BODY FATNESS AND HEALTH-RELATED PHYSICAL FITNESS: WHEN BIGGER IS NOT BETTER

Adeleke, P. A.
adepus2001@yahoo.com

&

Ogunleye, A. V. (Ph.D
Department of Human Kinetics and Health Education,
Faculty of Education, University of Port Harcourt,
Port Harcourt

Abstract
This paper reviewed the effects of body fatness on health-related physical fitness. Body Mass Index (BMI), a measure of body composition is the ratio of body weight in kilogramme to the square of height in meter; it is an index used to classify people as underweight, normal weight, overweight or obese. Health-related physical fitness is an aspect of physical fitness required for healthy life. It consists of cardiovascular fitness, muscular endurance, muscular strength, flexibility and body composition. Literature revealed that significant negative relationship exists between Body Mass Index (BMI) and health-related fitness. However, the effects of overweight/obesity on health-related physical fitness vary with the component of fitness being examined. While, body mass index correlates negatively with cardiovascular fitness and muscular endurance of athletes, Studies showed no significant difference in the performances of overweight/obese and normal weight in flexibility and muscular strength tests. The observed lack of difference is attributed to intense training of athletes irrespective of weight status. However, the reverse is the case in sedentary population. In addition, reviewed literature showed that overweight/obese have greater risk for chronic diseases, including cardiovascular diseases, type 2 diabetes, stroke and cancer of different kinds than normal weight. Most of the reviewed works affirmed that bigger body is not an asset; it is rather a source of bigger health issues, such as bigger blood pressure, bigger blood sugar, bigger serum cholesterol, bigger heart rate, bigger pain and bigger stress. It is therefore recommended that everyone must lead an active life in addition to a well balanced nutrition, in order to prevent the accumulation of unnecessary extra burden of fat which offers little or no significant benefits to man.

Key words: Body mass index, body composition, obesity, chronic diseases.

Introduction

The rising prevalence of obesity in youth and adult populations in the recent times, coupled with its attendant social and health implications calls for global attention. Owing to its effects on the health, economic and social life of the obese, obesity could be described as the worst enemy of the human race. Several studies have indicated obesity as the third leading cause of death globally, only ranked behind cardiovascular disease and stroke (Aladeniyi, Adeniyi, Fawole, Adeolu, Ter Goon, Ajayi & Owolabi, 2017). Consequent upon this, accurate measurements of body composition are needed to assess the individual's fat status in order to develop quality and effective preventive measures. Body composition is defined as the distribution of muscle and fat in the body. Body composition is the relative percentages of fat and lean body mass of which the body is composed; the percentages of fat and lean body mass co-

existing in the human body at any given time (Iro, 2008). The fat components are referred to as fat mass or percent body fat (Esan, 2010). Lean body mass is the total mass of which the body is composed minus fat mass (Iro 2008). This according to Charles and Ruth (2007) includes muscles, bones, skin, and body organs such as the heart, liver, skin, kidneys, and lungs. In young adults, 15-25 percent of body composition is fat and 75 to 85 percent is lean body mass (Powers & Howley, 2001). Excess body fat may lead to obesity and increase the chances of getting many chronic diseases such as coronary heart disease (CHD), stroke, osteoporosis, diabetes and hypertension. Heredity, rate of metabolism, diet, physical activities, and childhood fatness are some of the factors capable of influencing percent body fat, (Charles & Ruth, 2007). Until recently, under water weighing was considered the best method of assessing body fat level, (Charles & Ruth, 2007). With this technique, one is immersed in a tank of water and then weighed. Lean people weigh more under water, they sink; while fat people weigh less under water; they float (Igbanugo, 2006). Other methods of assessing body composition include air displacement plethysmography (ADP), Bioelectrical impedance analysis, Dual energy x-ray absorptiometry, skin fold measurements, waist circumference measurement and the use of body mass index. However, details of these methods are not covered in this paper.

