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Asthma in Mexican school-age children is not associated with passive smoking or obesity

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Background: Asthma has increased in various regions of the world. The factors associated with the growth in prevalence are still to be determined.

Objective: To evaluate the degree of association of the prevalence of asthma with passive smoking and obesity in school-children in western Mexico.

Methods: A population-based cross-section analytic study. A stratified random sample of 740 primary school pupils of between 6 and 12 years of age was chosen. Asthma, passive smoking and a background of allergic diseases were identified by means of a standardized questionnaire filled out by the parents of the participants. Obesity was identified by means of the body mass index. Proportional sections of population were estimated and the degree of association between asthma (dependent variable) and the independent variables was evaluated by means of multivariate logistic regression.

Results: The following factors of prevalence were found: asthma 8.1%; obesity 19.9%; background of smoking in the father 6.7% and in the mother 13.3%. There was no significant association to be found with asthma in either passive smoking where one of the parents smoked ($p = 0.39$) or in obesity ($p = 0.09$). On the other hand, the background of allergic diseases in the mother showed statistically significant association with asthma in the boys (odds ratio = 3.5, 95% confidence interval 1.4 to 8.59), but not in the girls.

Conclusion: With the exception of the maternal background of allergy, neither obesity nor passive smoking are factors associated with asthma in Mexican children.

Key words: Obesity; Asthma; Prevalence; Smoking; Epidemiology

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INTRODUCTION

Different studies carried out around the world have registered an increase in the frequency of allergic diseases [1-3] and when the corresponding social and economic impact is measured in terms of the loss of school days, working days and likewise in the quality of life, this is considerable [4, 5].

Considering the clinical characteristics of asthma, of suffering exacerbations and putting the life of the sufferer at risk, the researchers have centred their attention on evaluating its epidemiological behavior by means of the employment of different tools. By this means, not only is the prevalence determined, but also those factors associated with its development.

One of the factors most evaluated is atopy; however, non-allergic factors such as passive smoking [6], viral respiratory infections [7], the type and the duration of feeding at the moment of birth [8], among others, can be involved with the presentation of asthma. One area that has been repeatedly studied, but with inconsistent results, has been the passive or active exposure to cigarette smoke in the development of allergic diseases. The explanations emitted regarding the matter reveal the differences in the design of the studies. Recently, an association has been observed between the prevalence of asthma and its symptoms with the passive exposure to cigarette smoke; but not in the case of active smoking [9]. Actually, it has been observed that avoiding this exposure does not prevent allergic sensitization [10].

The nutritional disorders characterized by overweight, both in children and in adults, have shown a substantial increase, to the point of taking on epidemiological dimensions. In our environment, the frequency of obesity has been seen to be modified with an upward tendency in the last decade, above all in the rural regions, discovering a rise of up to a third in the combined prevalence of overweight and obesity in children; the major increase was observed in obesity and in the male sex [11]. Recently, the parallel rise in the prevalence of asthma and of obesity, have called attention towards analysing the existence of an association [12]. On the one hand, evidence exists that the adipose tissue is a producer of inflammatory factors such as leptin, which has been directly associated with the prevalence of asthma [13]; and on the other hand, it has also been observed that the loss of weight in subjects with obesity and asthma is associated with a lessening in the severity of the symptomatology [14].

In view of the available evidence, we have designed this study for the purpose of quantifying the prevalence of asthma and its symptoms in Mexican children aged from 6 to 12 years, by means of a standardized questionnaire; in addition to investigating its possible association with a family background of allergic diseases, the passive exposure to tobacco smoke and with obesity. This study forms part of an epidemiological research project on allergic diseases in the south of the state of Jalisco, Mexico.

MATERIALS AND METHODS

Study design and population

A cross-sectional study was designed in a city located in the south of the Mexican state of Jalisco. Ciudad Guzman has approximately 100 thousand inhabitants and a school population at primary level of 11,654 pupils.

