International Journal of Innovative Research and Advanced Studies (IJIRAS)
Volume 4 Issue 4, April 2017

ISSN: 2394-4404

Body Composition Factors As Predictors Of Oxygen Consumption Among Security Men Tertiary Institutions In Bauchi State, Nigeria

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Abstract: ***The study was conducted to determine the Relationship between Body Weight, Body Density, Percent Body Fat and Maximum Oxygen Consumption among Security men in some Tertiary Institutions in Bauchi State, Nigeria. Purposive sampling technique was used as the researcher used the whole population of the security men (N=273) of the four (4) institutions. Inferential statistics of regression was used and computed the relationship between Body Weight, Body Density, Percent Body Fat and Maximum Oxygen Consumption among the participants. The findings of the study also showed positive relationship Between Body Density and Maximum Oxygen Consumption among Security men in Tertiary Institutions in Bauchi State. This study concluded that Maximum Oxygen Consumption has no significant relationship with Body Weight, Body Density, and Percent Body Fat among Security men in Tertiary Institutions in Bauchi State. Exercise programmes for maintaining ideal body weight and acceptable percent body fat might not necessarily improved Cardio-respiratory fitness.***

Keyword security man, body weight, Body Density, Percent Body Fat and Maximum Oxygen

I. INTRODUCTION

The term body weight in medical and Para-medical sciences refers to a person's mass or weight determined with minimum clothes on, measured in kilogrammes (American College of Sports Medicine, 2006). Harsha and Bray (1996) explained body weight as one way of determining a person's health.

According to Higgins (2008) body density gives more information on person's health than body weight. Fahey, Insel and Roth (2010) added that body density is a measurement that expresses total body mass or weight relative to body volume. Heyward (1991) emphasizes that the measurement of body density is commonly used to estimate percentage of body fat, which determines how much fat one carries around. A skin fold is one of the most common methods for measuring body density and thereby applying the correct population-specific conversion formula to determine percent body fat. Heyward (1991) further says to convert body density to percent body fat, assumptions are made regarding the density of fat and the fat-free portion; this is referred to as a two-component model. This model divides the body into a fat portion, which consists of all extractable lipids, and the fat-free portion, which consists of connective tissue, organs, bone and muscle, minus any fat.

Jackson, Stanforth, Gagnon, Rankinen, Leon, Rao, Skinner, Bouchard and Wilmore (2002) defined percent body fat as the percentage of the total body weight composed of fat. According to Jackson, et.al (2002), body fat includes essential body fat and stored body fat. Gaya and Balami (1990)

emphasized that essential body fat is necessary to maintain life and reproductive functions. Gaya, and Balami, (1990); Kaidal, Abass, Sanusi, Mshelia and Balami (1999) contributed that the percentage of essential body fat for women is greater than that for men, due to the demands of childbearing and other hormonal functions. The American College of Sports Medicine (2006) narrated that; the percentage of essential fat is 3–5% in men, and 8–12% in women. According to the American Council on Exercise (2009) stored body fat consists of fat accumulation in adipose tissue, part of which protects internal organs in the chest and abdomen. The American Council on Exercise (2009) further explains that essential fat is the level below which physical and physiological health would be negatively affected.

Maximal Oxygen Consumption (VO_{2max}) is the maximum rate of oxygen uptake as measured during incremental exercise (Chatterjee, Chatterjee & Bandyopadhyay, 2005; Bouchard, Dionne, Simoneau & Boulay, 1992). According to Kaidal (1989) and Balami (1991) maximal oxygen consumption reflects the aerobic physical fitness of an individual, and is an important determinant of endurance capacity during prolonged, sub-maximal exercise. Kaidal (1989); Balami (1991); Chado (1992) and Venkateswarlu (2009) stated that Maximum oxygen consumption is expressed either as an absolute rate in litres of oxygen per minute (L/min) or as a relative rate in millilitres of oxygen per kilogramme of body mass per minute (ml/(kg•min)). However, Wilmore and Costill (2005) argued that Maximum oxygen consumption generally does not vary linearly with body mass, so comparisons of the performance capacities of individuals that differ in body size must be done with appropriate statistical procedures, such as analysis of covariance. Venkateswarlu (2009) stated that absolute values of Maximum oxygen consumption are typically 40-60% higher in men than in women. Chado (1992) stated that the average untrained healthy male may have a Maximum oxygen consumption of approximately 35–40 ml/(kg•min) while the average untrained healthy female may score a Maximum oxygen consumption of approximately 27–31 ml/(kg•min). Zuluaga, Briggs and Carsile (1995) observed that these scores can be improved with training and decrease with age though the degree of trainability also varies very widely: conditioning may double Maximum oxygen consumption in some individuals, and will never improve it in others.

