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Correlation between Anthropometric Measures and Pulmonary Function Parameters Of Obese and Non-Obese Male Adults In Rivers State

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ABSTRACT

The aim of the study was to determine the correlation between anthropometric measures and pulmonary function parameters of obese and non-obese males in Rivers State. The participants were 20 obese and non-obese male Adults as control group within the age range from 18 to 50 years respectively. The study adopted simple random sampling technique. Anthropometric and pulmonary parameters measurements were obtained directly from participants at the field and the study lasted for some 12 days. The data were presented as mean and standard deviation for each parameter, Pearson`s Product-Moment Correlation Coefficient was used the result analysis. The significance level is placed at $P<0.05$ using linear regression while confident level taken to be 95%. The result shows 21.11 as an average BMI of the non-obese, while that of obese males 22.54, revealed a positive relationship between BMI of obese and ERV with P-Value at 0.017 for non-obese males. A negative relationship between BMI and ERV with P-Value at 0.063, shows that as BMI increases, ERV decreases, not statistically significant. Revealed higher BMI, a lower ERV, a positive correlation between BMI, and IRV of obese and non-obese, BMI increases, IRV also increases, however, correlation is not statistically significant ($P>0.05$) for both non-obese and obese, values of IRV are higher in non-obese compared to obese, however, a positive correlation between BMI and IRV, a positive relationship between BMI and FVC in non-obese existed, this relationship is not statistically significant (P>0.05), shows increase in BMI accelerates FVC, a negative correlation between WC and ERV in non-obese , correlation is not statistically significant. A positive correction between WC and FVC in obese whereas a negative correlation between W C and FVC seen, a negative correlation between HtoWR and ERV in obese while there exists a positive relationship between WtoHR and ERV, a negative correlation between WtoHR and IRV in both obese and non-obese, a positive relationship between WtoHR and FVC for non-obese and obese, relationship was not significant. BMI showed a positive correlation with pulmonary function. Results obtained from the present study indicated that non-obese had a significantly higher FVC, ERV, and IRV than the obese. This Greater values among the non-obese could be explained due to better strengthening of respiratory muscles as a result of strenuous physical activity.

INTRODUCTION

Obesity, as defined by the World Health Organization [WHO] is a medical condition in which excess body fat accumulates to produce negative effect on health which ultimately leads to increased morbidity and reduced life expectancy (Manawat &Shweta, 2018). Obesity is one of the most preventable disease. Obesity has a multifactorial etiology that includes genetic, environmental, socioeconomic, and behavioural or psychological influence. Obesity measurement can also be used to estimate morbidity and mortality. Body mass index (BMI) has been used to screen overweight and obese individuals. Obesity has inflammatory components, directly and indirect, related to major chronic diseases such as diabetes, atherosclerosis, hypertension, and several types of cancer (Khanna & Rehman , 2021). Once restricted to high- income countries, obesity is now also prevalent in low and middle income countries where its incidence is constantly increasing. Recent data from the WHO show more than 1.9 billion adults, 18years and older, are overweight. Of these over 650 million are obese. In 2016, 39% of adults 18 years and over (39%of men and 40%of women) were overweight. Overall about 13%of the world adult population (11% of men and 15% of women) are obese. 3 Obesity is defined by body mass index (BMI) calculated as kilogram per square meters. WHO defines BMI >30 as obese. WHO Classification as Obesity Underweight: activities of daily living that require sustained aerobic metabolism. The integrated efforts and health of the pulmonary, cardiopulmonary, and skeletal muscle system dictate an individual’s capacity. Numerous investigations have demonstrated that the assessment of functional capacity provides important diagnostic and prognostic information in a wide variety of clinical and research settings.7 body and may pace externally.