Criteria selection and sampling

A sample of boys and girls aged from 6 to 12 years registered in primary education schools was included. The methodology for the inclusion of this sample has already been described in a previous work [15]. In synthesis, a probability sampling was carried out in three stages: In the first stage, schools were selected from each school zone (a group of around ten colleges formed for administrative purposes). In the second stage, at least one group from each school grade of the schools selected was included. In the third stage, after numerous random computer-generated samplings, a representative sample of children was selected taking care that all the school grades were included. The size of the sample of each school grade was in the same proportion in which the quantity of children from said grade contributed towards the total of the school. For example, if a college had 1,000 children registered, and the first grade was to contribute with 150, i.e. 15%; it was insured that the size of the sample of children from first grade would also contribute with 15% of the total size of the sample calculated.

Questionnaires and measurements

Prior to the collection of the information, a pilot test was carried out with 20 parents and their respective randomly-picked children (this data did not form a part of the final analysis). From April to July 2008, the school centers were visited in order to interview the parents and take the anthropometric measurements of the children. For this purpose, a structured questionnaire was used applied by a trained interviewer who applied it directly to the

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parents in a face-to-face interview, reading the questions in sequential form in order to avoid errors in the interpretation. The questionnaire permitted us to identify the presence of asthma, of allergic diseases and passive smoking, whilst the physical examination allowed us to identify the presence of obesity or overweight.

Definitions

Asthma: For the detection of asthma and its symptoms, we took into consideration the instrument developed by the group the International Study of Asthma and Allergies in Childhood (ISAAC), in its Spanish-validated version [16]. The question, "Has your child ever had asthma?" was used to assess the association between asthma, obesity and passive smoking.

Family background of allergic diseases: This was obtained through the history of asthma, allergic rhinitis or atopic dermatitis in the mother, the father or in some member of the family.

Obesity and overweight: The weight and height were obtained under standardized conditions, by two nutrition experts using equipment calibrated (SECA, Germany); the body mass index (BMI) was defined as the weight (in kilograms) divided by the square of the height (in meters). For this calculation, the specific growth tables were considered for sex and age provided on line by the Center for Disease Control and Prevention (CDC) [17]. When the BMI was between the percentiles of 85 to 95, this was considered as overweight and when this was >95, as obesity; an excess of weight consisted of the presence of overweight and obesity.

Smoking was considered as passive when one or more cigarettes were consumed by one or by both parents in the presence of the children.

Ethics

This study counted on the informed consent on behalf of the parents of the children included, and likewise, the approval of the Commission for Investigation and Ethics of Sanitary Region No. VI of the Ministry of Health for Jalisco and the compliance of the local school authorities.

Statistical analysis

In order to identify the frequency of asthma and its symptoms, its prevalence was calculated, estimating the 95% confidence interval (CI) for ratios. The chi square test was used (or Fisher's exact test when necessary) for comparing ratios. For comparing mean values of independent groups, the Student's *t*-test was used and to evaluate the adjusted risks, a logistic regression analysis was carried out. The affirmative answer to the question: "Has your child ever had asthma?" (dependent variable) was taken into consideration to evaluate the possible association between asthma with the background of allergic diseases in the family, obesity and passive smoking (independent variables). A value of $p \leq 0.05$ was considered statistically significant. The SPSS program for Windows, version 18.0 (SPSS, USA), was used for processing the information.

RESULTS

Seven hundred and forty children (6.5%) were included from the global study, the average age being 9.4 ± 1.8 years; there were 293 (53.1%) from the female sex. The frequency of asthma in the father and the mother was 4.7% and 1.1% respectively; 15.2% of the mothers and 6.6 % of the fathers had some allergic disease, whilst 30.7% had at least one relation with some type of allergic diseases.

Table 1 shows that the symptoms of asthma were more frequent in the boys than in the girls; whilst the prevalence of asthma was more common in the girls than in the boys, but in neither of the cases were there statistically significant differences.

The nutritional alterations detected in the participants were: obesity 19.9%, overweight 15.5% and undernourishment 3.5%.

In the univariate analysis (Table 2), the presence of allergic relatives or maternal asthma was significantly associated with asthma in children.

When we evaluated the association between the nutritional state and the asthma, this did not exist with the obesity or with the overweight. However, when combining the two categories, we found that the subjects with excess weight had a tendency towards significance ($p = 0.06$).

There was no significant association to be found with asthma in either passive smoking or obesity.