Astrand and Rodahl (1986) emphasized that the factors affecting oxygen consumption (VO_2) are often divided into supply and demand. Supply is the transport of oxygen from the lungs to the mitochondria (including lung diffusion, stroke volume, blood volume, and capillary density of the skeletal muscle) while demand is the rate at which the mitochondria can reduce oxygen in the process of oxidative phosphorylation. Similarly, Kaidal (1989); identified number of factors that may affect Maximum oxygen consumption which include age, sex, fitness, training, changes in altitude, and action of the ventilator muscles. Kaidal (1989); Gaya, Mshelia and Sanusi (2002) explained that cardiac output, pulmonary diffusion capacity, oxygen carrying capacity, and other peripheral limitations like muscle diffusion capacity, mitochondrial enzymes, and capillary density are all examples of Maximum oxygen consumption determinants. The body works as a system, if one of these factors is affected, then the whole system loses its normal capacity to function properly.

Goran, Fields, Hunter, Herd and Weinsier (2000) stated that total body fat and aerobic fitness are frequently used in association with each other, and it is often implied that these physiological parameters are strongly inter-related. Similarly, both body fatness and aerobic fitness have been shown to be risk factors for future health outcome, but it is unclear whether these effects are related to one another or are independent risk factors. For instance, Goran et.al (2000) has shown that there are separate and independent health effects of aerobic fitness and body fat while Harsha, and Bray, (1996) and Higgins (2008) argued that aerobic fitness is the primary factor influencing future health outcome, although the physiological basis of this concept remains unclear.

Data on relationship between percent body fat and Maximum Oxygen Consumption seem to be nonexistent among Security men of some Tertiary institutions in Bauchi State and in many instances, physically unfit and/or over aged individuals irrespective of their body composition have been observed to be recruited as security men in many institutions in Nigeria. As total body fat and aerobic fitness are frequently used in relation to each other, the parameters have been shown to be risk factors for future health outcome.

OBJECTIVES OF THE STUDY

The objectives of the study were to determine the relationship between:

- ✓ body weight, body density and percent body fat as a determinant of oxygen consumption among Security men in some tertiary institutions in Bauchi State, Nigeria.

RESEARCH QUESTIONS

The following research questions were answered:

- ✓ Could body weight, body density and percent body fat be determinant of oxygen consumption among Security men in some tertiary institutions in Bauchi State, Nigeria?

HYPOTHESES

The following hypotheses were tested:

$H0_1$: body weight, body density and percent body fat will not be significant predictors of oxygen consumption among Security men in some tertiary institutions in Bauchi State, Nigeria

II. RESEARCH METHODOLOGY

RESEARCH DESIGN

Correlational research design was used for this study. Asika (2000), Njodi and Bwala (2010) stated that Correlational design seeks to establish relationship between two or more quantifiable variables for making prediction. Asika (2000) further said the variables studied are normally those that do not constitute a cause and effect (independent and dependent) relationship. The design was found

appropriate because selected Body Weight, Body Density, and Percent Body Fat were compared with Maximum Oxygen Consumption and determined their relationship.

