p=0.000). Hence, (P <0.05) implies positive and significant correlation of height and explosive power of players. Players with better height can have longer hand span that helps them to generate powerful shoots during attack. The finding is in line with the results from Clarke, H.&Clarke.DH,1987).It has been suggested that playerswith longer fingers and larger hand surfa ces enjoy stronger power.

CHAPTER FIVE

SUMMERY, CONCLUSION AND RECOMMENDATION

5.1 Summery

The main target of this study was to investigate the relationship of anthropometric variables with shooting performance and selected basic motor abilities of handball players. The study was conducted at two distinct areas of west Gojam. The first one is at Bahir Dar handball project and the second is at Adet handball project. For this research purpose the researcher tries to review the related and available literatures in this area that helps to construct methodologies and to formulate objectives of the study

To address the target of this study the following specific research objectives were formulated.

- Examine the relationship between measured anthropometric characteristics and shooting accuracy.
- Identify the relationship between measured anthropometric variables and speed of handball players.
- Investigate the relationship between measured anthropometric variables and explosive power of players.
- Identify which anthropometric variable is the most dominant factor for shooting performance and selected basic motor abilities of players.

Based on these specific objectives the research questions were formulated. Participants for the study were 33 male players who are participating in Bahir Dar and Adet handball projects. All players participated in all anthropometric (height, weight, BMI, arm length and hand span), shooting performance (shooting score and shooting accuracy) tests and selected basic motor abilities tests (explosive power and speed) performance tests. The row data was gathered from all participants and had been organized using appropriate and relevant statistical method of analysis correlation and regression analysis which helps to come up with findings.

Finally the study shows that anthropometric variables have a significant correlation with shooting accuracy and selected basic motor abilities of players.

For this study through correlational and regression data was analyzed. As a result of this the following major findings were examined.

- The result shows that height has strong positive correlation with speed, explosive power performance and shooting performance of players and it is significant at <0.05 level of significance.
- From the analysis result weight has strong positive correlation with speed, explosive power and it has slightly week positive correlation with shooting performance of players. The correlation is significant at <0.05 level of significance.
- From the analysis result it shows that BMI has positive but very week correlation with speed and power of players and it has a week negative correlation with shooting performance of players. For all variables the correlation is insignificant at>0.05 level of significance
- The result shows that arm length has strong positive correlation with speed, power and shooting performance. The correlation is significant at <0.05level of significance for all variables.
- Hand span has strong positive correlation with speed, power and shooting performance of handball players. The correlation of hand span with this variable is significance at <0.005 level of significance.
- Height is the dominant predictor for speed performance of handball players.

5.2 Conclusions

Depends on the results the researcher was conclude the following points.

Height and weight has strong positive correlation with speed, explosive power performance and shooting performance of players. BMI has positive but very week correlation with speed and power of players and it has a week negative correlation with shooting performance of players.

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Arm length and hand span has strong positive correlation with speed, power and shooting performance. Height is the most dominant anthropometric variable of speed performance of handball players.

5.3 Recommendations

Based on the results, discussions, findings and conclusions above the researcher forward the following points as recommendation.

- Anthropometric variables are vitally important in handball since anthropometric variables influence player's skill and physical performance it is highly advisable to for coaches to consider those variables especially during player selection from the beginning and implement trainings for their players by considering it.
- Training program should design provide for players to improve the effectiveness of those anthropometric variables and support players to enhance physical and skill performance of handball players.
- There are many types of anthropometric variables and motor ability variables of handball players that unable to address by the researcher due to the shortage of measuring devices and their expensiveness in order to examine their effect and relationship it needs further investigation with other variables.
- Further studies should be conducted in the same area on different age categories, sex and higher number of participants which is highly affects the outcomes of the research.

