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Body mass index and asthma severity in a population of Nigerian asthmatics

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Abstract

Background: Asthma and obesity have considerable impact on public health. There is increase prevalence of both conditions worldwide. This study was undertaken to determine the prevalence of obesity among asthma patients as well as determine the effect of body mass index (BMI) on asthma severity and pulmonary functions.

Methods: The study was conducted at the asthma clinic of the medical outpatient of Lagos State University Teaching Hospital, Ikeja. Ethical clearance was obtained from the hospital's research and ethics committee. Non probability sampling method was used with consecutive asthma patients diagnosed by the respiratory physicians according to NHLBI guideline recruited into the study. The weight, height and pulmonary function tests were carried out using standard methods. A carefully designed interviewer administered questionnaire were used to collect information on the socio demographic characteristics of the patient, asthma symptoms, control use of rescue medications and emergency visits.

Results: One hundred and fifty eight (158) asthma patients participated in the study. There were 63 (39.9%) males and 95 (60.1%) females. The prevalence of obesity was 53.8%. The mean age of respondents was 46.48±17.16 years. Age, educational level and employment status were related to the body mass index while gender and duration of asthma were not. There was no difference in the severity of asthma and utilization of emergency services across the BMI categories. The obese asthmatics generally recorded lower lung function volumes compared with the non-obese asthmatic groups.

Conclusion: Prevalence of obesity is high among the asthmatics studied. There is no difference in asthma severity across the BMI categories. Pulmonary functions are lower in obese asthmatics.

Keywords: *Asthma, severity, body mass index, obesity*

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Résumé

Introduction: L'asthme et l'obésité ont un impact considérable en santé publique avec une augmentation de la prévalence mondiale. Cette étude était faite pour déterminer la prévalence de l'obésité parmi les patients asthmatiques et les effets de l'indice de masse corporelle (IMC) sur la sévérité de l'asthme et des fonctions pulmonaires.

Méthodologie: L'étude a eu lieu dans la clinique médicale de l'hôpital tertiaire de Lagos. La méthode de choix non-probalistique était utilisée de façon consécutive pour recruter les patients asthmatique diagnostiqués par les médecins spécialisés en respiration selon le guide de NHLBI (National Heart Lung and Blood institute). Le poids, la taille et les fonctions pulmonaires étaient mesurés par des méthodes standards. Une interview précise suivie d'un questionnaire était administré pour la collecte des informations sur les caractéristiques sociodémographiques du patient, des symptômes asthmatiques, sur le contrôle des médicaments d'urgences et les visites urgentes.

Résultats: Cent cinquante huit (158) patients asthmatiques ont participé à cette étude, composé de 63 (39.9%) males et 95 (60.1%) femelles. La prévalence de l'obésité était de 53.8%. L'âge moyen des sujets interrogés était 46.48±17.16 ans. L'âge, le niveau d'éducation et le statut professionnel étaient liée à l'indice de masse corporel, tandis que le genre et la durée de l'asthme ne l'étaient pas. Il n'y avait pas de différence entre la sévérité de l'asthme et l'utilisation des services d'ambulance auprès des catégories BMI.

Conclusion: Les sujets asthmatiques obèses présentaient généralement un volume des fonctions pulmonaires faible comparé au groupe des sujets asthmatiques non-obèses (normaux).

Introduction

In the last few decades asthma and obesity have both become more common and they both pose significant challenge to clinicians. In the United States of America, half of the population is overweight or obese with asthma affecting about 8% of its

population [1]. In Nigeria; an estimated 10.7% of the population suffers from Asthma while between 14- 16.9% of the population are obese [2].

Epidemiologic investigations have repeatedly shown a modest association between obesity or elevated body mass index (BMI) and asthma [3]. These studies have involved thousands of adults and children, relying mostly on self-reported weight and physician diagnosed asthma. Many of these studies were carried out in the Western populations and amongst Caucasians.

In a meta analysis, the pooled odds of one year incident asthma was 1.51(95% confidence interval (CI) 1.27-1.80 while adults with BMI >25Kg/m^2 had an odd of 1.92 (1.43-2.59) [4]. In the Black Women 's Health Study, there was a dose – response relationship of increasing asthma incidence with increasing BMI, similar in magnitude to studies in white [5]. Thus giving credence to an association between obesity defined as Body Mass Index (BMI >30 Kg/m^2) and asthma. Studies have also shown that obese asthmatics have significant improvement of their asthma with weight loss, needing fewer medications, less hospitalisations and better lung functions [6].