POPULATION AND SAMPLE

The population of this study comprised Security men in tertiary institutions in Bauchi State. The total population was two hundred andseventy three participants (N=273) which comprised AbubakarTatari Ali Polytechnic, Bauchi Campus N=116 (AbubakarTatari Ali Polytechnic, Bauchi Secret Registry Staff Statistics 2014); AbubakarTatari Ali Polytechnic, Azare Campus N=35 (AbubakarTatari Ali Polytechnic, Azare Secret Registry Staff Statistics 2014); College of Education, Azare N=80 (College of Education, Azare Secret Registry Staff Statistics 2014) and College for Legal and Islamic Studies, Misau N=42 (College for Legal and Islamic Studies, Misau Secret Registry Staff Statistics 2014). Availability sampling technique was used because all the participants were used for the study.

RESEARCH INSTRUMENT

The research instruments used to collect data for this study were as follows:

- ✓ a digital stop-watch (Kadio KD-6128 Quatz timer battery operated brand, manufactured in China in 2010) was used to time the participants during Cooper 12 minutes run-walk tests;
- ✓ a whistle (CMG Classic Fox 40 No. 1.276,822 manufactured in Canada in 2009) was used to start and stop the participants at the beginning and at the end of the time during Cooper 12 minutes run-walk tests;
- ✓ a digital blood pressure, pulse rate and heart rate monitor (Omron M2 Basic, HEM-7116-E) manufactured by Healthcare co. Ltd. Made in China was used to measure exercise heart rate of the participants.
- ✓ a weighing Scale (Metlar ZT.120 made in China 2010) was used for measuring weight of the participants.
- ✓ Stadiometer attached to the weighing Scale (Metlar ZT.120 made in China 2010) was used for measuring height (metre) of the participants.
- ✓ Lange skin fold caliper with constant tension 10gm per square millimeter (Model 003 manufactured by the Cambridge scientific industry in 2009, USA) was used to measure skin fold thickness of the participants.
- ✓ a400 meter track was used for Cooper 12 minutes run-walk test.

PROCEDURE FOR DATA COLLECTION

An introductory letter containing the purpose of the research was obtained from the Head of Department of Physical and Health Education of the University of Maiduguri to the Provost and Rectors of the tertiary institutions that were involved in the study. After having permission from the management of the respective institutions, the participants were briefed about the nature of the exercise, testing procedures, risk and benefits. Participants were given an informed consent form and signed. After signing the informed consent form, the participants came up for the tests the following morning by 7.00 O'clock with their code numbers boldly printed on a piece of paper each and attached to their singlet for identification. The measurements took place on 400 metre Trackof each of the Institutions. Five (5) trained research assistants helped the researcher. Each result obtained from each participant was recorded on the data sheet record form immediately using a pencil (2B).

BODY WEIGHT

Body Weight was measured on a Weighing scale while a participant wore minimum clothing shorts and light T-Shirt, with no shoes. The scale was positioned on a level, solid floor. Weight was read to the nearest 0.5kg.

HEIGHT

Height (stature) was determined in metre (m) with a vertical ruler attached to the weighing scale when the horizontal headboard brought into contact with the highest pong on the head. The participant stood without shoes, heels together, back as straight as possible and looking straight ahead. The participant inhaled deeply and held the breath, with sufficient pressure to compress the hair.

SKINFOLD MEASUREMENT FOR DETERMINING BODY DENSITY AND PERCENT BODY FAT (%BF)

The measurement of subcutaneous skin fold was used by the researcher to estimate percent body fat. Anatomical land marks were indicated at specific sites where measurements of skin folds were taken. All measurements were taken diagonally from the right side of the body (Puhl & Clark 2008) consisted the chest, the iliac crest and the front thigh.