Anthropometric measurements are a series of quantitative measurements of the muscle, bone, and adipose tissue used to assess the composition of the body. The core elements of anthropometry are height, weight, body mass index (BMI), body circumferences (waist, hip, and limbs), and skinfold thickness, age, sex. Anthropometric measurements can be used as a baseline for physical fitness and to measure the progress of fitness. Anthropometric parameters can be used to describe the body as a whole or to subdivide the body into compartments. Anthropometric data can be utilized directly (such as body weight) to estimate lean or fat mass, or to predict energy and protein needs. Anthropometric measures such as height and age are used in equations for estimating/predicting spirometric values for various populations (Hankinson et al, 1999; Stanojevic et al., 2008). Most of these equations have been derived from measurements data collected from people outside Africa while little or none in Nigeria. On the other hand, some studies have reported positive relationships between some spirometric variables and endurance performance (Adegoke & Arogundade, 2002; Fatemi et al, 2012; Pringle et al, 2005). The human body composition has been of great interest as inadequate lean body mass and excess fat mass are major risk factors related to major health outcomes. A healthy balance between fat and muscle is vital for health and wellness. An array of evidence shows that maintaining of healthy body composition increases longevity and reduces the risk of heart diseases, leading to an increase in energy level whilst improving self-esteem.

Anthropometric characteristics play a crucial role in the performance of athletes. Some of the variables that can commonly affect performance are body weight, body height, body mass index (B.M.I) limb length, and circumference of limbs. Although some, not all, physical characteristics seemed to favour non-obese males, the best successful athletes are limited to specific ethnic and regional origins. Hence, this research work is intended to envisage/ determine the correlation between anthropometric measures and pulmonary function parameters of non-obese males in Rivers State in Nigeria.

METHODOLOGY

.Research Design

This study uses a descriptive correlational research design to obtain the needed demographic data such as anthropometric and pulmonary measurements after their informed consent. A correlational research design looks into correlations between variables without allowing the researcher to control or manipulate any of them. Correlational studies reveal the magnitude sand/or direction of a link between two (or more) variables. Correlational studies or correlational study design might have either a positive, negative or zero. Correlational research design is great for swiftly collecting data from natural settings. This allows you to apply your results to real-world circumstances in an externally legitimate manner.

Population for the Study

The study population comprised of 20 obese and non-obese male adults within the age range from18 years and above to 50years within Rivers State were recruited into the study that met the inclusion criteria set up for the study.

Sample and Sampling Technique

The study adopted simple random sampling technique. The research participants were obese non-obese male adults selected at random within Rivers State.

Method of Data

Primary data would be used for the study. Direct anthropometric and pulmonary parameters measurements would be obtained directly from subjects at the field. No previously recorded data would be involved in this study.

Inclusion Criteria

1. Must be obese and non-obese males

2 health male Adults

Exclusion Criteria

1. People with disease/ medical disorders.
2. Drug dependent non-obese
3. Female adults

At the end of the twelve days training, those that involved in long distance race who stayed till the end of the training programme their measurements were used for the analysis.

Instrument for Data Collection

The instruments for data collection would be Stadiometer (SECA 217, Hamburg, Germany) which would be used to measure the heights and weights of the study participants were used to determine the BMI, Spirometer, spirolab II AII MIR S/N A23 – 050.3550 and peak Flow meter which would be used to determine pulmonary parameters, Recording Pen and papers.

Method of Data Collection

1. Recruited athletes gathered on each day of meeting.

2. On each second day of meeting, only those that complied with the advice would be eligible for the study, information would be obtained using respondents constructed by the researcher.

3. Anthropometric measurement of weight (Kg), Height (cm), Waist Circumference (cm), with Hip Circumference (cm) would be taken. The data collected were thereafter checked for completeness and assembled on a spreadsheet. .

4 The assistants were be briefed by the researcher on the data collection tool and procedures. The assistants guided by the researcher were also be involved in the selection of participants, requested consent, then guided the respondents to provide information and also carried out the Anthropometric and pulmonary measurements. The researcher and team gathered from 8:00am till 10:00am to gather the data needed from the respondents and from 10:00am to 2:00pm to assemble the data onto a spreadsheet on every data collection day. The study intend to last for some (12) days.