This study hope to determine the effect of BMI on asthma in a subpopulation of asthmatics attending the specialist asthma clinic in a tertiary centre in Lagos, Nigeria with the specific objectives of determining the prevalence of obesity among the asthmatics, describing the socio-demographic characteristics of asthma patients according to their BMI categories, determining the influence of BMI categories on asthma severity and pulmonary functions.

Materials and methods

The study was conducted at the asthma clinic of the medical outpatient of Lagos State University Teaching Hospital, Ikeja, Nigeria.

The sample size was calculated using the Yamaro Yamane formula nf = n/ (1+n/N). Where nf is the desired sample size when study population is less than 10,000 and n the desired sample size when population is greater than 10,000 and N the estimate of population size. N in our study was the number of patients on the Asthma register at the commencement of the study, which equals 210. n =Z^2pq/d^2 where z is the standard estimate and =1.96, p is prevalence given as 0.5 in this study, q=1-p and d is precision at 0.05.The calculated nf adjusted for 80% response rate was 108 which is the minimum sample size.

Non probability sampling method was used with consecutive consenting asthma patients diagnosed by the respiratory physicians according to NHLBI (National Heart lung and blood institute) expert panel guidelines[7] and recruited over a five month period. Written informed consent was obtained from each of the participants. A carefully designed interviewer administered questionnaire was used after a pilot study of about 30 patients. The questionnaire sought information on the socio demographic characteristics of the participants (age, sex, marital status, level of education, occupation categories, income and social status). It also evaluated asthma symptoms at diagnosis, duration of diagnosis, asthma control, night time symptoms, frequency of emergency visit and rescue medication use etc. Information on drug use and family history of asthma was also obtained. Physical examination was carried out by the researcher. The height and weight were measured using the mechanical beam scale Seca Model 700 Balance Beam Scale with the height rod. The Weight was measured in Kilograms and the Height in meters.

The scale was calibrated before each measurement. The Body mass index was calculated by using the formula, Weight / (Height) ^{2} in kg/ meters^2. The patients were further categorised into three BMI groups namely; non- overweight (BMI<25), overweight (25≤BMI≤ 30) and obese (BMI>30).

The pulmonary function tests was done using in the sitting position using desktop Alpha Spirometer model 6000 made by Vitalograph UK (year 2007) according to ATS guidelines [8]. The Spirometer was calibrated daily using 1litre syringe. Pre and post bronchodilator values of forced expiratory volume in one second (FEVI) and forced vital capacity (FVC) were measured in Litres. Peak expiratory flow rate (PEFR) was also measured, thereafter the post bronchodilator responses was noted following inhalation of 200ug salbutamol.

Data analysis

All information collected from each respondent was entered into an IBM compatible computer equipped and analysed using statistical package STATA 10.

Continuous variables were expressed as means ± standard deviation; categorical variables were expressed as proportions. Comparisons of categorical variables were done using the chi square and the one-way ANOVA for continuous normally distributed data. A multivariate logistic regression was also carried out to test the association of the BMI

categories with Global initiative for asthma (GINA) severity grades [9]. A p-value <0.05 was taken as significant. Ethical clearance was obtained from the hospital's research and ethics committee.

Results

One hundred and fifty eight (158) asthma patients participated in the study. There were 63 (39.9%) males and 95 (60.1%) females. The mean age of respondents was 46.5±17.2 years Obesity as defined by body mass index greater than 30kg/m^2 occurred in 85 (53.8%) patients. Table 1 shows the characteristics of the studied population according to the BMI categories. Age, educational level and employment status were related to the body mass index while gender and duration of asthma were not.

asthmatics recorded significantly lower lung volumes. The Bonferroni Post Hoc Analysis carried out on the results of the ANOVA procedure revealed that the obese asthmatic had significantly lower predicted FEV1 than the non-overweight (p<0.0001) and the overweight (p = 0.013) groups, lower predicted FVC than non overweight (p<0.0001) and overweight (p = 0.007). The predicted PEFR was also lower in the obese asthmatics compared with the non-overweight group (p = 0.011) but did not differ with that obtained in the overweight asthmatics.