The equation of Pollock and Jackson (1985) cited by Johnson and Nelson (2001), correlation and reliability coefficient 0.93 and 0.84 respectively was used and calculated the participant's body density as follows:

BD (g/cc) = $1.112-0.00043499\ (x_1) + 0.00000055(x_1)^2 - 0.00028826(x_2)$

Key:-

x_1 = sum of the three (3) skin folds

x_2 = Approximate age of the participant

The following formula adapted by Siri (1961) reviewed by Johnson and Nelson (2001), correlation 0.89 and reliability coefficient 0.84 was used and estimated the participant's percent body fat:

$$\% \text{ Body fat} = \frac{(4.950 - 4.500)}{\text{BD}} \times 100$$

Key: BD = Body Density

COOPER 12-MINUTE RUN-WALK TEST FOR MAXIMUM OXYGEN UPTAKE

The objective of this test was to determine the cardio-respiratory fitness of the participants. Heyward (1991) agreed that Cooper's 12-minute run-walk test was found highly correlated with $V0_2max$ (r = 0.90); validity coefficient of 0.90

have been obtained when maximum oxygen intake was used as the criterion for adult men. Based on the measured distance, an estimate of VO_2 max in ml/min/kg was recorded. The number of laps completed was counted and multiplied by the course distance. The course (track) was divided into quarters by suitable lines to quickly determine the exact distance covered during the exercise. The participant stood behind a starting line and upon the starting signal they run and/or walk as many laps as possible around the course (track) for 12 minutes. Five (5) participants run at a time with five (5) research assistants who counted the number of laps completed for each. When the signal was given to stop, the participant stay where the last whistle was blown and the tester and his helper recorded the distance covered to the nearest quarter of a lap past the starting line. The score was computed using the following formula (McArdle, Katch, &Katch, 1994):

VO2Max = 132.853 – (0.0769 x W) – (0.3877 x A) + (6.315 x G) – (3.2649 x T) – (0.1565 x HR_{1-4}) mil/kg/min

Key:

W = body weight,

A = age,

G = gender (0=female, 1=male),

T = time for the laps on track run-walk expressed in minutes and hundredths of a minute,

HR_{1-4} = the heart rate in beats/min_{-1} at the end of the last quarter lap.

METHOD OF DATA ANALYSIS

Descriptive statistics of mean and standard deviation was used and analyzed the Bio-data collected of the participants. multiple regression was used to test hypothesis at 0.05 level of significance.

III. DATA ANALYSIS AND RESULTS

Variables	$\bar{X}$	SD
Age (yrs)	40.77	±9.99
Body density (g/cc)	1.09	±0.01
Bodyweight (kg)	71.66	±12.10
Exercise heart rate (bpm)	106.78	±12.64
Height (m)	1.71	±0.05
Percent body fat (%)	21.44	±0.32
Skinfold (mm)	3.98	±18.09
VO_2 (mil/kg/min)	28.06	±3.36

Note: $\bar{X}$ = Mean, SD = standard deviation

Table 1: Physical Characteristics of the Participants

Table 4.1 presents information on the physical characteristics of the participants of the study. Mean age, body density, bodyweight, exercise heart rate and height of the participants were 40.77±9.99yrs, 1.09±0.01g/cc, 71.66±12.10kg, 106.78±12.64bpm, 1.71±0.05m respectively. Similarly, mean percent body fat, skinfold and VO_2 of the participants involved in the study were 41.44±0.32%, 3.98±18.09mm, 28.06±3.36mil/kg/min respectively.

IV. RESULT AND DISCUSSION

Independent variable	Unstandardized Coefficients		Standardized Coefficients	t	Sig	Remarks
	β	S.E				
percent body fat	-.347	2.471	-.047	-.159	.874	NS

Table 2: Influence of percent body fat on oxygen consumption among Security men in some tertiary institutions in Bauchi State, Nigeria

Table 1 indicated that percent body fat is not significant predictors of oxygen consumption among Security men in some tertiary institutions in Bauchi State, Nigeria. The computed outcome has B weight of -.047, E=-.159 and p = .874, since p = .874>0.05. This shows that percent body fat was not significant predictors of oxygen consumption among Security men in some tertiary institutions in Bauchi State, Nigeria. The result of this study is not in line with Kanae, Nobuyuki, Noriko, Takeshi, Motohiko, Izumi and Takeyuki(2014) whichfound out that Peak oxygen uptake was closely correlated with total body fat percentage (p < 0.01)