Finally, by means of the logistic regression multivariate analysis, it was observed that the nutritional state was not associated with the asthma (Table 3) and that the background of allergic diseases in the mother remained significantly associated with the diagnosis of asthma in the school children (Table 4); however, in a sub-analysis by sex, this association was maintained in the boys, odds ratio (OR) of 3.5 (95% CI 1.4 to 8.59, $p = 0.006$), but not in the girls ($p = 0.518$).

In our study, it was also observed that the excess in weight was

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Table 1. Prevalence of asthma and asthma symptoms in school-children

	General n = 740		Boys n = 347		Girls n = 393		*p*
	n	% (95% CI)	n	% (95% CI)	n	% (95% CI)	
Wheezing ever	126	17.0 (14.3 - 19.7)	68	19.6 (15.4 - 23.8)	58	14.8 (11.3 - 18.3)	NS
Asthma symptoms in the last year							
Wheezing	49	6.6 (5.8 - 7.4)	27	7.8 (7.3 - 8.2)	22	5.6 (5.1 - 6.1)	NS
Exercise-induce wheezing	49	6.6 (6.2 - 6.9)	25	7.2 (6.7 - 7.6)	24	6.1 (5.6 - 6.6)	NS
Nocturnal cough	233	31.5 (28.1 - 34.9)	113	32.6 (27.7 - 37.5)	120	30.5 (25.9 - 35.0)	NS
Asthma ever	60	8.1 (7.8 - 8.4)	24	6.9 (6.4 - 7.4)	36	9.2(8.8 - 9.4)	NS

CI, confidence interval; n, number of cases with the concerning feature; NS, non-significant.

Table 2. Asthma associated factors in school-children

	Asthma		
	Yes n = 60	No n = 680	*p*
Girls	36 (60.0%)	357 (52.5%)	0.26
Age, mean ± SD	9.6±1.8	9.4±1.8	0.41
Age < 8 years old	14 (23.3%)	176 (25.9%)	0.66
Family history			
Maternal asthma	5 (8.3%)	29 (4.4%)	0.20
Paternal asthma	2 (3.3%)	6 (0.9%)	0.14
Maternal allergic disease	15 (25.9%)	94 (14.3%)	0.02
Paternal allergic disease	4 (6.8%)	43 (6.5%)	0.99
Any other relative with allergic disease	30 (50.8%)	190 (28.9%)	< 0.001
History of smoking			
Maternal	4 (6.7%)	40 (5.9%)	0.78
Paternal	8 (13.3%)	127 (18.9%)	0.29
Paternal and maternal	2 (3.3%)	23 (3.4%)	0.99
Paternal or maternal	10 (16.7%)	144 (21.4%)	0.39
Nutritional status			
Underweight (BMI percentiles < 5)	2 (3.3%)	24 (3.5%)	0.29
Normal (BMI percentiles 5-85)	30 (50%)	422 (62.1%)	
Overweight (BMI percentiles 85-95)	12 (20%)	103 (15.1%)	
Obese (BMI percentiles > 95)	16 (26.7%)	131 (19.3%)	

Means comparison by using Student's *t*-test. Proportions comparison by using chi square test. Some parents didn't answer to all questions, so proportions were calculated over the base amount of those that gave an answer. BMI, body mass index.

associated with a greater frequency of wheezing during exercise ($p = 0.04$) and that the obesity was the same with the presence of nocturnal cough during the year prior to the study ($p = 0.001$). On comparing the frequency of wheezing in the previous year, among children with and without obesity (10.2% vs. 5.8%) we did not find a significant difference ($p = 0.063$).

DISCUSSION

This study has found that 8 out of every 100 school-age children from a city in western Mexico have a diagnosis of asthma, the associated factors of which are the background of allergic diseases in the mothers and in some other member of the family. No

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Table 3. Evaluation of the association between nutrimental status and asthma

Nutritional status	Asthma			
	Yes* n = 58	No* n = 656	OR (95% CI)	*p*
Weight excess†	28	234	1.7 (1.0 - 3.0)	0.06
Obese	16	131	1.7 (0.9 - 3.4)	0.09
Overweight	12	103	1.6 (0.8 - 3.5)	0.17
Normal‡	30	422	1.0	-

*Children with body mass index in percentile ≤ 5 were excluded. †Include children with overweight or obesity. ‡Children with normal weight were the reference group. OR, odds ratio; CI, confidence interval.