Physical fitness on the other hand is generally defined as the ability to perform daily tasks without undue fatigue. It is the ability of the body systems to work together efficiently to allow the individual to be healthy and effectively perform activities of daily living (Charles & Ruth, 2007). Physical fitness can be divided into health-related and skill-related fitness (Emiola, 2007). While skill-related fitness is crucial to performance, health-related fitness is critical for everyday activities. The factors that make physical fitness measurable are what Emiola (2007) termed components of physical fitness. According to Emiola (2007), Performance or skill-related components of physical fitness includes, balance, agility, speed, muscular coordination, and muscular power. Health-related fitness includes cardiovascular fitness, muscular endurance, muscular strength, flexibility and resistance to disease and body composition. Since excess body fat lowers fitness and reduces the ability to perform many activities that requires jumping and moving quickly (Baumgartner, Jackson, Mahar & Rowe, 2007) this paper discusses and reviews the relationship between body composition and components of health-related physical fitness in both active and sedentary populations with the aim of pointing out the direction and magnitude of association between body fatness and selected health-related components.

Body composition and Cardiovascular Fitness

Cardiovascular fitness is the ability to exercise your entire body for long periods of time without stopping (Charles and Ruth, 2007). Cardiovascular fitness requires a strong heart, healthy lungs and clear blood vessels to supply the cells of the body the oxygen they need. This implies that cardiovascular fitness comprises of two major systems of the body, namely: circulatory and pulmonary systems. The circulatory (heart and blood vessels) and pulmonary (lungs) systems work together to deliver the oxygen necessary for efficient (aerobic) energy metabolism to the exercising muscles.

Oxygen is extracted from air in the lungs and then transported in the blood to the cells where it is deposited and utilized. The byproduct of energy production, carbon dioxide, is then transported back to

the lungs by the circulating blood and leaves the body in expired air. According to William, (2006), cardiovascular fitness is highly important for good health, and to the athletes, it is required both for performance and prevention of undue fatigue that may predispose them to injury. The greatest rate at which oxygen can be taken in and used during exercise is referred to as maximal oxygen uptake (VO_2max) (Iro, 2008). Aerobic capacity which is another name for maximal oxygen uptake is a good indicator of cardiovascular or aerobic fitness. A VO_2 max test in the laboratory setting is considered to be the best measure of cardiovascular fitness. Commonly administered field tests include the One mile run/walk, the 12-minute run, the PACER run for children and various bicycle, step, and treadmill tests (Charles and Ruth, 2007).

In general, there is good data indicating that VO_2 max decreases in direct relationship to the degree of obesity. Incel, 2002 investigated differences in health-related fitness in 2,474 Spanish adolescent boys and girls, classified as underweight, normal weight, overweight or obese according to body mass index. Body composition of the participants was obtained from skinfold thickness analysis, while 20m shuttle run was used to measure their cardiovascular fitness. It was discovered that overweight and obese adolescents presented a lower performance in 20-m shuttle run, compared to normal weight. Therefore, it was concluded that body mass index is the determinant of health related physical fitness in underweight, over weight and obese adolescents. Moore (2003), conducted a study on assessing the relationship between BMI and cardiovascular fitness. Pearson's correlation coefficients were calculated to assess the relationship between BMI and VO_2max as a measure of cardiovascular fitness. It was found out that the Pearson's correlation coefficient between BMI and VO_2max was negative and statistically significant ($p< 0.05$) for both boys: r= -0.280 and girls: r= -0514. The study also revealed that in boys, for every 1 kg/m^2 lower BMI the VO_2max is 0.66 ml/kg/min higher, while in girls, for every 1kg/m^2 lower BMI the VO_2max is 1.09 ml/kg/min higher. The author then submitted that cardio respiratory fitness was negatively associated with obesity. Consequent upon this, some researchers strongly believe that because aerobic fitness levels are lower among the obese, exercise is more difficult, and inactivity is then a result of the increase in body fat stores (Nieman, 2011). The position which is in agreement with the findings of Smidth, (2006) and Huang, Zeitler and Malina (2007) who investigated the relationship between health-related physical fitness and weight status in adolescents and school children respectively. They both found out that there exists a negatively significant relationship between obesity and cardiovascular fitness. Evidence linking cardiovascular diseases to obesity abounds; studies have revealed that obesity is a risk factor for most chronic diseases such as coronary heart disease, hypertension, myocardial infarction, diabetes, stroke, and cancer (Nieman, 2011). Spalding, McAuley, Williams, Barbezat, Nielsen, and Mann, (2008) stated that obesity is increasing in an epidemic manner in most countries and constitutes a public health problem by enhancing the risk for cardiovascular disease and metabolic disorders such as type 2 diabetes. There is also evidence that overweight children may not only become obese adults but also suffer certain chronic diseases in adulthood (WHO, 2005). In order to prevent the aforementioned negative consequences of obesity on cardiovascular fitness, lifestyle

modifications in terms of aerobic exercise and energy intake is inevitable.

