Revista da
ASSOCIAÇÃO MÉDICA BRASILEIRA
www.ramb.org.br

Original article

Prevalence of obesity in asthma and its relations with asthma severity and control☆

Gabriele Carra Forte[a], *Denis Maltz Grutcki*[a], *Samuel Millán Menegotto*[a], *Rosemary Petrik Pereira*[a], *Paulo de Tarso Roth Dalcin*[a,b,*]

[a] *Faculdade de Medicina, Universidade Federal do Rio Grande do Sul, Porto Alegre, RS, Brazil*
[b] *Service of Pneumology, Hospital das Clínicas de Porto Alegre, Porto Alegre, RS, Brazil*

ARTICLE INFO

Article history:
Received 2 May 2013
Accepted 30 June 2013
Available online 31 October 2013

Keywords:
Obesity
Lung function
Asthma control
Disease severity
Body mass index

ABSTRACT

Objective: To determine the prevalence of obesity in asthmatic patients attending at an outpatient clinic, and to investigate its relationships with asthma severity and level of asthma control.

Methods: In a cross-sectional study we recruited patients aged 11 years and older with confirmed asthma diagnosis from the outpatient asthma clinic of Hospital de Clínicas de Porto Alegre, Brazil. They underwent an evaluation by a general questionnaire, an asthma control questionnaire and by pulmonary function tests. Nutritional status was classified by body mass index (BMI).

Results: 272 patients were included in the study. Mean age was 51.1 ± 16.5 years and there were 206 (74.9%) female patients. Mean BMI was 27.5 ± 5.3 kg/m^2, and 96 (35.3%) patients were classified as normal weight, 97 (35.7%) as overweight and 79 (29%) as obesity. There was a significant higher proportion of female than male patients (34.3% vs. 13.2%, p = 0.002) in the obesity group. There were no significant differences with respect to asthma control (p = 0.741) and severity classification (p = 0.506). The FEV_1% predicted was significantly higher in the obese than in the non-obese group (73.7% vs. 67.2%, p = 0.037). Logistic regression analysis identified sex (OR = 3.84, p = 0.002) as an independent factor associated with obesity.

Conclusions: This study showed a high prevalence of obesity in asthmatic patients. Obese and non-obese subjects were similar in regard to asthma severity and level of asthma control. Female sex was associated with obesity in this asthma population.

Prevalência de obesidade na asma e suas relações com gravidade e controle da asma

Palavras-chave:
Obesidade

RESUMO

Objetivo: Determinar a prevalência de obesidade em pacientes asmáticos atendidos no ambulatório clínico, e investigar sua relação com a gravidade e controle da asma.

☆ Study conducted at Universidade Federal do Rio Grande do Sul, Porto Alegre, RS, Brazil.

* *Corresponding author.*
E-mail: pdalcin@terra.com.br (P.T.R. Dalcin)

Função pulmonar
Grau de controle
Gravidade da doença
Índice de massa corporal

Métodos: Estudo transversal, envolvendo pacientes, com idade igual ou superior a 11 anos e diagnóstico de asma confirmado, do ambulatório clínico do Hospital de Clínicas de Porto Alegre, Brasil. Os pacientes foram submetidos à avaliação através de um questionário geral, questionário de controle da asma e teste de função pulmonar. O estado nutricional foi classificado conforme o índice de massa corporal (IMC).

Resultados: Foram incluídos no estudo 272 pacientes, sendo 206 (74,9%) pacientes do sexo feminino. A média de idade foi 51.1 ± 16.5 anos. O IMC médio foi 27.5 ± 5.3 kg/m^2, sendo 96 (35.3%) pacientes classificados como eutróficos, 97 (35,7%) como sobrepeso e 79 (29%) como obesidade. Observou-se significativamente maior proporção de pacientes do sexo feminino no grupo de obesidade quando comparados aos pacientes do sexo masculino (34.3% vs. 13.2%, p = 0.002). Não houve diferença significativa em relação ao controle da asma (p = 0.741) e classificação de gravidade (p = 0.506). O FEV_1% predito foi significativamente maior nos pacientes obesos quando comparados aos não obesos (73.7% vs. 67.2%, p = 0.037). A análise de regressão logística identificou gênero como fator independente associado com a obesidade. (OR = 3.84, p = 0.002).