Measurement of Anthropometric Parameters

1. Body mass index (BMI). This would be calculated by measuring the body weight (kg) and dividing by the square of the height (m).

2. Weight: This would be done using standard scale (Seca GMBH & Co., German). The scale was zeroed, respondents were directed to stand erect on bare feet with light clothing. The weighing scale would be read to the nearest 0.1kg (100g). Measurement was taken in the morning hours and it was ensured that those participants had their both feet together without any support.

3. Height: Standing in an erect position with barefoot and head in contact with the wall, the height of each respondent would be taken. Participant's head would be pressed down with a meter rule in other to make a right angle with the wall and a mark was made on the wall where the meter rule touched the wall. The distance between the floor and the chalk mark was measured with a measuring tape and this would be read to the nearest 0.1cm.

4. Waist Circumference**:** This would be determined with a measuring tape at the point of the mid-axillary line, approximately halfway between the last rib and the superior iliac crest and taken to the nearest 0.1cm.

5. Hip Circumference**:** measured using a tape horizontally at the point of maximum gluteal protrusion and taken to the nearest 0.1 cm. It was ensured that the measuring tape would be held lightly so as not to compress the skin.

Peak Expiratory flow

Measurement of peak expiratory flow rate would be done using a personal best® full range peak flow meter. The subjects took a deep breath, applied his/her lip firmly to the mouth piece, expires as hard as fast as possible. A direct reading of the peak expiratory flow was obtained before and after sporting activity on the peak flow meter.

Vital Volume and Capacity

The pulmonary function tests would be carried out using digital spirometer after their age, weight, height were recorded and also, before and after one hour of the sporting activity. The parameters analyzed from the equipment would expiratory reserved volume (ERV), Inspiratory vital capacity (IVC), Inspiratory capacity (IC), Vital Capacity (VC).

The test module would then activated and the subjects were properly instructed about the procedure to be performed. All pulmonary tests would be done on subjects, comfortably seated in an upright position. The Subjects would be connected to the mouth piece and were asked to breath in order to familiarize with the equipment. During the test the subjects would adequately encouraged to perform at their optimum level and also a nose clip was applied during the entire processes.

Data Analysis

The data collection would be presented as mean and standard deviation for each parameter. Pearson`s Product-Moment Correlation Coefficient would be used to answer the research questions. The hypotheses would be fixed at 0.05 level of significance using linear regression while confident level taken to be 95%.

Table 1: Relationship between Body Mass Index (B.M.I) and Expiratory Reserve Volume (ERV) of non-obese male in Rivers State.

Parameter	Obese (mean ± SD)	Non- obese (mean ± SD)
BMI	22.54±1.85	21.11±2.18
ERV	415.55±134.03	832.95±174.11

Parameter	Pearson Correlation	P-value	N
BMI/ERV (Obese)	.475	0.017*	20
BMI/ERV (Non-obese)	-353	0.063	20

Table.2: Relationship between Body Mass Index (B.M.I) and Inspiratory Reserve Volume (IRV) of non-obese males in Rivers State

	obese (mean ± SD)	Non-obese (mean ± SD)
BMI	21.54±1.85	22.11±2.18
IRV	1378.35±384.32	2722.00±220.46

Parameter	Pearson Correlation	P-value	N
BMI/IRV (Obese)	.122	0.61	20
BMI/IRV (Non-Obese)	.082	0.731	20

Table.3: Relationship between Body Mass Index (B.M.I) and Forced Vital Capacity (FVC) of non-obese male in Rivers State.

Parameter	Obese (mean ± SD)	Non-obese (mean ± SD)
BMI	21.54±1.85	22.11±2.18
FVC	71.95±5.26	83.35±2.60

Parameter	Pearson Correlation Coefficient	P-value	N
BMI/FVC (Obese)	.134	0.389	20
BMI/FVC (Non-obese)	.065	0.393	20

Table 4: Relationship between waist circumference and Expiratory Reserve Volume (ERV) of non - obese males in Rivers State.