Independent variable	Unstandardized Coefficients		Standardized Coefficients	t	Sig	Remarks
	β	S.E				
body density	1.138	1.143	.397	7.996	.002	S

Table 3: Influence body density on oxygen consumption among Security men in some tertiary institutions in Bauchi State, Nigeria

Table 3 observed that body density is a significant predictors of oxygen consumption among Security men in some tertiary institutions in Bauchi State, Nigeria. The computed outcome has B weight of -.397, E=7.996 and p = .002, since p = .002<0.05. This shows that body density was significant predictors of oxygen consumption among Security men in some tertiary institutions in Bauchi State, Nigeria. This result is in line with Satipati, Pratima and Amit (2005) established Significant (P<0.001) correlation of VO_{2max} with body density, age, body mass, body height and Body Surface Area.

Independent variable	Unstandardized Coefficients		Standardized Coefficients	t	Sig	Remarks
	β	S.E				
body weight	-.871	2.155	-.111	5.404	.007	S

Table 4: Influence body weight on oxygen consumption among Security men in some tertiary institutions in Bauchi State, Nigeria

Table 3 observed that body weight is significant predictors of oxygen consumption among Security men in some tertiary institutions in Bauchi State, Nigeria. The computed outcome has B weight of-.111, E=5.404 and p =.007, since p = .007<0.05. This shows that body weight was significant predictors of oxygen consumption among Security men in some tertiary institutions in Bauchi State, Nigeria. This viewpoint in an early study has been expressed by Goran, Fields, Hunter, Herd and Weinsier (2000) examined that, fatness and excess body weight do not necessarily imply a

reduced ability to maximally consume oxygen, but excess fatness does have a detrimental effect on submaximal aerobic capacity.

Source of variance	df	Ss	ms	F-ratio	sig	remark
	2	531.473	371.110	32.5228	0.0001	S
	271	3105.530	1.307			
	273					

NOTE: S represents Significant; NS represents Not Significant

Multiple R = 0.391,
Multiple R^2= 0.394,
R^2 ADJUSTED=0.39,
F – VALUE= 32.5228

Table 5: Summary of Multiple Regression Result showing the composite effect of independent variables on oxygen consumption among Security men in some tertiary institutions in Bauchi State, Nigeria

The result of regression analysis oxygen consumption among Security men recorded a coefficient of determination which is the adjusted R^2 value of 0.39 implies that the variables included in the model explain 39% variation on the oxygen consumption among Security men were explained by the independent variables included in the model which include body weight, body density and percent body fat. The remaining 61% can be attributed to error in specification and the exclusion of other factors from the model. Two of the variables such as body weight and body density, were statistically significant while the remaining one such as the independent variable of percent body fat were statistically insignificant, this indicated that the number of independent member in percent body fat were not determinants of oxygen consumption among Security men . The regression was analyzed at 0.05 level of significance. Conclusively, this means that all the three (3) variables taken together accounted for 39% of the variance in oxygen consumption among Security men.

The F-Statistic is32.5228; this is very high and statistically significant at 0.05 levels. This is higher than its theoretical values. The F-statistic confirms that oxygen consumption among Security men is statistically related to the independent variables body weight, body density and percent body fat.

V. CONCLUSION

The study found that body weight and body density predict oxygen consumption among Security men in some tertiary institutions in Bauchi State, Nigeria while percent body fat did not.

VI. RECOMMENDATIONS

Based on the findings of the study, the following recommendations were made: Body weight, body density and percent body fat should not be used as predictors for maximum oxygen consumption among security men in Tertiary Institutions in Bauchi State especially during recruitment. Cardio-respiratory fitness exercise may be designed for security men in Tertiary Institutions in Bauchi State irrespective of their body weight, body density, and percent body fat. Exercise programmes for maintaining ideal body weight and acceptable percent body fat might not necessarily improved Cardio-respiratory fitness.

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