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Original Research Article

Changes in Basic Pulmonary Indices of Obese Women Resident in Rivers State, Nigeria

Tamuno-Opubo A[1*], Zosa Ugbana Dienye[2], Rosemary Oluchi Stanley[3], Joy Tonye Wihioka[4], Siyeofori Belema Dede[4]

[1]Department of Human Physiology Rivers State University, Rivers State, Nigeria
[2]Department of Public Health Science, Rivers State University, Nigeria
[3]Department of Internal Medicine, University of Port Harcourt Teaching Hospital, Rivers State, Nigeria
[4]Rivers State Primary Health Care Management Board, Nigeria

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***Corresponding author:** Tamuno-Opubo A
Department of Human Physiology Rivers State University, Rivers State, Nigeria

Abstract

Obesity and pulmonary diseases are said to be co-prevalent and debilitating chronic illnesses that are becoming more and more commonplace globally. This study thus, evaluated the changes in basic pulmonary indices of obese women resident in Rivers State, Nigeria. The minimum sample size of 272 was determined using the Leslie Fischer's formula; exactly 334 obese and non-obese women within their 18 and 65 years of age with no critical health condition and resident in Upland and Riverine areas of Rivers State were actually surveyed by the present study. A multistage sampling technique was adopted, and subjects were surveyed across the upland and riverine locations of the State. These subjects were evenly drawn from the multi-ethnic residents of the state. Automated spirometer was used to measure forced vital capacity (FVC); forced expiratory volume in 1 second (FEV_1 and forced expiratory volume in 1 second (FEV_1) and forced expiratory volume in 6 second (FEV_6) and the FEV1/FVC ratio. The quantitative data were subjected to statistical analyses using the statistical package for social sciences (SPSS) version 21.0. One-way analysis of variance (ANOVA) and independent t-test with a $p < 0.05$ considered statistically significant were determined. The result indicated that the obese subjects had reductions in some pulmonary indices, like FVC levels. On the other hand, the FVC/ FEV1 ratio had significant ($p<0.05$) increases following increasing BMI. Further evaluations on the actual impact of obesity on FVC/ FEV1 ratio may shade more light in this direction.

Keywords: Obesity, pulmonary diseases, obese women resident, Rivers State, Nigeria.

INTRODUCTION

Abnormal weight gain that is capable of resulting into health challenges is referred to as "overweight" and "obesity" (WHO, 2023). The determination of overweight and obesity in adults is better considered by measuring body weight in kilograms (Kg), and dividing it by the value of the individual's height in metres square (m^2). The foregoing approach is referred to as body mass index (BMI) and a BMI within 25 to 29.9kg/m^2 indicates overweight but when the value is≥30 kg/m^2, it marks obesity (WHO, 2021).

On the other hand, obesity constitutes a significant risk factor and disease modifier for a variety of respiratory disorders (Kamal *et al.*, 2015). This is so because, the mechanical characteristics of the lungs and chest wall are considerably altered by fat accumulation in the mediastinum and abdominal cavities and such alterations may also remarkably affects the normal physiology of the lungs (Kamal *et al.*, 2015).

Considering the global public health burden that obesity and its comorbidities constitute—especially with the resultant over four million annual deaths (James, 2008; WHO, 2023, it is important to evaluate population variance in the severity of the disease and some of its complications (Pommer, 2018).

This investigation therefore evaluated the changes in basic pulmonary indices of obese women resident in Rivers State, Nigeria. The choice of the study area is based on the fact that it is a major host to several multinationals (Jones, 2000; RvSG, 2023) with the attendant urban characteristics that could promote the prevalence of the disease.

MATERIALS AND METHODS

Research Design

This cross-sectional survey recruited obese women resident in upland (UPL) and riverine (RVR) areas of Rivers State, Nigeria using multistage sampling techniques. Ethical backing was granted by the Ethics Committee of the University of Port Harcourt. All recruited subjects gave their respective consent before being enlisted into the study.

Study Area

The study location, Rivers State of Nigeria, remains the sixth most populated state in the country. It is made up of multiple indigenous ethnic groups which include Ijaws, Eleme/Ogoni, Etche, Abua, Ikwerre, Ekpeye, Ogba, Engeni, Egbema, and others (Jones, 2000).

Sample Size Determination

A minimum sample size of 272 was obtained using the Leslie Fischer's formula (Azuogu *et al*., 2018):

$$n = \frac{Z^2pq}{d^2}$$

with confidence interval set at 95%, normal deviate--**Z**
Z = 1.96, (Z—score for 95% confidence interval)
d(d is considered 0.05 to produce good precision and smaller error of estimate) = 0.05.
q=1-P (expected level of precision)

P=Expected prevalence or proportion of population if unknown 0.5; but in this case, the report of Chukwuonye e*t al*., (2022) reported a prevalence rate of obesity in women Nigeria at 23% (i.e. 0.23). Consequently, a total of 334 subjects were actually surveyed by the current study.