Parameter	obese (mean ± SD)	Non-obese (mean ± SD)
WC	88.15±3.08	69.95±2.72
ERV	415.55±134.03	832.95±174.11

Parameter	Pearson Correlation	P-value	N
WC/ERV (Obese)	.104	0.33	20
WC/ERV (Non-obese)	.032	0.44	20

Table 5: Relationship between waist circumference and Inspiratory Reserve Volume (IRV) of Non- obese males in Rivers State.

Parameter	obese (mean ± SD)	Non-Obese (mean ± SD)
WC	88.15±3.08	69.95±2.72
IRV	1378.35±384.32	2722.00±220.46

Parameter	Pearson Correlation	P-value	N
WC/IRV (Obese)	.260	0. 269	20
WC/IRV (Non-Obese)	.185	0.435	20

Table 6: Relationship between waist circumference and Forced Vital Capacity (FVC) of Non-obese male in Rivers State.

Parameter	Obese (mean ± SD)	Non-Obese (mean ± SD)
WC	88.15±3.08	69.95±2.72
FCV	71.95±5.25	83.35±2.60

Parameter	Pearson Correlation	P-value	N
WC/ FCV (Obese)	.069	0.389	20
WC/ FCV (Non-Obese)	-198	0.201	20

Table 7: Relationship between waist to height ratio and Expiratory Reserve Volume (ERV) of Non-Obese male in Rivers State

Pararmeter	Obese (mean ± SD)	Non-Obese (mean ± SD)

(Ht/Wc)	0.0192±0.0009	0.0199±.0012
ERV	415.55±134.03	832.95±174.12

Table 8: Relationship between waist to height ratio and Inspiratory Reserve Volume (IRV) of Non-Obese males in Rivers State.

Parameter	Obese (mean ± SD)	Non-Obese (mean ± SD)
(Ht/Wc)	0.0192±0.0009	0.0199±.0012
IRV	1378.35±384.32	2722.00±220.46

Parameter	Obese (mean ± SD)	Non-Obese (mean ± SD)
(HT/WC)	0.0192±0.0009	0.0199±.0012
FVC	71.95±5.25	83.35±2.60

Table 9: Relationship waist to height ratio and Forced Vital Capacity of Non- obese males in Rivers State

Parameter	Pearson Correlation	P-value	N
(Ht/Wc)/ IRV (Obese)	-187	0.430	20
(Ht/Wc)/ IRV (Non-obese)	-090	0.352	20

Parameter	Pearson Correlation	P-value	N
(Ht/Wc)/ ERV Obese)	-190	0.421	20
(Ht/Wc)/ ERV (Non-Obese)	.184	0.439	20

Parameter	Pearson Correlation	P-value	N
(HT/WC)/ FVC (Obese)	.358	0.121	20

(HT/WC)/ FVC (Non-Obese)	.136	0.567	20

Discussion of findings

The current study investigated the Correlation between anthropometric measures and pulmonary parameters of male athletes in University of Port Harcourt. 20 male non-Obese were randomly selected for this research while 20 obese males were used as control subjects for the investigation. The parameters under study included the Body Mass Index (BMI), Expiratory Reserve volume (ERV), forced vital capacity (FVC), Waist Circumference (WC), Inspiratory Reserve Volume (IRV), Waist to Height Ratio (W/HT). The result of the investigation is therefore discussed according to the objectives of the study below:

According to the result as shown in table1, the average BMI of non-obese was 21.11, while that of obese 22.54. According to Pearson correlation carried out, there was a positive relationship between the Body Mass Index (BMI) of non-athletes and Expiratory Reserve Volume with P-Value at 0.017 for athletes. There was a negative relationship between BMI and ERV with P-Value at 0.063, this shows that as BMI increases ERV decreases. However the values was not statistically significant. The Expiratory Reserve Volume (ERV) is the volume of air that can be forcefully exhaled after a normal resting expiration, leaving only the RV in the lungs. Forcefully exhaling the ERV is an active process requiring the contraction of expiratory muscles in the chest and abdomen (Loferese *et al*, 2023). This result revealed that a higher BMI results in a lower ERV. Similar results were described by Melo *et al*. (2011) who observed that the higher the BMI, the greater the degree of lung function impairment, corroborating the present study. Jones and Nzekwu (2006) reported a reduction in the functional residual capacity (FRC), suggesting that the ERV reduces 5% per unit of increase in BMI and that, above 30 kg/m2, it reduces 1% per unit of BMI. According to Koenig (2001), this fact is attributed to the reduction of the diaphragm mobility in the chest, as the diaphragm is pressed upwards due to the expanded abdominal volume of obese individuals, a mechanical disadvantage for this muscle.