Conclusão: O presente estudo observou alta prevalência de obesidade em pacientes asmáticos. Indivíduos obesos e não obesos tiveram similaridade para gravidade e controle da asma. O gênero feminino foi associado com obesidade nesta população asmática.

Introduction

The prevalence of asthma has been increasing in recent years throughout the world.[1] In Brazil, it is estimated that asthma affects more than 16 million people, approximately 10% of the population.[2,3] It is observed an alarming concomitant increase in obesity, which prevalence reaches epidemic proportions.[4] Survey data (POF 2008/2009) showed that being overweight affects 50.1% of men and 48% of adult women, and of that group, 12.4% of men and 16.9% of women are obese.[5] In Brazil, these two diseases have become a serious public health problem, thus increasing costs from the public and private sectors.[4]

An increasing body of literature suggests that there is an association between obesity and asthma.[6–9] Although the exact nature of this association remains unclear, many investigators have interpreted the data suggesting that obesity both increases the risk of incident asthma and alters prevalent asthma toward a more difficult-to-control phenotype.[10]

A variety of reported observations suggest that obesity might impact the lung in multiple ways.[11–15] Moreover, studies report that individuals with persistent asthma are significantly limited in the practice of physical activity, thus reducing energy expenditure, a fact that contributes to the growing increase in the prevalence of overweight and obesity.[14,16] Likewise, obesity seems to have negative impact on the level of asthma control.[17–19]. Lessard et al. showed that obese individuals are more likely to have not controlled asthma when compared to non-obese.[20] A previous study, however, did not find a relationship between asthma severity and obesity.[21]

The objective of this study was to determine the prevalence of obesity in asthmatic patients attending at an outpatient clinic in a large tertiary care hospital in Southern Brazil, and to investigate its relationships with asthma severity and level of asthma control.

Methods

This is a secondary analysis of a larger study conducted to determine the factors associated with asthma control. It was a cross-sectional study with prospectively collected data. All patients who volunteered were sequentially included. The protocol was approved by the Ethics Committee of Hospital de Clínicas de Porto Alegre (HCPA) and all participants or their parents – in case of patients younger than 18 years – gave written informed consent.

The patients selected were referred from a public institution. All patients were recruited from the outpatient Asthma Clinic of HCPA, Porto Alegre, RS, Brazil. The study included patients above 11 years of age, with a physician's diagnosis of asthma. The diagnosis was confirmed following three criteria: symptoms of asthma, reversible airflow obstruction with improvement of 12% or more and 200 mL in forced expiratory volume in one second (FEV_1) after administration of a short-acting β_2-agonist, or bronchial hyperresponsiveness to a bronchoconstricting agent. Patients who refused to participate, as well as those who did not complete all the evaluations required by the study protocol and patients with chronic pulmonary diseases other than asthma such as emphysema, chronic bronchitis or bronchiectasis were excluded.

After a scheduled outpatient consultation with an asthma specialist, all subjects were interviewed by a researcher using a structured questionnaire that evaluated the influence of the following variables: age, gender, race, marital status, educational level, socioeconomic status, smoking status, comorbid conditions, asthma severity and asthma control. All subjects underwent a comprehensive clinical, nutritional and pulmonary function evaluation.

According to World Health Organization (WHO) criteria,[22] nutritional status was classified by body mass index (BMI), which was calculated as weight in kilograms divided by the square of height in meters (kg/m^2). In accordance with

the International Standard Definition,[22] normal/underweight were defined as a BMI < 25 kg/m^2, overweight was defined as a BMI of 25-29.99 kg/m^2, and obesity was defined as BMI ≥ 30 kg/m^2. Obesity was classified in three classes according to the BMI classification: class I (BMI ≥ 30 and < 35 kg/m^2), class II (BMI ≥ 35 and < 40 kg/m^2), and class III (BMI ≥ 40 kg/m^2). Body weight was measured with subjects wearing light clothes and no shoes, and height was measured with an anthropometer attached to the scale.[2]

Pulmonary function was assessed with a computerized spirometer (Jaeger, v 4.31, Germany). Forced vital capacity (FVC), FEV_1 and FEV_1/FVC were measured three times, the best trial being reported. All parameters were reported as percent of the predicted for age, height, and gender.[23] PEF was measured using a portable Peak Flow Monitor (Vitalograph; Boehringer Ingelheim, Germany). Three successive expiratory maneuvers were performed, and the one with the highest value was recorded. The result was reported as percentage of the predicted for age, height and gender.[24]

We used the 2002 GINA classification system to assess disease severity according to the daily medication regimen,[25] which divides patients into 4 severity categories (mild intermittent; mild, moderate, and severe persistent asthma) based on frequency of symptoms, spirometric data and intensity of drug therapy.