The subjects who were all females were within the age range of 18 and 65 years. A proportionate number of the study proforma were allocated to each stratified group based on their total number. During the periodic scheduled meetings the subjects, the attendance lists were used as a sampling frame. And the systematic random method was used to select participants with sampling interval of three until total number of questionnaires allocated to that group was exhausted.

Inclusion Criteria

It were obese women who are resident in Upland and Riverine areas of Rivers State, who are within their 18 and 65 years of age. And non-obese women with similar criteria as above to serve as control.

Exclusion Criteria

Were subjects as stated in the inclusion criteria but were critically ill; those who were non-residents of the study area; women below 18 years or above 65 years. And then, women who met the inclusion criteria but did not give consent to be recruited into the study.

Method of Data Analyses

Numerical data received from the present study were subjected to statistical analysis using the statistical package for social sciences (SPSS) version 21.0. Statistical significance was determined using the following tools: one-way analysis of variance (ANOVA) and independent t-test. A p< 0.05 was considered statistically significant.

RESULTS

Table 1(A): Changes in Some Pulmonary Function Test (FEV1 and FVC) of obese and non-obese resident in the UPL and RVR areas of RvS.

Groups	FEV1 (m/l)			FVC (m/l)		
	All subjects	UPL Residents	RVR Residents	All subjects	UPL Residents	RVR Residents
Non-Obese Subjects	1.30 ± 0.06	1.30 ± 0.04	1.29 ± 0.06*	1.71 ± 0.19	1.80 ± 0.06	1.65 ± 0.08*
Obese Class I	1.36 ± 0.08 [a]	1.37 ± 0.08 [a]	1.34 ± 0.07	1.67 ± 0.09	1.68 ± 0.08 [a]	1.66 ± 0.09
Obese Class II	1.39 ± 0.09 [a]	1.35 ± 0.09 [a]	1.42 ± 0.09 [a, b]	1.61 ± 0.20 [a]	1.63 ± 0.08 [a, b]	1.63 ± 0.07
Obese Class III	1.56 ± 0.16 [a, b, c]	1.46 ± 0.08 [a, b, c]	1.62 ± 0.16 [a, b, c]	1.68 ± 0.08	1.64 ± 0.07 [a]	1.71 ± 0.08 [a, c]

Values are expressed as Mean ± Standard Deviation (SD); n [Non-obese All=125; UPL=58; RVR =67; Obese Class I: All=77; UPL=51; RVR =26; Obese Class II: All=72; UPL=32; RVR =40; Obese Class III: All=60; UPL=21; RVR =39]. [a]Significant at P <0.05 when compared to Non-obese; [b]Significant at P <0.05 when compared to Obese Class I; [c] Significant at P <0.05 when compared to Obese Class II; * Significant at P <0.05 when values of RVR residents are compared to those of UPL residents. Table 1(A) shows changes in some pulmonary function of obese women in RvS, Nigeria.

The forced vital capacity (FVC) of all surveyed subjects only indicated significant (p <0.05) reduction in obese class II group compared to that of the non-obese. However, the changes in the FVC values of the UPL residents showed a non- uniform significant (p <0.05) decreases in all obese subjects and it was much reduced when the value of class II was compared to that of class I. On the other hand, the changes in FVC values amongst the RVR subjects was significantly ($p < 0.05$) higher in obese class III with respect to non-obese and obese class II. Looking at the variation of the FVC values of the RVR residents with respect to those of the UPL's, there was a significant ($p < 0.05$) reduction of it in the non-obese RVR subject compared to their UPL counterparts.

The changes in the forced expiratory volume in 1 second (FEV_1) in all surveyed subjects had BMI ranked/significant elevations in all obese subjects compared to that of the non-obese; it was even more in obese class III compared to those of classes I and II respectively.

For the UPL residents, the FEV_1 varied in same pattern with that of all subjects as described earlier. But then, the FEV_1 of that of the RVR subjects showed significant ($p < 0.05$) increases in obese classes II and III when compared to those of non-obese and obese class I. Again, the RVR residents' non-obese FEV_1 value was significantly lower compared to the UPL counterparts.

Table 1 (B): Changes in Some Pulmonary Function of obese and non-obese resident in the UPL and RVR areas of RvS.