Body Composition and Muscular Strength

Muscular strength is the amount of force a muscle or muscle group can generate against a resistance in a maximal contraction. Oworu, Adewumi, Agomoh, and Musa (2010) explained that strength is the ability of a muscle group to overcome a resistance in one maximum contraction. According to the authors, it is the application of explosive force against a resistance in one contraction by a group of muscles. Strength is often measured by how much weight an individual can lift or how much resistance one can overcome. Strength is needed for many everyday activities; walking, cooking, driving, lifting weight and washing are some daily activities requiring strength. According to Iro (2008), muscular strength is the highest amount of tension or force a muscle or muscle group can wield against a resistance in one all-out effort or maximal contraction. When a muscle or group of muscles contracts it produces a force which can be used to produce motion or cause an object to move. This is actually the position of Williams (2006), when he defined muscular strength as simply the ability of a muscle to generate force against resistance. Here, resistance could refer to any force working in opposite direction to the force generated by the contraction of a muscle. It is also the capacity of the muscles to provide tension necessary for maintaining posture and initiating or controlling movement during conditions of loading of the musculoskeletal system (Smidth & Rogers, 2008). Muscular contractions could be seen in three ways. These according to Smidth and Rogers (2008) are dynamic or isotonic, static or isometric and isokinetic contractions. Isotonic contraction is the shortening of a group of muscles due to tension generated during contraction; isometric contraction is a type of muscle contraction in which the length of the muscle remains the same as it develops tension, while isokinetic contraction is a special situation in which the muscle is changing in length (either shortening or lengthening), but at a constant rate (isokinetic means same speed), normally this state of contraction is achieved using expensive machinery (Igbanugo, 2010). Muscular strength can be measured in many ways and by different instrument but the easiest and the most accurate method is the use of dynamometers. These instruments can be used to measure the strength of any muscle or muscle group in the body. The grip strength can be efficiently measured with a standard grip strength dynamometer (Bellace, Healy, Besser, Byron & Hohman, 2000).

Studies on the relationship between body mass index and muscular fitness revealed that muscle mass and composition are some of the main somatic predispositions influencing muscular strength in addition to age (Igbanugo, 2010; Baumgartner, et.al. 2007). There have been claims and counter claims regarding the relationship between body fat and muscular strength. Incel, (2002) observed that overweight/obese adolescents performed poorly in bent-arm-hang, but higher in handgrip strength compared to their normal weight counterparts. In another study conducted by Smidth, (2006), obese and underweight school children had poorer performances compared to normal weight children in push-up and sit up tests. In a similar study conducted by Huang, et.al, (2007) to investigate the effect of BMI on health-related physical fitness (Muscular strength) among 120 obese seventh graders, it was found that BMI has no significant relationship with muscular strength (r= 0.175). Hoeger and Hoeger (2002) examined the prevalence of

childhood and adolescent obesity in Taiwan and investigated the association between excess weight and physical fitness and blood pressure. It was found that the overweight/obese youngsters tend to have poorer muscular strength and cardiovascular endurance than the normal weight group. In contrast, Kader, Hasan, Kamal, & Hussein, (2016) observed a positive correlation between muscle strength (quadriceps, triceps, and abdominal muscles) and body mass index percentile among seventy five (75) healthy normal and obese school children.

Due to conflicting reports on the relationship between adiposity and muscular strength, more study is needed in this area to clear all doubts and misconceptions. It is also pertinent to know that obese fit individuals are more likely able to improve and maintain muscular strength than obese unfit, because fit and seasoned athletes tend to have lower rates of muscle atrophy which goes with age due to constant training (Nieman, 2011). Therefore, irrespective of weight status, fitness plays an important role in the development and maintenance of muscular strength and endurance. However, Esan, (2010) disclosed that in sports, excess fat hinders performance as it does not contribute to muscular force production; it is rather, an extra weight that requires energy to move about. Going by this assertion, any individual with more body fat than required in relations to lean body mass may suffer poor muscular strength if not now, but certainly later in life.