The classification of asthma control was based on the 2011 GINA guidelines [26]. Asthma was considered to be controlled if all the following features were present: daytime symptoms only twice a week or less and no asthma attack (requiring oral corticosteroids, hospitalizations or emergency visits) in the last 3 months, no limitation of activities, no nocturnal symptoms or awakenings, need for reliever/rescue treatment only twice a week or less, normal airflow (FEV_1 and peak expiratory flow rate – PEF – equal to or greater than 80% of predicted value). Asthma was considered to be partly controlled if one or two of the above features were absent. Asthma was considered to be uncontrolled if more than two features were absent or if asthma had caused hospital/emergency department admission in the previous 12 months.

Statistical analysis

All analyses were performed with the Statistical Package for the Social Sciences, version 19.0 for Windows (SPSS Inc., Chicago, IL, EUA). Statistical analyses included simple frequencies and descriptive statistics of the variable of interest. The results obtained are presented as cases (proportion), mean ± SD, or median (interquartile range).The Chi-square test and the Student's *t* test or the Mann-Whitney U test were, respectively, used for testing differences among categorical variables and among continuous variables. Nominal statistical significance was set at a $p < 0.05$ for all the analyses.

Multivariate analyses were performed by using logistic regression techniques with enter method. The *odds ratio* (OR) from this analysis is the OR for obesity. Selected non collinear variables with a $p < 0.10$ were introduced in the binary logistic regression, controlled by gender and age.

Table 1 – General characteristics of the patients.

Characteristics	n = 272
Gender, N (%)	
Female	204 (75)
Male	68 (25)
Age (years), mean ± SD	51.1 ± 16.5
Age at diagnosis (years), median (IR)	25 (38.8)
Race, N (%)	
White	229 (84.2)
Non-white	43 (15.8)
BMI (kg/m^2), mean ± SD	27.5 ± 5.3
Nutritional status classification, n (%)	
Normal weight	96 (35.3)
Overweight	97 (35.7)
Obesityclass I	56 (20.6)
Obesityclass II	17 (6.3)
Obesityclass III	6 (2.2)
GINA severityclassification, n (%)	
Mild, intermittentorpersistent	38 (14.0)
Moderate, persistent	93 (34.2)
Severe, persistent	141 (51.8)
GINA levels of asthma control, n (%)	
Controlled	48 (17.6)
Partly controlled	74 (27.2)
Uncontrolled	150 (55.1)
PEFR% predicted, mean ± SD	64.1 ± 22.1
FVC% predicted, mean ± SD	83.8 ± 21.4
FEV_1% predicted, mean ± SD	69.1 ± 23.1
FEV_1/FVC, mean ± SD	66.1 ± 12.5
FEV_1/FVC% predicted, mean ± SD	81.0 ± 14.1

n, number of cases; SD, standard deviation; BMI, body mass index; GINA, Global Iniative for Asthma; IR, interquartile range; PEFR, peak expiratory flow rate; FVC, forced vital capacity; FEV_1, forced expiratory volume in 1 second.

Results

Three hundred thirty-four eligible subjects were examined in this study. Thirty patients refused to participate, 27 patients were excluded because they had another chronic pulmonary disease, and 5 patients were excluded because they failed to complete all the evaluations required by the study protocol. Thus, 272 patients were included in the study.