Table 4. Evaluation of the association between maternal allergy disease and asthma

	Unadjusted model			Adjusted model†		
	OR	95% CI	*p*	OR	95% CI	*p*
Maternal allergic diseases	2.1	1.2 - 4.0	0.02	2.1	1.1 - 4.0	0.02
Weight excess*	1.6	0.9 - 2.7	0.12		NS	
Age	1.1	0.9 - 1.2	0.41		NS	
Female	1.6	0.9 - 2.7	0.12		NS	
Breastfeeding	1.2	0.4 - 4.2	0.74		NS	
Cesarean delivery	1.3	0.7 - 2.2	0.39		NS	

*Include overweight and obesity. Dependent variable: presence of asthma (yes/no). Independent variables: maternal allergic diseases, weight excess (yes/no), age (variable continuous), gender (female/male), breastfeeding (yes/no) and cesarean delivery (yes/no). Those variables that were not statistically significant were used to adjust (omitted variables in the model adjusted). †Model adjusted by the variables: weight, age, gender, breastfeeding and cesarean delivery. Odds ratio (OR) obtained through logistic regression. NS, non-significant; CI, confidence interval.

association with positive smoking or with obesity was found.

In the context of Mexico, the prevalence of asthma found in Ciudad Guzman was higher than that observed in other regions of the country [18, 19]; with the exception of that reported by Barraza-Villarreal and colleagues in Cuernavaca [2]. On the international front, the results corresponding to phase III of the ISAAC were recently published, which included 388,811 children aged from 6 to 7 years, distributed in 144 centers in 61 different countries; the global prevalence of asthma was 9.4%, observing geographic variations that were between 3.4 and 29.2%; the frequencies of Africa, India and Eastern Europe were the lowest, contrasting with the figures of North American and Oceania which were the highest [20]. Having employed the same research tool as the ISAAC group and by means of the random sampling carried out, we believe that our results can be compared with the above-mentioned centers, situating Ciudad Guzman at an intermediate point. There have been attempts to explain these variations in the prevalence of asthma, and likewise, of the allergic diseases, due to the diversity of environmental factors to which genetically predisposed subjects expose themselves deliberately or inadvertently. Two important factors that have shown contradictory results are obesity and smoking.

The data from the 2006 Health and Nutrition Survey in Mexico revealed an increase in the prevalence of obesity with respect to the national survey previously carried out in 1999, where in the case of the boys, this rose from 5.3 to 9.4% (77%) and in the girls, from 5.9 to 8.7% (47%) [11]. In Ciudad Guzman, as there were no previous specific results available to evaluate this phenomenon, we considered those obtained in the state of Jalisco, where the excess of weight (overweight and obesity) continued to relate with the national figures; however this was not so with obesity (exclusively) where the men maintained higher percentages than the women, 17.5% and 3.2% respectively [21]; thus revealing that the children in this study have serious problems both of obesity and of overweight. These results led us to consider that in the case of an association existing between obesity and asthma, the latter must have suffered an equally substantial increase. However, two important epidemiological studies carried out in Mexico have evaluated the tendency of asthma in different periods of time. The first of these [22] was carried out with a population using the

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medical services of the most important public medical institution, the Mexican Institute of Social Security, where the annual necessities of medical attention were retrospectively evaluated in asthmatic subjects during a period of 11 years. The second of these was carried out with a school-age children population [2], during a period of 7 years, employing the methodology recommended by the ISAAC group, and considering the presence of wheezing in the 12 months prior to the study. The conclusion in both studies was that no substantial increases had been observed in the frequency of asthma; hence, on the one hand it is evident that at least in the last 15 years, Mexico has not experienced an "outbreak" of asthma and on the other hand, we can argue that possibly there is no existing association between obesity and asthma, since only the first of the two has suffered important changes during the last decade and there have been no important modifications in the prevalence of asthma.