According to the result of Pearson Correlation as shown in table.2B there exist a positive relationship between body mass index (BMI), and Inspiratory Reserve volume (IRV) of Non-obese and obese, this shows that as BMI increases, IRV also increases, however, this relationship is not statistically significant as p-Value is above 0.05 for both obese and non-obese. Koenig, (2001) stated that increase in the IRV in obese individuals is not a common finding, but it was already reported by some authors. Rasslan *et al*. (2004) showed that the inspiratory capacity (IC) was higher in obese individuals than in non-obese ones, even when all the other spirometric values were within the normal range. These authors suggested that this fact may indicate normal lung compliance and an ability of the respiratory muscles to compensate, though temporarily, for the excess weight on the chest and abdomen. According to our results, the values of IRV is higher in non-obese compared to obese, however, correlation revealed a positive relationship between BMI and IRV.

According to Pearson Correlation. There is a positive relationship between Body Mass Index (BMI) and Force Vital Capacity in non-obese, although this relationship is not statistically significant as P-Value is above 0.05. This shows that increase in BMI accelerates FVC. This result is consistent with previous research in young adults (Thyagaran et al, 2008) which demonstrates how weight changes can affect lung function until late adulthood. Two potential mechanisms have been proposed to explain the association of weight gain with accelerated lung function decline. First, weight gain can affect lung function through mechanical effects on lungs. Abdominal and thoracic fat mass are likely to reduce vital capacity by limiting the room for lung expansion during inspiration, in turn leading to expiratory flow limitation (Young et al, 2007).

From the result in table 4, there is a negative correlation between Waist Circumference and Expiratory reserve volume in non-obese males. However the relationship is not statistically significant. Waist circumference provides a simple measure of central fatness and it may have a direct effect on the chest wall properties. Waist Circumference mirrors body shape, while BMI provides an estimate of body mass and volume (Klein *et al*, 20117). As previously shown, obesity is not a good parameter to evaluate body fat distribution when measured by BMI (Salome et al, 2010). One of the most discussed explanations in the literature is that abdominal fat may interfere in pulmonary mechanics, causing restrictions during breathing, potentially reducing respiratory volumes, such as ERV (Piper & Grunstein, 2010). This mechanical effect is more evident if central obesity is considered instead of overall or peripheral fat. The excess of fat in the abdomen and thoracic region may lead to decreases in the compliance and resistance of respiratory system, increasing energetic demands of breathing (Piper & Grunstein, 2010). Another potential mechanism is that the increase in WC may have an effect on the diaphragm, limiting its movements (Salome et al, 2010).

The result as revealed in table 6A showed a positive correlation between Waist Circumference and Forced Vital capacity in obese whereas there was a negative correlation between waist circumferences and forced vital capacity in non-obese. Hence, these relationships are not statistically significant. A systematic review and meta-analysis on WC and pulmonary function parameters found that each of the included ten studies showed statistically significant inverse associations between WC and lung function, in keeping with the results of the current study (Wehrmeister *et al*, 2012: Kjer *et al*. 2018: García-Rio et al, 2013).