The obese asthmatics also recorded lower obtained FEV1 compared with the non-overweight asthmatics (p<0.0001), and overweight asthmatics (p = 0.001). They also had lower obtained FVC than the non –overweight (p <0.0001) and the overweight (p =

Table 1: Characteristics of the study population by BMI categories

	Non-Overweight BMI BMI<25	Overweight 25≤BMI≤	Obese BMI≥30	p value
Gender				
Male (n)	18	30	30	
Female (n)	15	25	55	0.150
Age {Mean (SD)}	31.6± (15.92)	43.7± (20.32)	53.6± (10.91)	0.0001
Educational level (n)				
None	0	11	6	
Primary	12	3	9	
Secondary	0	12	32	
Tertiary	21	14	38	<0.0001
Employment Status (n)				
Employed	9	17	54	
Unemployed	21	18	11	
Retired	3	5	20	<0.0001
Family History of Asthma (n)				
Yes	18	14	29	
No	15	26	56	0.107
Duration of Asthma (Years)				
1-9	15	18	38	
10-19	9	11	19	
≥ 20	9	8	28	0.754

There was no difference in the severity of asthma and utilization of emergency services across the BMI categories as shown in Table 2. There was however a difference in the use of oral steroids and beta agonists across the BMI categories with these agents in uses more by the overweight and obese asthmatics.

Table 3 shows the predicted, obtained and post bronchodilatory lung volumes of the studied population according to BMI categories. There were significant differences between the parameters across the BMI groups and in the predicted, obtained and post bronchodilatory measurements. Generally, the obese

0,004), lower obtained PEFR than the non-overweight (p = 0.021) and the overweight asthmatics (p = 0.001). The ratio of the FEV1 to FVC was also lower in the obese compared with the overweight asthmatics (p = 0.005).

Table 4 showed the results of the multivariate logistic regression procedure testing the association between the three BMI categories and the GINA asthma severity grades with the non-overweight as the reference group. There was no significant association between asthma severities across the BMI categories according to the GINA grades of severity.

Table 2: Distribution of asthma severity outcomes and medications by body mass index categories

	Non-Overweight BMI BMI<25	Overweight 25≤BMI≤30	Obese BMI≥30	p
E R visit in last 4 weeks				
None	30	35	75	
1	1	2	3	
2	1	1	2	
3	0	0	2	
>3	0	11	2	0.996
Frequency of symptoms				
Frequent	13	12	34	
Infrequent	20	28	51	0.539
Night time symptoms past 4weeks				
None	10	17	31	
1	7	13	15	
2	3	5	15	
3	5	1	10	
4	8	4	14	0.239
GINA Severity grade (n)				
Intermittent	9	18	34	
Mild Persistent	10	11	14	
Mod Persistent	6	6	27	
Severe Persistent	8	5	10	0.094
Medications in use (n)				
Inhaled Steroids only	18	15	30	0.150
Oral Steroids	3	14	21	0.035
Beta Agonist	18	40	67	<0.001
Oral Theophyline	3	6	9	0.737
Oral beta Agonist	6	3	15	0.257
Zirfilucast	0	3	3	0.244

BMI=Body Mass Index, SD=standard deviation of mean

Table 3: Comparisons of pulmonary functions of study population by BMI categories

	Non-Overweight BMI BMI<25	Overweight 25≤BMI≤30	Obese BMI≥30	p value
Predicted [Mean (SD) in Litres]				
FEV1	2.7(0.75)	2.56(0.57)	2.23(0.54)	0.0002
FVC	3.2(0.99)	3.08(0.67)	2.66(0.83)	0.0001
PEFR	415.55(82.01)	395.25(66.90)	370.46(73.66)	0.0105
Obtained [Mean (SD) in Litres]				
FEV1	2.19(0.97)	2.11(0.90)	1.48(0.78)	<0.0001
FVC	3.14(1.10)	2.82(1.00)	2.21(0.85)	<0.0001
PEFR	318.27(121.86)	340.43(162.11)	243.38(119.41)	0.0003
FEV1/FVC0.	70 (0.15)	0.73(0.11)	0.65(0.15)	0.0058
Post Bronchodilatory [Mean (SD) in Litres]				
FEV1	2.36(0.9)	2.35 (0.9)	1.65(0.68)	<0.0001
FVC	3.27(1.08)	3.00 (0.95)	2.54(0.80)	0.0003

FEV1=Forced Expiratory Volume in 1 sec, FVC=Forced Vital Capacity, PEFR=Peak Expiratory Flow Rate