Groups	FEV6 (m/s)			FEV1/FVC RATIO (percent)		
	All subjects	UPL Residents	RVR Residents	All subjects	UPL Residents	RVR Residents
Non-Obese Subjects	1.71 ± 0.19	1.80 ± 0.06	1.65 ± 0.08*	75.70 ± 5.40	72.31 ± 2.38	78.63 ± 5.57*
Obese Class I	1.67 ± 0.09	1.68 ± 0.08 [a]	1.66 ± 0.09	81.47 ± 5.33 [a]	81.74 ± 4.38 [a]	80.93 ± 6.89*
Obese Class II	1.61 ± 0.20 [a]	1.63 ± 0.08 [a, b]	1.63 ± 0.07	84.81 ± 4.41 [a, b]	82.61 ± 4.53 [a]	86.56 ± 3.46 [a, b, *]
Obese Class III	1.68 ± 0.08	1.64 ± 0.07 [a]	1.71 ± 0.08 [a, b, c]	92.70 ± 6.42 [a, b, c]	89.10 ± 4.38 [a, b, c]	94.63 ± 6.56 [a, b, c]

Values are expressed as Mean ± Standard Deviation (SD); n [Non-obese All=125; UPL=58; RVR =67; Obese Class I: All=77; UPL=51; RVR =26; Obese Class II: All=72; UPL=32; RVR =40; Obese Class III: All=60; UPL=21; RVR =39]. [a]Significant at $P < 0.05$ when compared to Non-obese; [b] Significant at $P < 0.05$ when compared to Obese Class I; [c] Significant at $P < 0.05$ when compared to Obese Class II; * Significant at $P < 0.05$ when values of RVR residents are compared to those of UPL residents. Table 1(B) shows the changes in forced expiratory volume in 6 seconds (FEV_6) and the FEV_1/FVC ratio of the study subjects.

The FEV_6 changes in all surveyed subjects indicated non-uniform decreases in all obese subjects compared to the non-obese subjects, but only the value of the obese class II was statistically significant ($p < 0.05$).

In a similar fashion, the FEV_6 changes in the UPL residents had remarkably (<0.05) reduced levels compared to the non-obese and obese class II showed a much more significantly lower levels when compare to those of obese classes I and III. However, the FEV_6 levels in the RVR subjects just indicated marginal ($p > 0.05$) reductions in obese classes I and II, but significant increase in obese class III when compared to non-obese and obese classes I and II. More so, the non-obese subjects' FEV_6 of the RVR residents had significantly ($p < 0.05$) lower level compared to their corresponding subjects at the UPL region.

Considering the changes in the FEV_1/FVC ratio of all the study subjects, there were BMI graded significant ($p < 0.05$) increases in across all obese subjects. And these increases were comparatively significant ($p < 0.05$) with increasing obese classes. This trend was virtually same for the UPL residents. Although there were increases in the FEV_1/FVC ratio of all obese subjects amongst the RVR subjects, but only obese classes II and III had significant ($p < 0.05$) values when compared to the non-obese and amongst the obese subjects.

Lastly, aside from the FEV_1/FVC ratio of obese class I, with a significantly ($p < 0.05$) low value, those of non-obese and obese class II had significantly ($p < 0.05$) raised levels when the RVR residents' values were compared to the UPL residents.

DISCUSSION

The outcome of the investigation on obesity related changes of pulmonary function tests although indicated non-uniform changes in FVC, FEV_1 and FEV_6 values, the FVC/ FEV_1 ratio showed significant increases with increasing BMI. The FVC levels were seen to be mainly reduced in the obese subjects.

Reduced lung airflow, which may be brought on by obstructive lung condition, results in drastic alterations of the FEV1 and FEV1/FVC (Franssen *et al.*, 2008). According to Al-Ashkar *et al.*, (2003), the FEV1/FVC ratio measures how much of a person's vital capacity they can exhale in the first second of forced expiration compared to their complete, forced vital capacity. It is recognized that abnormalities of the FEV1 and FEV1/FVC are brought on by a reduction in lung airflow, which may be brought on by obstructive lung conditions. It has been reported that with respect to the general population, chronic obstructive pulmonary disease (COPD) patients had a higher likelihood of being obese.

Obesity and COPD are said to be co-prevalent and debilitating chronic illnesses that are becoming more and more commonplace globally (Franssen *et al*., 2008). It was also reported that, compared to the overall population, those with severe COPD appear to have a lower prevalence of obesity (Verberne *et al*., 2017).

This implies that the obese subjects may present with higher risks of obstructive lungs diseases/dysfunction. This is a significant multiple impact of obesity, and like an earlier report puts it, obesity has proven to capable of reducing the quality of life for those with COPD, it may make managing COPD more challenging and thus call for the need of in debt proper care and management such subjects (Veale *et al*., 2009).

CONCLUSION

The present investigation has shown that the obese subjects had reductions in some pulmonary indices, like FVC levels. On the other hand, the FVC/ FEV1 ratio had significant increases following increasing BMI. While there are possibilities of higher risks of obstructive lungs dysfunction in the subjects, further enquiry on the actual impact of obesity on FVC/ FEV1 ratio may shade more light.

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