

HYPERREACTIVE AIRWAY DISEASE IN ADULTS: DATA FROM A NATIONAL STUDY IN LEBANON

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ABSTRACT • BACKGROUND : Asthma and hyperreactive airway (HRA) disease are a major cause of health resource utilization and poor quality of life worldwide; its prevalence in adults may widely vary according to the definition used. It is mainly a childhood disease, but its natural history till adulthood is not well known. This is due to other confounding factors such as smoking and environmental factors that may lead to misdiagnose asthma as chronic obstructive pulmonary disease. Correct and timely diagnosis of asthma and HRA is important because it can be treated successfully and affected individuals may achieve good control of their disease.

OBJECTIVE : To evaluate the prevalence of asthma and HRA in Lebanese adults, their symptoms and predictors.

METHODS : A cross-sectional study using a multi-stage cluster sample was carried out in Lebanon, between October 2009 and September 2010. Lebanese residents aged 40 and above participated to the study; a post-bronchodilator spirometry was performed to confirm diagnosis.

RESULTS : Out of 2201 individuals, 218 (9.9%) were considered to have HRA. The following factors were found associated with HRA in the Lebanese population: Northern (ORa: 3.54) and Bekaa Plain (ORa: 2.44)] versus other regions; occupational exposure to toxic gases and fumes (ORa: 2.08); heating home with wood (ORa: 1.75); having a family history of chronic respiratory disease (ORa: 2.19), a history of childhood lung problem (ORa: 5.53), and father smoking during childhood (ORa: 1.47). Added to these factors, HRA was also predicted by female gender (ORa: 1.81); lower education (ORa: 1.20); older age (ORa: 1.28) and low birth weight (ORa: 3.14).

CONCLUSION : This is the first epidemiological study in Lebanon that determined physician diagnosed asthma prevalence and hyperreactive airway disease and their associated factors among Lebanese adults. It also provides useful contributions that local health organizations may use for national programming and a foundation for health researchers to pursue further study in asthma research. Public awareness about the increased risk of asthma associated with heating homes with wood and exposure to passive smoking should be raised; Lebanese policy makers should also generate higher efforts to implement and reinforce the smoking ban law in public places.

Keywords : asthma, hyperreactivity, adults, occupation, pollution, passive smoking

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RÉSUMÉ • INTRODUCTION : L'asthme et l'hyperréactivité bronchique sont des causes majeures de mortalité, d'utilisation de ressources et de baisse de la qualité de vie au niveau mondial ; leur prévalence varie chez les adultes selon la définition utilisée. Il s'agit d'un problème infantile dont l'histoire naturelle n'est pas bien connue chez les adultes, dû à la confusion de son diagnostic avec celui de la broncho-pneumopathie chronique obstructive. Cependant, le diagnostic correct est important parce qu'il permet de traiter avec succès les individus affectés et assure un contrôle adéquat de leur condition.

OBJECTIF : Évaluer la prévalence de l'asthme et de l'hyperréactivité bronchique chez les adultes libanais, en plus de leurs symptômes et facteurs prédictifs.

MÉTHODES : Une étude transversale a été menée au Liban, entre octobre 2009 et septembre 2010 avec la participation de résidents libanais âgés de 40 ans et plus ; une spirométrie en post-bronchodilatation a été utilisée pour confirmer le diagnostic.

RÉSULTATS : Parmi 2201 individus, 218 (9,9%) étaient considérés atteints d'hyperréactivité bronchique. Les facteurs suivants y étaient associés : habiter au Nord Liban (ORa: 3,54) et la plaine de la Bekaa (ORa: 2,44) comparé à d'autres régions • exposition professionnelle aux gaz et fumées toxiques (ORa: 2,08) • chauffage de la maison au bois (ORa: 1,75) • histoire familiale de maladie respiratoire chronique (ORa: 2,19) • antécédents personnels de problèmes respiratoires durant l'enfance (ORa: 5,53) et • tabagisme du père durant l'enfance (ORa: 1,47). En plus de ces facteurs, l'hyperréactivité bronchique était aussi prédite par le sexe féminin (ORa: 1,81), un niveau d'éducation inférieur (ORa: 1,20), un âge supérieur (ORa: 1,28) et un poids inférieur à la naissance (ORa: 3,14).

CONCLUSION : Il s'agit de la première étude au Liban déterminant la prévalence de l'asthme et de l'hyperréactivité bronchique et leurs facteurs associés parmi les adultes. Elle nous permet de contribuer à l'organisation adéquate de programmes nationaux de santé et de fonder des recherches plus poussées sur l'asthme au Liban. La sensibilisation du public concernant le risque accru d'asthme dû au chauffage au bois et au tabagisme passif devrait être augmentée ; les autorités concernées devraient aussi générer plus d'efforts pour implanter et renforcer la loi anti-tabac dans les lieux publics.

Mots-clés : asthme, hyperréactivité, adultes, profession, pollution, tabagisme passif

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INTRODUCTION

Asthma is a chronic pulmonary disease considered as a major cause of morbidity and mortality around the world; it is also a major cause of health resource utilization and poor quality of life worldwide; its prevalence in adults may widely vary according to countries, and according to the definition used to determine its presence [1-2]. Asthma is mainly a childhood disease, but the natural history of asthma till adulthood is not well defined, neither well diagnosed. This is due to other confounding factors such as smoking and environmental factors that may lead to misdiagnose asthma as chronic obstructive pulmonary disease (COPD) [1-2].

Many personal and environmental risk factors are associated with asthma. On an individual level, the genetic influence on asthma has been clearly established [3-4]; current asthma prevalence seems higher in females (15.1%) when compared to males (11.8%) in a nationwide study performed in the United States [5]. In addition, other factors seem to be involved, such as obesity [6], low birth weight [7], lower education and socioeconomic status [8]. On an environmental exposure level, studies suggest that exposure to outdoor and indoor pollutions are involved in the development and exacerbations of asthma [9-10].