Body Composition and Muscular Endurance

Muscular endurance is the ability to use a muscle or muscle group without tiring. According to Oworu, et.al (2010), muscular endurance is defined as the ability of a group of muscles to contract over a longer period of time; it is the ability of a group of muscles to persist in vigorous physical activity for a very long time. In assessing muscular endurance, duration of a physical task is an important indicator of one's level of endurance. For instance, a marathon runner is said to have more muscular endurance than a sprinter, since he or she has to run for a longer time than a sprinter, who only runs for a time less than three minutes. William (2006) submitted that muscular endurance is the ability to perform repetitive muscular contractions against some resistance for an extended period of time. A crucial point addressed by the above definition is the concept of repetitive muscular contraction. Here, the number of repetitions made during a physical task may be used as an indicator of one's level of muscular endurance. As muscular strength increases there tends to be a corresponding increase in endurance. For example, an athlete can lift a weight twenty-five times. If muscular strength is increased by ten percent through weight training, it is likely that the maximum number of repetitions would be increased because it is easier for the athlete to lift the weight. In his own view Iro (2008), said muscular endurance is the ability to maintain a static or fixed contraction for an extended period of time. When a muscle is able to sustain contraction for a longer period of time, the muscle is said to have exhibited muscular endurance. For example, if two people of the same size are made to hold an equal amount of weight, on any part of the body, the group of muscles concerned is contracted in that position. The individual who can hold the load longer has more endurance in the muscles involved. Measurement of muscular endurance can be done using various laboratory and field tests. In general, field tests are easier and less expensive. According to Igbanugo (2010), age, gender, time of the day, temperature and psychological factors are some of the factors that affect muscular

endurance. According to Deforche, Lefevre, De Bourdeaudhuij, Hills, Duquet & Bouckaert, (2003) when compared with normal weight, overweight adolescents had poorer muscular endurance (measured by sit-up). This is consistent with the findings of Mak, Ho, Lo, Thomas, McManus, Day, & Lam, (2010) where push up and sit-up tests were used to assess muscular strength and endurance of underweight, normal weight and overweight/obese adolescents. Similarly, Kim, Must, Fitzmaurice, Gillman, Chomitz, …. & Peterson (2005) and Graf, Koch, Kretschmann-Kandel, Falkowski, Christ, …. and Dordel, (2004) reported significant negative relationship between obesity and muscular endurance. A study carried out by Robert (2013), on relationship between BMI and Endurance-Strength Abilities revealed that overweight and obesity expressed by the body mass index (BMI) negatively influence the level of endurance abilities assessed. It was discovered that overweight female students were characterized by a significantly lower level of endurance abilities than their underweight or normal peers. Based on the available literature we can sufficiently conclude that higher body mass limits muscular endurance.

Body composition and Flexibility

Another health-related component of physical fitness is flexibility. Flexibility is the ability to use a joint fully through a wide range of motion. According to Oworu et.al (2010), flexibility is defined as the range of motion or movement within a joint. In the same vein, Williams (2006) defined flexibility as the ability to move a joint or series of joints smoothly and easily through-out a full range of motion. Flexibility can be discussed in relation to movement involving only one joint, such as the knees, or movement involving a whole series of joints, such as the spinal vertebral joints, which must all move together to allow smooth bending or rotation of the trunk. The range of motion allowed by a joint differs from person to person and from one joint to another in the same individual. Range of motion (ROM) is the amount of movement you can make in a joint (Charles & Ruth, 2007). William (2006) made it clear that low back pain is frequently associated with tightness of the muscles in the lower spine and the hamstrings. People with good flexibility have fewer sore and injured muscles (Charles & Ruth, 2007). Research over the years has shown a number of factors limiting the ability of a joint to move through a full, unrestricted range of motion. Such factors according to Charles and Ruth (2007) include type of joint, structure of joint, level of activity, age and sex. Flexibility is specific to each joint of the body, thus there is no general measurement of flexibility as there is for cardiovascular fitness. Flexibility is typically measured in the laboratory using measuring devices such as goniometer, flexometer and in the field with test exercises such as the sit and reach, and the zipper (Charles & Ruth, 2007). It appears weight has no significant relationship with flexibility. Most studies conducted to investigate the relationship between flexibility and weight status reported no relationship, while a few studies reported positive relationships. As regards flexibility, Mak, et.al (2010) found that overweight/obese and normal weight adolescents had similar sit-and-reach (flexibility test) results. This is in consonance with two Taiwanese studies (Chen, Fox, Haase & Wang, 2006) but in contrast to another report that slightly better sit-and-reach results were achieved by overweight than normal weight girls (Prista, Maia, Damasceno & Beunen, 2003). However, regular flexibility exercise is recommended for all irrespective of weight status in order to