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APPENDIXES

Appendix 1: Profile of participants

Players number	Age	Playing experience (year)	Training area
1	17	1	Adet
2	16	2	Adet
3	19	3	Adet
4	19	3	Adet
5	18	2	Adet
6	20	2	Adet
7	20	3	Adet
8	18	3	Adet
9	19	2	Adet
10	20	3	Adet
11	20	3	Adet
12	19	3	Adet
13	17	2	Adet
14	16	2	Adet
15	20	2	Adet
16	19	3	Adet
17	20	3	Adet
18	19	1	Adet
19	20	3	Adet
20	19	3	Adet
21	17	2	Bahir Dar
22	16	2	Bahir Dar
23	17	2	Bahir Dar
24	17	2	Bahir Dar
25	17	2	Bahir Dar
26	15	1	Bahir Dar
27	15	1	Bahir Dar
28	17	2	Bahir Dar
29	16	2	Bahir Dar
30	16	2	Bahir Dar
31	16	1	Bahir Dar
32	16	2	Bahir Dar
33	17	2	Bahir Dar

Appendix2. Results for anthropometric variables of players

Players number	Height(m)	Weight(kg)	BMI(kg/m2	Arm length(cm)	Hand span(cm)
1	1.61	56	24.24	78.6	29.8
2	1.59	54	21.36	79.3	25.3
3	1.58	58	23.23	80.8	26.5
4	1.66	59	21.41	89.0	31.3
5	1.64	57	21.19	86.0	29.1
6	1.69	65	22.76	93.0	33.5
7	1.65	60	22.03	81.0	27.6
8	1.69	59	20.66	94.0	33.0
9	1.67	63	22.59	91.0	32.0
10	1.75	73	23.84	93.0	34.0
11	1.62	54	20.58	81.5	28.7
12	1.65	53	19.47	82.8	30.5
13	1.62	56	21.34	84.0	28.3
14	1.61	51	19.67	86.0	27.7
15	1.65	64	23.51	86.8	30.2
16	1.66	61	22.14	88.7	30.0
17	1.70	64	22.15	94.2	34.0
18	1.68	62	21.97	92.0	32.4
19	1.67	60	21.51	90.3	31.2
20	1.61	61	23.53	80.6	27.9
21	1.76	64	20.66	96.0	33.8
22	1.64	55	20.45	84.0	30.0
23	1.80	67	20.68	98.0	35.0
24	1.65	57	20.94	85.0	31.5
25	1.70	61	21.11	95.0	33.4
26	1.59	57	22.55	82.0	26.8
27	1.63	50	18.82	83.3	28.2
28	1.62	55	20.96	82.6	28.6
29	1.60	53	20.70	83.8	27.3
30	1.63	59	22.21	84.7	29.9
31	1.65	56	20.57	87.2	30.4
32	1.61	58	22.38	85.4	27.9
33	1.67	62	22.23	89.5	32.7

Appendix3. Results for shooting accuracy of players

Players number	Shooting accuracy test			
	6m(20pt)	7m(20pt)	9m(20pt)	Total
1	11	9	7	27
2	9	10	8	27
3	10	10	8	28
4	8	9	7	24
5	12	11	9	32
6	14	13	11	38
7	13	10	9	32
8	13	13	12	38
9	15	12	10	37
10	13	11	8	32
11	11	9	7	27
12	12	11	9	32
13	9	8	6	23
14	10	11	9	30
15	11	9	8	28
16	9	7	7	23
17	13	13	10	36
18	11	11	8	30
19	13	11	9	33
20	12	10	10	32
21	15	12	13	40
22	14	13	11	38
23	16	16	14	46
24	10	9	7	26
25	13	11	9	33
26	9	7	5	21
27	10	8	7	25
28	12	9	8	29
29	13	8	6	27
30	9	9	7	25
31	12	8	9	29
32	10	7	5	22
33	13	10	8	31

Appendix4. Results for basic motor abilities of players

| Players number	Speed(sec)	Explosive Power (cm)
1	4.9	36.5
2	5.2	32.0
3	5.3	34.0
4	4.6	39.9
5	4.9	39.5
6	4.7	41.6
7	5.0	37.8
8	4.8	42.5
9	4.5	41.0
10	4.3	43.7
11	5.5	38.5
12	5.6	37.0
13	5.6	35.5
14	5.4	33.0
15	5.3	40.0
16	4.8	40.5
17	4.6	42.9
18	4.8	41.2
19	4.3	40.0
20	5.1	38.6
21	4.2	44.0
22	5.6	40.3
23	4.0	45.5
24	5.3	39.0
25	4.7	42.0
26	5.7	37.9
27	5.3	38.9
28	5.4	38.7
29	5.1	38.0
30	5.5	39.1
31	5.6	40.9
32	5.6	38.4
33	5.2	40.8

Appendix5. Pictures during height and weight test

Appendix6. Pictures during arm length test

Appendix7. Pictures during hand span test

Appendix8. Pictures during shooting performance test

Appendix9. Pictures during power performance test