The result in table 4.7 showed there was a negative correlation between height to waist ratio and Expiratory Reserve Volume in non-athletes while there exist a positive relationship between waist to height ratio and Expiratory Reserve Volume (ERV) in non-obese males .Although no studies have evaluated this cut-off point so far, the literature has shown that WHtR is related to the appearance of pulmonary function impairment and that shows the strongest correlation with FEV1 and FCV in different populations (Solí-Aguilar et al, 2016)

Table8 showed that a negative correlation between waist to height ratio and Inspiratory Reserve Volume (IRV) in both non-obese and obese males.

Studies by some authors (Davila et al, 2004) have shown an improved lung function in patients evaluated after a year following weight loss induced by bariatric surgery, and others have attributed this improvement mainly to the reduction in the W/H ratio. El-Gamal et al. (Mart´ et al, 2007) found that the patients showed an improvement in dyspnea and a reduction in the respiratory drive after weight loss induced by bariatric surgery.

The result Pearson correlation showed a positive relationship between waist to height ratio and forced vital capacity for on non-obese and obese. However, the relationship was not significant. Several studies used WHR as a predictor of pulmonary dysfunction (Collins et al, 1995). Canoy et al (17) compared the relations of WC, WHR, and BMI with FVC and FEV1 and found that pulmonary function was negatively associated with increasing quintiles of WHR, WC, and BMI, and, after adjustment for height, WHR in men and WC in women were associated with a bigger reduction in respiratory function than was BMI

The overall results of the study revealed that anthropometric measures and pulmonary parameters are better in non-obese than obese. One proposed mechanism is that abdominal fat displaces the diaphragm into the abdomen (Koenig, 2001). This is supported by one study that showed lung volumes were affected more in patients with a waist-to-hip ratio >0.95 ‘upper’ body fat distribution (Collins et al, 1995). In addition, chest-wall adiposity may simply compress the thoracic cage, leading to lower lung volumes. This is supported by the similar pattern observed when lung volumes are measured after elastic strapping of the chest, (Caro et al, 1960) although there is some question as to whether obesity acts as a mass (threshold) load or an elastic load. It is likely that both play a role in decreasing lung volumes, and it would be difficult to isolate and study one component independently.

Regardless of which type of activity a person participates in, in almost all cases athletes have a higher lung capacity than non-athletes simply because they use their lungs more. Increased oxygen intake and lung usage allow the lungs to grow in strength and therefore can expand more readily and take in more air. Exercise is not just limited to increasing lung capacity however. Activity also increases blood flow to the heart, increased metabolic breakdown, and endurance of muscles. All of these factors combine with increased lung capacity for an overall healthy body. A non-athlete however has atrophied muscles, decreased metabolic enzymes and a diminished lung capacity (UKessays, 2018). The overall results is in agreement with several studies which have observed the effects of obesity in the adolescent age group (Dietz, et al. 1999). Increased weight causes a major change in the respiratory system, resulting in loss of thoracoabdominal synchronism and limitation of diaphragmatic mobility (Winck et al, 2016). Thus, BMI showed a positive correlation with pulmonary function. Increased metabolic activity during physical activity improves pulmonary functions through strengthening of the pulmonary muscles. We demonstrated that both non-obese and singers had better vital capacity sthan the control group, similar to other studies (Paralikar et al, 2012: Angane *et al*, 2014).

Conclusion

Results obtained from the present study indicated that non-obese had a significantly higher forced vital capacity, expiratory reserve volume, inspiratory reserve volume, than the obese. These findings are in line with those of reported by many researchers (Adegoke and Arogundade, 2002; Cordian, 1990; Newman et al., 1961, Bloomfield et al., 1985). Adegoke and Arogundade (2002) reported greater lung functions in footballers, volleyball and basketball players when compared to non-athletes. Greater values among the athletes could be explained due to better strengthening of respiratory muscles as a result of strenuous physical training. Cordain (1990) also reported larger lung volumes in swimmers and divers when compared to normal non-athletes. Many other previous studies (Onadeko et al., 1976; Bjorstrom, 1987) also showed a significantly greater vital capacity in non-obese when compared with obese. However, the findings of the present study are in contrast to the findings of the other studies (Hagberg, 1988) which reported no significant differences between non-obese and obese males.

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