Table 4: Multivariate logistic analysis for GINA severity classification of asthma in the studied population

	OR (compared with non-overweight patient BMI≤25)	
	Overweight 25≤BMI≤30 OR (95%CI) p value	Obese BMI≥30 OR (95%CI) p value
Intermittent	1.78(0.74–4.29)0.20	2.18(0.81–5.86)0.12
Mild Persistent	0.45(0.18–1.16)0.1	0.87(0.31–2.41)0.79
Moderate Persistent	2.09(0.77–5.67)0.15	0.79(0.23–2.74)0.72
Severe Persistent	0.42(0.15–1.17)0.10	0.45(0.13–1.53)0.20

OR = Odds Ratio, CI= Confidence Interval, BMI= Body Mass Index in Kg/m²

Discussion

The prevalence of obesity among the group of Nigerian asthmatics studied is high. Carmargo *et al* demonstrated with the Nurses' Health study database that weight gain after 18 years in women was strongly associated with adult onset asthma [10]. Castro–Rodriguez *et al* demonstrated using the Tucson children's Respiratory study database that girls becoming overweight or obese between 6 and 11 years had increased odds of development of new asthma symptoms [11].

Parkhale *et al* have reported that asthma morbidity as measured by various outcome is higher in obese compared with non-obese [12]. They found that respiratory symptoms such as dyspnea and wheezing were more prevalent in subjects with asthma who were obese. However there was no difference in the use of emergency hospital visits and in the severity of asthma across the BMI categories in our study unlike the finding of Grammer *et al* where higher BMI was associated with asthma – related emergency visit or urgent care [13]. The reason for this remain largely unknown, this may be a result of the delay in seeking health care services generally by the people in our environment which might be a consequence of several other socio-economic factors.

In this study we observed worsening measures of pulmonary function and predicted FEV1 with increasing BMI. The FEVI in non-overweight and overweight asthmatics were significantly higher than in the obese group. This is at variance with the findings of Grammer *et al* who did not find any correlation between BMI and an objective measure of lung function, FEV1 % predicted [13].

Despite the established association between asthma prevalence and obesity, the available literatures on obesity and asthma severity have produced inconsistent conclusions. While several works reported an association between asthma severity and obesity or increasing BMI, others did not establish an association. Using the 1997 National Heart, Lung and Blood Institute Guidelines for asthma severity, Akerman *et al* demonstrated that adults asthmatics with both moderate or persistent asthma are more likely to be obese compared with those with mild intermittent asthma [14]. This was consistent with the report of Varraso *et al* who demonstrated an increase in asthma severity with increasing BMI [15]. However, in our current study employing the GINA classification as a measure of asthma severity, we found no association between the severity grades and the BMI categories (Table 4). De Marco *et al* had reported similar outcome of no difference between baseline BMI categories and asthma severity grades using the GINA classifications in a 9 year European longitudinal study [16]. However, on follow up, remission of symptoms were better in those with lesser weight gain. These varied outcomes of research into this subject has been attributed to a number of limiting factors like small study population sizes, different definitions of asthma and varied measures of severity of asthma employed. There is a need to have further research with larger longitudinal cohorts of subjects with asthma who are obese and non-obese to study these inconsistent reports more carefully.

Our current report had some limitations similar to those found with earlier studies on this subject. We studied a total number of 158 asthma patients in an hospital based cross sectional study. The cross sectional nature of the study made it difficult to be very certain about asthma severity and long term control in the patients studied. Similar to other previous reports, the reliance on recall of events of the past months might have been a source of bias as well.

It is desirable that a future study into this subject will employ measures of central obesity such as waist circumference, waist to hip ratio and also investigate the possible roles of inflammatory markers such as adipokines, interleukins (iL)6, tumour necrosis factor (TNF)-á in the relationship between asthma and obesity.

Conclusion

Prevalence of obesity is high among the group of adult Nigerian asthmatics studied. There is no difference in asthma severity across the BMI categories employing the GINA severity grades. However, pulmonary functions are lower in obese asthmatics compared with non obese asthmatics. It is therefore important to advice ideal body weight for asthma patients as part of their management. Obese asthma patients should be advice appropriately on weight loss. There is also a need to carry out a more prospective multicentre study among a larger population of asthmatics to be able to define the magnitude of this problem in our practice ,however this present study re –emphasises the potential of obesity at worsening asthma by the reduction in their pulmonary functions.

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