The general characteristics of the patients are presented in Table 1. There were 204 (75%) females. Mean age was 51.1 ± 16.5 years and median age at asthma diagnosis was 25 years (IR = 38.8 years). There were 229 (84.2%) white and 43 (15.8%) non-white patients. Mean BMI was 27.5 ± 5.3 kg/m^2, and 96 (35.3%) patients were classified as having normal weight, 97 (35.7%) as being overweight, 56 (20.6%) as with obesity class I, 17 (6.3%) as with obesity class II and 6 (2.2%) as with obesity class III. There were 38 (13.9%) patients with mild intermittent or persistent asthma, 93 (34.2%) with moderate asthma and 141 (51.8%) with severe asthma. Asthma was controlled in 48 (17.6%) patients, partly controlled in 74 (27.2%) and uncontrolled in 150 (55.1%). The mean FVC was 83.8 ± 21.4% of the predicted, the mean FEV_1 was 69.1 ± 23.1% of the predicted, the mean FEV_1/FVC was 66.1 ± 12.5%, the mean FEV_1/FVC was 81.0 ± 14.1% of the predicted and the mean PEF was 64.1 ± 22.1% of the predicted.

Table 2 – Comparison of patient characteristics betweenBMI group classification.

Variable	Obese (n = 79)	Non-obese (n = 193)	p
Gender, n (%)			
Female	70 (25.7)	134 (49.3)	0.002
Male	9 (3.3)	59 (21.7)	
Race, n (%)			
White	65 (23.9)	14 (5.1)	0.711
Non-white	164 (60,3)	29 (10.7)	
Age at diagnosis (years), median (IR)	30 (39)	23 (38)	0.301
Educational level, n (%)			
≤ 8 years of school	52 (19.1)	112 (41.2)	0.491
> 8 years of school and < high school	22 (8.1)	66 (24.3)	
≥ high school	5 (1.8)	15 (5.5)	
Income level per annum, n (%)			
≤ US$8,300	59 (21.7)	131 (48.2)	0.344
US$8,300-US$27,660	20 (7.4)	59 (21.7)	
> US$27,660	0 (0)	3 (1.1)	
Smoking status, n (%)			
Never	46 (16.9)	121 (44.5)	0.783
Past	30 (11.0)	66 (24.3)	
Current	3 (1.1)	6 (2.2)	
Asthma control			
Controlled	14 (5.1)	34 (12.5)	0.741
Partly controlled	19 (7.0)	55 (20.2)	
Uncontrolled	46 (16.9)	104 (38.2)	
GINA severity classification, n (%)			
Mild, intermitente or persistent	14 (5.1)	24 (8.8)	0.506
Moderate, persistent	25 (9.2)	68 (25.0)	
Severe, persistent	40 (14.7)	101 (37.1)	
PEF predicted, mean ± SD	66.3 ± 21.2	63.2 ± 22.5	0.291
FVC% predicted, mean ± SD	86.4 ± 17.5	82.8 ± 22.6	0.209
FEV_1% predicted, mean ± SD	73.7 ± 19.8	67.2 ± 24.1	0.037
FEV_1/FVC % predicted, mean ± SD	84.9 ± 14.0	79.5 ± 13.9	0.011

n, number of cases; BMI, body mass index; IR, interquartile range; GINA, Global Initiative for Asthma; FVC, forced vital capacity; FEV_1, forced expiratory volume in 1 second; PEF, peak expiratory flow.
Chi-square test for categorical variables, Student's *t* test or Mann-Whitney U test for continuous variables.

The comparison of patient characteristics and their relationship to BMI group classification is showed in Table 2. There was a significant higher proportion of female than male patients (34.3% vs. 13.2%, p = 0.002) in the obesity group. There were no significant differences with respect to race (p = 0.711), age at diagnosis (p = 0.301), educational level (p = 0.491), income level (p = 0.344), smoking status (p = 0.783), asthma control (p = 0.741), GINA severity classification (p = 0.506), PEFR % predicted (p = 0.291) and FVC% predicted (p = 0.209). The FEV_1% predicted and the FEV_1/FVC% predicted were significantly lower in the non-obese group than in the obese group (67.2% vs. 73.7%, p = 0.037; and 79.5% vs. 84.9%, p = 0.011, respectively).

A logistic regression analysis (Table 3) identified sex (OR = 3.84, p = 0.002) as an independent factor associated with obesity.

Table 3 – Logistic regression analysis with enter method for factors associated with obesity.

Variable	β	Wald	p	OR	CI 95% OR
Sex	1.35	9.54	0.002	3.84	1.64-9.03
Age	0.01	1.29	0.26	1.01	0.99-1.03
FEV_1	0.01	3.42	0.065	1.01	0.99-1.03
Constant	−3.47	17.85	< 0.001	0.031	-

β, coefficient; OR, odds ratio; CI, confidence interval; FEV_1, forced expiratory volume in 1 second.