prevent health issues such as back pain, often associated with poor flexibility.

Conclusion

Body composition has been defined as the ratio of body weight that is composed of fat in relations to lean body mass. This can be assessed using different techniques, including body mass index (BMI). Although higher BMI does not automatically translate to higher fat mass, it is an indicator that the individual is having more weight than required for his height (adult) or age (children). However, people with higher body mass are naturally seen as having higher fat mass. Studies affirmed that an appropriate amount of fat is required for optimum health and maintenance of life; nevertheless, excessive accumulation of fat, known as obesity has also been indicted by studies as comobidity with most chronic diseases, such as diabetes, coronary heart disease, stroke and cancer. Similarly, there is weight of evidence that BMI negatively correlates with health-related physical fitness. Available literature reveals that increasing BMI often leads to decreasing health-related physical fitness. However, the effects of overweight on health-related physical fitness vary with the component of fitness being examined. While it appears bigger body size negatively and significantly affects cardiovascular fitness and muscular endurance of athletes and highly active people, evidence shows it has little or no effect on flexibility and strength ability of the same population. However, few studies conducted among sedentary populations showed that bigger body size is detrimental to health; it correlates negatively and significantly with health-related components of physical fitness. And more importantly, overweight and obese people are more likely to suffer degenerative diseases that may limit their functional abilities. When it comes to body size, we can sufficiently conclude that bigger body size is not an asset and should not to be desired, because it is not better. Bigger body size, is a precursor of bigger fat mass, bigger blood pressure, bigger cholesterol, bigger heart rate, bigger blood sugar and bigger stress. The result of which is poor social life due to stigma, poor health, loss of man hour due to ill health and visits to hospitals, poor economy due to high cost of drugs and health care. It is therefore, recommended that everyone, athletes or non athletes; adults, youth and children alike should be physically active and cut down calorie intake in order to prevent obesity; for bigger is not better.

References

Baumgartner, T.A., Jackson, A. s., Mahar, M. T. & Rowe, D. A. (2007). Measurement for Evaluation in Physical Education and Exercise Science, 8th edition. McGraw Hill

Bellace, V., Healy, D., Besser, M. P., Byron, T. & Hohman, L. (2008). Validity of the Dexter Evaluation systems Jamar Dynamometer Attachment for Assessment of Handgrip strength in a normal population. Department of physical Therapy, Thomas Jefferson, University, Philadelphia, Pennsylvania, USA.

Charles, B.C. & Ruth, L. (2007) *Fitness for Life (fifth edition).* Foresman and Company.

Chen L. J., Fox, K.R., Haase, A., Wang, J.M. (2006) Obesity, fitness and health in Taiwanese children and adolescents. *Eur J Clin Nutr*, 60(12):1367-1375.

Deforche B, Lefevre J, De Bourdeaudhuij I, Hills AP, Duquet W, Bouckaert J. (2003): Physical fitness and physical activity in obese and nonobese Flemish youth. *Obes Res, 11(3):434-441.*

Emiola M. L. (2007). Tips on how to maintain a fit and healthy body. *Journal of Nigerian Association of Sports Science and Medicine.* 9;15-16

Esan, J. A. (2010), Effects of a 12-week circuit strength training programme on selected body composition variables of college women. *Optimal Health Performance: The Basis of Human Movement Education in the 21st Century.* Vol 1. Pp 24-33.