The association between asthma and obesity could not be established in our study; this is consistent with the data obtained in New Zealand [23], Canada [24] and Brazil [25]; controversially, Jacobson [26] and Garcia-Marcos [27] have found that obesity increased the risk of asthma and that this is more notorious in girls. One possible explanation for this discrepancy arises from the methods employed for evaluating the weight and height of the participants. Some authors take into consideration the quantities reported by the participants or their relations; on the other hand, the cut-off point used for considering obesity has not always been the same. This observation was revealed in Mexico [28], where on employing the criteria of the CDC and of the International Obesity Task Force (IOTF) the figures for overweight and obesity varied notably. Later studies employing both of the evaluation criteria could help to make it clear if this factor is relevant in evaluating the association of obesity in the prevalence of asthma. Finally, the subjects with obesity have a greater possibility of being diagnosed with asthma; evidence of this is seen from the results obtained by Sin et al. [29], where the greater the BMI, the greater the possibility of presenting dyspnoea, self-reporting asthma and using bronchodilators, but inversely, less air-flow obstruction, documented by the respiratory function tests.

Noticeably, we found an association between the background of maternal allergy and asthma, but only in the case of the boys, OR of 3.5. Recently, in Liaoning, China [30] it was found in a cross-sectional study that the atopy in both parents increased the risk of being diagnosed with asthma, OR of 3.12 (95% CI 2.61-3.73), this risk being more pronounced when the mother was the one who had the background of asthma, OR of 5.42 (95% CI 3.60-8.16); however, in the background of allergic diseases no association was observed, OR of 1.06 (95% CI 0.76-1.46). Similar results were found in Northern Sweden [31], where the background of asthma in the father, the mother and a brother or sister were associated with the development of asthma, OR of 13.2 (95% CI 4.1-41.9); whilst with respect to the atopy in the parents, this was only significant when present in the father, but not in the mother. Finally, Jacobson [26] found an association between the background of asthma in the mother and the development of asthma in the girls, OR of 3.6 (95% CI 1.4-9.5). In view of the evidence, it is clear that the family backgrounds of allergic diseases are preponderant in the development of asthma, but that the inheritance patterns are not completely explained.

The influence of the exposure to tobacco smoke on the development of asthma has been investigated at different stages of life and by means of diverse study models. It has been observed that the children who are exposed *in utero* have a greater risk of presenting wheezing at some time during their lives and in the previous year [32]; in the same way, they also have a greater necessity of medical attention for asthma in the emergency services [33]. When considering the passive exposure to and the prevalence of, asthma, the results have been contradictory, discovering studies with a direct association [9, 33], and others in which, inclusively, a protective effect has been reported [34]. Finally, active smoking appears not to be associated with either asthma or with its symptoms [9]. Our results did not permit the establishment of an association between the passive exposure to tobacco smoke and the prevalence of asthma, probably as a consequence of only having investigated current smoking in one of the parents, putting aside the *in utero* exposure, the number of additional persons who smoke in the children's home and the intensity of the parents' smoking.

The limitations in this study were that the children were categorized with asthma based on a questionnaire, without succeeding in confirming the diagnosis according to the case-history or to the respiratory function tests; an additional limitation was not being able to establish with precision the date of the diagnosis of asthma, and likewise, the commencement of the nutritional disorders characterized by the excess of weight. However, we consider that our results are reliable, since instead of sending the questionnaires to the participating subjects' homes to avoid errors in the filling-out of forms, the children's parents were invited to attend the school centers; it was there that the reason

for the meeting was explained to them and then the questionnaire was applied by way of a collective interview. Likewise, instead of employing the report of the children's weight and height supplied by the parents, two nutrition experts measured these according to international standards, thus permitting a reliable calculation of the BMI, and avoiding inexact reports.

In conclusion, to date, there continues to exist a scarcity of information in our environment with respect to one of the most important health problems in the world, asthma. To our knowledge, this is the first study developed in Jalisco, where the results were obtained by means of a previously-validated tool; and which also evaluated the relation between obesity and passive exposure to cigarette smoke with asthma, without finding evidence of any association. Prospective studies are necessary with larger cohorts in order to allow a better evaluation of the problems.