Discussion

This cross-sectional study showed a high prevalence of obesity (29.1%) in patients who attended at an outpatient asthma clinic in a large, tertiary care, university-affiliated hospital in Southern Brazil. Obese and non-obese subjects were similar in regard to asthma severity and level of asthma control. However, FEV_1 was found to be higher in obese than in non-obese subjects. Female sex was an independent factor associated with obesity in this asthma population.

Similarly to the present study, Pelegrino et al.[21] studied 200 patients (72.5% were women) and reported that 32% presented a BMI ≥ 30 kg/m^2. Barros et al.[27] studied 508 patients (79.3% were women) with severe asthma in an asthma

reference center. The mean BMI was 28.03 ± 5.88. The patients were classified as follows: 17.9% of patients in obesity class I, 10.3% in obesity class II and 3.7% in obesity class III.

In our sample, the prevalence of obesity was higher among the women. This is consistent with previous studies that found that the increased risk of asthma associated with obesity was only significant in women, but not in men.[28]

Asthma is more common in women than in men, which is reflected in various frequency measures including prevalence,[29] incidence[30] and hospitalization.[31,32] In the present study, 75% of the patients were women. This finding is consistent with previous studies in our institution that reported a higher proportion of females than male patients with asthma (from 70.9 vs. 73.9%).[33–36]In the present study, asthma severity was assessed by the GINA classification system according to the daily medication regimen.[25] With this approach, effective therapy could control the disease, but would not interfere with the classification of disease severity. In contrast to our study, Fitzpatrick et al.[37] found that obesity was associated with more severe asthma and Ackerman et al.[38] showed a positive relationship between weight and asthma severity. However, our data demonstrates that the asthma severity of obese individuals did not differ from that of non-obese people. In agreement to our results, Pelegrino et al.[21] found no correlation between asthma severity and obesity.

Asthma control, which is defined as the extent to which the various manifestations of asthma are reduced or removed by treatment, is increasingly receiving attention, both in clinical trials and clinical practice.[39] In the present study we used a composite measure of asthma control according to a scheme based on GINA guidelines.[25] Although this measure has not yet been validated, it simultaneously takes into account several markers of uncontrolled asthma. More recently, several studies have used this measure to evaluate asthma control.[39] In the present study, obesity was not related to asthma control. In contrast, previous cross-sectional studies found that obese adults were more likely to report poor asthma control.[27] Saint-Pierre et al., in a prospective study, evaluated that non-obese patients, compared to obese asthmatics, were more likely to have poorly controlled asthma.[17] Also, Lavoie et al.,[18] in a cross-sectional study, showed that obesity is associated with a decline in asthma control. In contrast, a questionnaire-based study of asthma control in primary care clinics demonstrated no significant association with obesity.[40]

Obesity is associated with a reduction in residual volume, functional residual capacity and expiratory reserve volume that were reversed by weight loss with bariatric surgery. Obesity also causes a reduction of both FEV_1 and FVC with a preserved FEV_1/FVC ratio.[20] However, previous studies yielded contradictory data on whether obesity affects respiratory function in asthmatic subjects.[41,42] We found that subjects with asthma who were obese were more likely to have a higher FEV_1 than their counterparts of normal weight, despite similar levels of asthma severity and control. One possible explanation for this finding was the more difficult control of the disease in obese patients, despite better pulmonary function, assessed by spirometric tests, when compared to non-obese patients.

The present study has some potential limitations. It is a cross-sectional study, and therefore it is not possible to establish the temporal sequence between asthma and obesity. Our study population is made up of people with lower income and education. So, our patient sample is biased toward the socially disadvantaged. Also, the study population was selected from patients referred to a reference center and was probably biased toward the more severely diseased.

Conclusion

In conclusion, this study showed a high prevalence of obesity in patients who attended at an outpatient asthma clinic in Southern Brazil. Obese and non-obese subjects were similar in regard to asthma severity and level of asthma control. Female sex was associated with obesity in this asthma population.

As excess weight is highly prevalent in Brazil and increasing in many parts of the world, and because it is potentially preventable, clinical counseling about obesity should be part of asthma education programs aimed at helping those patients who are overweight to improve health status and outcomes.