Graf, C., Koch, B., Kretschmann-Kandel, E., Falkowski, G., Christ, H., Coburger, S., Lehmacher, W., Bjarnason-Wehrens, B., Platen, P., Tokarski, W., Predel, H.G., & Dordel, S. (2004). Correlation between BMI, leisure habits and motor abilities in childhood (CHILT project). Int J Obes Relat Metab Disord 2004, 28(1):22-26

Hoeger, W. W. K. & Hoeger, S. A. (2002). *Principles and labs for Fitness and Wellness. (6th ed.)* Belmont: Wadsworth

Huang Y. C., Zeitler G. T. & Malina R. M., (2007). BMI and Health-related Physical Fitness in Taiwanese youth 9-18 years. *Med Science Sports Exercise, 39(4):701-708.*

Igbanugo, V.C. (2006) Sports Science; the Bedrock of Sports development in Nigeria. Journal of International Council for Health, Physical Education, Recreation, Sports and Dance African Region. ISSN 1117-1936.

Incel, N. A. (2002). Grip Strength, effect of Hand dominance. *Singapore Medical Journal.* 43 (5): 234-237.

Iro, P.C.E. (2008). *Dictionary of Physiology of Exercise and Related Terms,* pp 189.

Kader, N. A., Hasan, A. K., Kamal, H. M. & Hussein, Z. A. (2016): Relation between body mass index percentile and muscle strength and endurance. The Egyptian Journal of Medical Human Genetics www.ejmhg.eg.net www.sciencedirect.com

Kim, J., Must, A., Fitzmaurice, G.M., Gillman, M. W., Chomitz, V., Kramer, E., McGowan, R., & Peterson, K. E. (2005). Relationship of physical fitness to prevalence and incidence of overweight among schoolchildren. Obes Res, 13(7):1246-1254.

Mak, K., Ho, S., Lo, W., Thomas, G.N.,2, McManus, A.M., Day, J. R. & Lam, T. (2010) Health-related physical fitness and weight status in Hong Kong adolescents. BMC Public Health, 10:88 http://www.biomedcentral.com/1471-2458/10/88

Moore, R. L. (2003) Exercise Training and Cellular Adaptations of Normal and Diseased Hearts. In Holloszy, J.O. (ed). *Exercise and Sports Sciences: American College of Sports Medicine (ASCM).* Philadelphia. Lippincott Williams and Wilkins. Pp 285-315.

Nieman, D. C. (2011). Exercise Testing and Prescription: A Health-Related Approach. The McGraw-Hill Companies, Inc., 1221 Avenue of the Americas, New York, NY 10020.

Oworu, O., Adewumi, S., Agomoh, U. & Musa, B. (2010) *Fundamentals of Physical and Health Education for Junior Secondary School, UBE edition*. Longman Nigeria PLC.

Powers S. K. & Howley, E.T. (2001). Exercise Physiology: Theory and application to Fitness and Performance, fourth edition, McGraw Hill.

Prista, A., Maia, J.A., Damasceno, A., Beunen, G. (2003). Anthropometric indicators of nutritional status: implications for fitness, activity, and health in schoolage children and adolescents from Maputo, Mozambique. Am J Clin Nutr 2003, 77(4):952-959.

Smidth, B. & Roger J. (2008), "The Validity of Self-Reported Physical Fitness Test Scores", *Military Medicine*, vol.172, n°2, February 2008, pp.115-120.

Smidth, M. G. (2006) Factors contributing to the regulation and clinical assessment of instant strength. *Physical Therapy. 62:1283-1289.*

Spalding, R. W., McAuley, K. M., Williams, S. M., Barbezat, W., Nielsen, G., & Mann, J. I. (2008). Reducing weight gain in children through enhancing physical activity and nutrition: the apple project. *International Journal of Pediatric Obesity*, *1*(3):146-152.

World Health Organization (2005). *Global Database on Body Mass Index*. Retrieved from http://apps.who.int/bmi/index.jsp.

William, E. P. (2006). *Arnheims Principles of Athletic Training, a competency Based Approach.* McGraw Hill Higher Education. *Pp 420.*