REFERENCES

1. Gupta R, Sheikh A, Strachan DP, Anderson HR. Time trends in allergic disorders in the UK. Thorax 2007;62:91-6.
2. Barraza-Villarreal A, Hernandez-Cadena L, Moreno-Macias H, Ramirez-Aguilar M, Romieu I. Trends in the prevalence of asthma and other allergic diseases in schoolchildren from Cuernavaca, Mexico. Allergy Asthma Proc 2007;28:368-74.
3. Arnedo-Pena A, García-Marcos L, García Hernández G, Aguinagua Ontoso I, González Díaz C, Morales Suárez-Varela M, Domínguez Aurrecoechea B, Busquets Monge R, Blanco Quiros A, Batlles Garrido J, Miner Kanflanka I, López-Silvarrey Varela A. Time trends and geographical variations in the prevalence of symptoms of allergic rhinitis in 6-7-year-old children from eight areas of Spain according to the ISAAC. An Pediatr (Barc) 2005;62:229-36.
4. Meltzer EO, Blaiss MS, Derebery MJ, Mahr TA, Gordon BR, Sheth KK, Simmons AL, Wingertzahn MA, Boyle JM. Burden of allergic rhinitis: results from the Pediatric Allergies in America survey. J Allergy Clin Immunol 2009;124:S43-70.
5. Braman SS. The global burden of asthma. Chest 2006;130:4S-12S.
6. Guedes HT, Souza LS. Exposure to maternal smoking in the first year of life interferes in breast-feeding protective effect against the onset of respiratory allergy from birth to 5 yr. Pediatr Allergy Immunol 2009;20:30-4.
7. Huckabee MM, Peebles RS Jr. Novel concepts in virally induced asthma. Clin Mol Allergy 2009;7:2.
8. Takemura Y, Sakurai Y, Honjo S, Kusakari A, Hara T, Gibo M, Tokimatsu A, Kugai N. Relation between breastfeeding and the prevalence of asthma: the Tokorozawa Childhood Asthma and Pollinosis Study. Am J Epidemiol 2001;154:115-9.
9. Vázquez Nava F, Saldívar González AH, Martínez Perales G, Lin Ochoa D, Barrientos Gómez MC, Vázquez Rodríguez EM, Vázquez Rodríguez CF, Beltrán Guzmán FJ. Associations between family history of allergy, exposure to tobacco smoke, active smoking, obesity, and asthma in adolescents. Arch Bronconeumol 2006;42:621-6.
10. Hancox RJ, Welch D, Poulton R, Taylor DR, McLachlan CR, Greene JM, Sears MR. Cigarette smoking and allergic sensitization: a 32-year population-based cohort study. J Allergy Clin Immunol 2008;121:38-42.e3.
11. Olaiz G, Rivera J, Shamah T, Rojas R, Villalpando S, Hernández M, Sepúlveda J. National Survey of Health and Nutrition 2006. Cuernavaca: National Institute of Public Health; 2006. Available from: http://www.insp.mx/ensanut/ensanut2006.pdf.
12. Story RE. Asthma and obesity in children. Curr Opin Pediatr 2007;19:680-4.
13. Nagel G, Koenig W, Rapp K, Wabitsch M, Zoellner I, Weiland SK. Associations of adipokines with asthma, rhinoconjunctivitis, and eczema in German schoolchildren. Pediatr Allergy Immunol 2009;20:81-8.
14. Hakala K, Stenius-Aarniala B, Sovijärvi A. Effects of weight loss on peak flow variability, airways obstruction, and lung volumes in obese patients with asthma. Chest 2000;118:1315-21.
15. Bedolla-Barajas M, Cuevas-Ríos G, García-Barboza E, Barrera-Zepeda AT, Morales-Romero J. Prevalence and associated factors to allergic rhinitis in school children of ciudad Guzmán, Mexico. Rev Invest Clin 2010;62:244-51.
16. Mata Fernández C, Fernández Benítez M, Pérez Miranda M, Guillén Grima F. Validation of the Spanish version of the Phase III ISAAC questionnaire on asthma. J Investig Allergol Clin Immunol 2005;15:201-10.
17. Centers for Disease Control and Prevention (CDC). BMI percentile calculator for child and teen. English version [Internet]. Atlanta: CDC. Available from: http://apps.nccd.cdc.gov/dnpabmi/.
18. Barraza-Villarreal A, Sanín-Aguirre LH, Téllez-Rojo MM, Lacasaña-Navarro M, Romieu I. Prevalence of asthma and other allergic diseases in school children from Juarez City, Chihuahua. Salud Publica Mex 2001;43:433-43.
19. Del-Rio-Navarro B, Del Rio-Chivardi JM, Berber A, Sienra-Monge JJ, Rosas-Vargas MA, Baeza-Bacab M. Asthma prevalence in children living in north Mexico City and a comparison with other Latin