Funding

This study was supported by Fundo de Pesquisa do Hospital de Clínicas de Porto Alegre (FIPE-HCPA) and Pró-Reitoria de Extensão da Universidade Federal do Rio Grande do Sul.

Conflicts of interest

The authors declare no conflicts of interest.

REFERENCES

1. Bateman ED, Hurd SS, Barnes PJ, Bousquet J, Drazen JM, FitzGerald M, et al. Global strategy for asthma management and prevention: GINA Executive Summary. Eur Resp J. 2008;31:143–78.
2. Sociedade Brasileira de Pneumologia e Tisiologia. IV Diretrizes Brasileiras para o Manejo da Asma. J Bras Pneumol. 2006; 32(Suppl 7): 447-74.
3. DATASUS. Ministério da Saúde. 2008 [citado 2 set 2011]. Available from: http://www.datasus.gov.br/
4. Portal da Saúde. Ministério da Saúde [citado 7 set 2011]. Available from: http://portal.saude.gov.br
5. IBGE. Instituto Brasileiro de Geografia e Estatística. Análise da disponibilidade domiciliar de alimentos e do estado nutricional no Brasil: pesquisa de orçamentos familiares 2008-2009. Rio de Janeiro; 2010.
6. Nystad W, Meyer HE, Nafstad P, Tverdal A, Engeland A. Body mass index in relation to adult asthma among 135,000 Norwegian men and women. Am J Epidemiol. 2004;160:969–76.
7. Beckett WS, Jacobs Jr DR, Yu X, Iribarren C, Williams OD. Asthma is associated with weight gain in females but not males, independent of physical activity. Am J Respir Crit Care Med. 2001;164:2045–50.

8. Celedon JC, Palmer LJ, Litonjua AA, Weiss ST, Wang B, Fang Z, et al. Body mass index and asthma in adults in families of subjects with asthma in Anqing. China Am J Respir Crit Care Med. 2001;164:1087–140.
9. Chen Y, Dales R, Tang M, Krewski D. Obesity may increase the incidence of asthma in women but not in men: longitudinal observations from the Canadian National Population Health Surveys. Am J Epidemiol. 2002;155:191–7.
10. Beuther DA, Weiss ST, Sutherland ER. Obesity asthma. Am J Respir Crit Care Med. 2006;174:112–9.
11. Sutherland TJT, Cowan JO, Young S, Goulding A, Grant AM, Williamson A, et al. The association between obesity and asthma. Am J Respir Crit Care Med. 2008;178:469–75.
12. Delgado J, Barranco P, Quirce S. Obesity and asthma. J Investig Allergol Clin Immunol. 2008;18:420–5.
13. Rodríguez JAC. Relationship between obesity and asthma. Arch Bronconeumol. 2007;43:171–5.
14. Ford ES. The epidemiology of obesity and asthma. J Allergy Clin Immunol. 2005;115:897–909.
15. Stephanie AS. Obesity and asthma: possible mechanisms. J Allergy Clin Immunol. 2008;121:1087–93.
16. Guerra S, Sherrill DL, Bodadilla A, Martinez FD, Barbee RA. The relation of body mass index to asthma, chronic bronchitis, and emphysema. Chest. 2002;122(4): 1256–63.
17. Saint-Pierre P, Bourdin A, Chanez P, Daures JP, Godard P. Are overweight asthmatics more difficult to control? Allergy. 2006;61:79–84.
18. Lavoie KL, Bacon SL, Labrecque M, Cartier A, Ditto B. Higher BMI is associated with worse asthma control and quality of life but not asthma severity. Respir Med. 2006;100: 648–57.
19. Killic H, Oguzulgen IK, Bakir F, Turktas H. Asthma in obese women: Outcomes and factors involved. J Investig Allergol Clin Immunol. 2011;21:290–6.
20. Lessard A, Turcotte H, Cormier Y, Boulet LP. Obesity and asthma: a specific phenotype? Chest. 2008;134: 317–23.
21. Pelegrino NRG, Faganello MM, Sanchez FF, Padovani CR, Godoy I. Relationship between body mass index and asthma severity in adults. J Bras Pneumol. 2007;33:641–6.
22. World Health Organization. Physical status: the use and interpretation of anthropometry. Geneve: World Health Organization;; 1995 (WHO Technical Report Series, n.854).
23. Pereira CA, Barreto SP, Simões JG, Pereira FW, Gerstler JG, Nakatani J. Valores de referência para espirometria em uma amostra da população brasileira adulta. J Pneumol. 1992;18:10–22.
24. Gregg I, Nunn AJ. Peak expiratory flow in normal subjects. Br Med J. 1973;3:282–4.
25. National Heart Lung and Blood Institute. Global Initiative for Asthma (GINA). Global strategy for asthma management and prevention: NHLBI/WHO Workshop Report. Bethesda: National Institute of Health. National Heart, Lung and Blood Institute. Publication N. 02-3659; 2002.
26. National Heart Lung and Blood Institute. Global Initiative for Asthma (GINA). Global strategy for asthma management and prevention: NHLBI/WHO Workshop Report. Bethesda: National Institute of Health. National Heart, Lung and Blood Institute. Publication N. 02-3659; 2011.
27. Barros L, Machado AS, Correa L, Santos JS, Cruz C, Leite M, et al. Obesity and poor asthma control in patients with severe asthma. J Asthma. 2011;48:171–6.
28. Chen Y, Rennie D, Cormier Y, Dosman J. Sex specificity of asthma associated with objectively measured body mass index and waist circumference: the Humboldt study. Ches. 2005;128:3048–54.
29. Senthilselvan A. Prevalence of physician-diagnosed asthma in Saskatchewan, 1981 to 1990. Chest. 1998;114:388–92.
30. de Marco R, Locatelli F, Sunyer J, Burney P. Differences in incidence of reported asthma related to age in men and women. A retrospective analysis of the data of the European Respiratory Health Survey. Am J Respir Crit Care Med. 2000;162:68–74.
31. Chen Y, Stewart P, Johansen H, McRae L, Taylor G. Sex difference in hospitalization due to asthma in relation to age. J Clin Epidemiol. 2003;56:180–7.
32. Skobeloff EM, Spivey WH, Clair StSS, Schoffstall JM. The influence of age and sex on asthma admissions. JAMA. 1992;268:3437–40.
33. Vieira AA, Santoro IL, Dracoulakis S, Caetano LB, Fernandes ALG. Ansiedade e depressão em pacientes com asma: impacto no controle da asma. J Bras Pneumol. 2011;37:13–8.
34. Dalcin PT, da Rocha PM, Franciscatto E, Kang SH, Menegotto DM, Polanczyk CA, et al. Effect of clinical pathways on the management of acute asthma in the emergency department: five years of evaluation. J Asthma. 2007;44:273–9.
35. Fernandes AK, Mallmann F, Steinhorst AMP, Nogueira FL, Ávila EM, Saucedo DZ, et al. Characteristics of acute asthma patients attended frequently compared with those attended only occasionally in an emergency department. J Asthma. 2003;40:683–90.
36. Mallman F, Fernandes AK, Ávila EM, Nogueira FL, Steinhorst AMP, Saucedo DZ, et al. Early prediction of poor outcome in patients with acute asthma in the emergency room. Braz J Med Biol Res. 2002;35:39–47.
37. Fitzpatrick S, Joks R, Silverberg JI. Obesity is associated with increased asthma severity and exacerbations, and increased serum immunoglobulin E in inner-city adults. ClinExpAllergy. 2012;42(5):747–59.
38. Akerman MJH, Calacanis CM, Madsen MK. Relationship between asthma severity and obesity. J Asthma. 2004;41:521–6.
39. Reddel HK, Taylor DR, Bateman ED, Boulet LP, Boushey HA, Busse WW, et al. An official American Thoracic Society/European Respiratory Society statement: asthma control and exacerbations: standardizing endpoints for clinical asthma trials and clinical practice. Am J Respir Crit Care Med. 2009;180:59–99.
40. Clerisme-Beaty EM, Karam S, Rand C, Patino CM, Bilderback A, Riekert KA, et al. Does higher body mass index contribute to worse asthma control in an urban population? J Allergy Clin Immunol. 2009;124:207–12.
41. Ghabashi AE, Iqbal M. Obesity and its correlation withspirometric variables in patients with asthma. Med Gen Med. 2006;8:58.
42. Lin WY, Yao CA, Wang HC, Huang KC. Impaired lung function is associated with obesity and metabolic syndrome in adults. Obesity. 2006;14:1654–61.