http://dx.doi.org/10.5415/apallergy.2013.3.1.42

American cities and world regions. Allergy Asthma Proc 2006;27:334-40.
20. Lai CK, Beasley R, Crane J, Foliaki S, Shah J, Weiland S. Global variation in the prevalence and severity of asthma symptoms: phase three of the International Study of Asthma and Allergies in Childhood (ISAAC). Thorax 2009;64:476-83.
21. National Institute of Public Health. National Survey of Health and Nutrition 2006. Results by state, Jalisco. Cuernavaca: National Institute of Public Health, Ministry of Health; 2007. Available from: http://www.insp.mx/ensanut/centroocci/Jalisco.pdf.
22. Vargas MH, Díaz-Mejía GS, Furuya ME, Salas J, Lugo A. Trends of asthma in Mexico: an 11-year analysis in a nationwide institution. Chest 2004;125:1993-7.
23. Wickens K, Barry D, Friezema A, Rhodius R, Bone N, Purdie G, Crane J. Obesity and asthma in 11-12 year old New Zealand children in 1989 and 2000. Thorax 2005;60:7-12.
24. To T, Vydykhan TN, Dell S, Tassoudji M, Harris JK. Is obesity associated with asthma in young children? J Pediatr 2004;144:162-8.
25. Bertolace Mdo P, Toledo E, Jorge PP, Liberatore Junior Rdel R. Association between obesity and asthma among teenagers. Sao Paulo Med J 2008;126:285-7.
26. Jacobson JS, Mellins RB, Garfinkel R, Rundle AG, Perzanowski MS, Chew GL, Andrews HF, Goldstein IF. Asthma, body mass, gender, and Hispanic national origin among 517 preschool children in New York City. Allergy 2008;63:87-94.
27. Garcia-Marcos L, Canflanca IM, Garrido JB, Varela AL, Garcia-Hernandez G, Guillen Grima F, Gonzalez-Diaz C, Carvajal-Urueña I, Arnedo-Pena A, Busquets-Monge RM, Morales Suarez-Varela M, Blanco-Quiros A. Relationship of asthma and rhinoconjunctivitis with obesity, exercise and Mediterranean diet in Spanish schoolchildren. Thorax 2007;62:503-8.
28. del Río-Navarro BE, Velázquez-Monroy O, Sánchez-Castillo CP, Lara-Esqueda A, Berber A, Fanghänel G, Violante R, Tapia-Conyer R, James WP. The high prevalence of overweight and obesity in Mexican children. Obes Res 2004;12:215-23.
29. Sin DD, Jones RL, Man SF. Obesity is a risk factor for dyspnea but not for airflow obstruction. Arch Intern Med 2002;162:1477-81.
30. Dong GH, Ding HL, Ma YN, Jin J, Cao Y, Zhao YD, He QC. Asthma and asthma-related symptoms in 16 789 Chinese children in relation to pet keeping and parental atopy. J Investig Allergol Clin Immunol 2008;18:207-13.
31. Bjerg A, Hedman L, Perzanowski MS, Platts-Mills T, Lundbäck B, Rönmark E. Family history of asthma and atopy: in-depth analyses of the impact on asthma and wheeze in 7- to 8-year-old children. Pediatrics 2007;120:741-8.
32. Wang C, Salam MT, Islam T, Wenten M, Gauderman WJ, Gilliland FD. Effects of in utero and childhood tobacco smoke exposure and beta2-adrenergic receptor genotype on childhood asthma and wheezing. Pediatrics 2008;122:e107-14.
33. Tsai CH, Huang JH, Hwang BF, Lee YL. Household environmental tobacco smoke and risks of asthma, wheeze and bronchitic symptoms among children in Taiwan. Respir Res 2010;11:11.
34. Hjern A, Hedberg A, Haglund B, Rosén M. Does tobacco smoke prevent atopic disorders? A study of two generations of Swedish residents. Clin Exp Allergy 2001;31:908-14.