According to the GINA guidelines, asthma remains based on a clinical diagnosis of a variable airflow obstruction. The reversible airway obstruction on spirometry after bronchodilator is pathognomonic of asthma without being an exclusive feature of this disease [3]. Thus asthma remains a part of a wider spectrum of bronchial reversible obstruction called hyperresponsive airway (HRA) disease [3]. Correct and timely diagnosis of asthma and HRA is important because it can be treated successfully with new medications and affected individuals are being able to achieve good control of their disease [2]. The current trend in present practice for physician diagnosed asthma is a high index of suspicion based on symptoms and risk factors collected by thorough history and physical exam confirmed in some cases by reversible airway obstruction on spirometry [3].

In Lebanon, previous studies have focused singularly on childhood asthma [11]. Indeed, the risk factors in the schoolchildren asthmatic population have been well established but were not studied in adults [12]. On the other hand, surveys in real life addressed the compliance, adherence and control of treated asthma in school children across Lebanon [13] and in adults and children [14]. They showed a high proportion of altered quality of life despite availability of treatment and a high proportion of non control of their disease [13], leading to absence from school and work in the past year reported by 69% of children and 31% of adults, respectively [14]. Moreover, since obesity – linked to cases of refractory asthma – seems to be an emerging problem in Lebanon but studied only in children [15], and since reports emphasized on the role of outdoor pollution on the respiratory health [16], the purpose of this epidemiological study is to pro-

vide data about the prevalence and correlates of asthma and HRA among Lebanese adults.

METHODS

Study design and population

A cross-sectional study was carried out using a multistage cluster sample all over Lebanon between October 2009 and September 2010, with the objective of evaluating chronic respiratory diseases (asthma, chronic bronchitis, COPD) [17]; in this manuscript, results pertaining to asthma will only be presented. The study was conducted on Lebanese residents aged 40 years and above, with no exclusion criteria. This age range was chosen to better detect the three diseases and their risk factors overall.

Procedure

From the list of circumscriptions in Lebanon [18], we randomly selected one hundred villages or circumscriptions. In every selected circumscription, we contacted a representative of local authorities, such as the municipality or the elected notary (*mukhtar*). After explaining the study objectives and obtaining the authorities' permission, we randomly selected individuals to be interviewed from a provided list of dwelling households (once a household was selected, all its individuals aged 40 years of more were eligible). Thirty selected individuals were then given appointments through the joint effort of the researcher and the local representative to conduct the study.

After an oral informed consent and explanations about the techniques for performing spirometry, subjects had a prebronchodilator spirometry in the presence of a trained technician; the spirometer we used was of the Micro Lab brand (Micro Medical Limited, England); the subject also answered a standardized questionnaire. Later on, a post-bronchodilator spirometry was performed using similar methods after the administration of two puffs of bronchodilator Combivent® (Ipratropium + Albuterol). Spirometry results were taken after insuring a good blowing technique; the best results out of three trials were taken into account. Moreover, the American Thoracic Society questionnaire was used for assessing respiratory symptoms [19] and the Medical Research Council dyspnea scale (MRC) was used to evaluate dyspnea [20].

Questionnaires were translated into Arabic by an independent translator and checked by investigators; a back translation by another translator was done to ensure lack of discrepancy between English and Arabic versions and was pretested in a pilot sample of 20 individuals for finalization of details. Moreover, questions about weight, height and a diagnosed cardiac problem were also asked. In addition to health questions, data were collected concerning sociodemographic characteristics (age, sex, education, marital status, region of dwelling, etc.), and cigarette and waterpipe smoking history (current, previous or never smokers). Cigarette smoking was defined as smoking more than one pack in a lifetime, while current waterpipe smoking was defined as a positive answer to

the question “Do you regularly smoke waterpipe?” and previous waterpipe smoking as a positive answer to the question: “Were you a regular smoker of waterpipe?” Additional methodological details are available in another publication [17].

Asthma definition

The individuals showing a reversible obstruction on spirometry such as an increase in FEV1 of 12% or more and 200 mL or more after a bronchodilator administration were considered as “airway hyperreactivity”; and those with “physician diagnosed asthma” with or without reversibility on spirometry as confirmed “asthma.” [3]. The sum of both was considered as HRA.

Sample size calculation

Results from other studies in the world showed a prevalence of clinical asthma varying between 1 and 30% [21]; choosing the value of 10% (close to values in the Middle Eastern region), as the worst acceptable result of $\pm 2\%$ difference with the abovementioned prevalence and a 95% confidence interval, a minimal simple random sample size of $n = 865$ was required to measure the prevalence of asthma in Lebanon adults. The study design factor was then taken into account by multiplying the sample size by 2, since multistage cluster sampling usually widens the confidence interval: a minimal sample size of 1730 individuals was thus selected to allow for narrowing back the confidence interval. Among 3000 individuals who were approached, a total of 2201 individuals (73.4%) agreed to participate to the study.

Statistical analysis

SPSS version 17.0 was used to enter and analyze data. Weighting was performed according to the numbers published by the Lebanese Ministry of Social affairs and the Central Administration of Statistics in 2007, taking into account gender, age and dwelling region [22]. Cluster effect was taken into account for confidence interval calculation, according to Rumeau-Rouquette and collaborators [23].

A p -value of 0.05 was considered significant. The Chi² test was used for cross tabulation of qualitative variables in bivariate analysis, and prevalence ratios (PR) were calculated. Somers’ d test was used to evaluate trends between ordinal variables.

A backward stepwise likelihood ratio logistic regression was performed for multivariate analysis, with probable asthma as the dependent variable. Socio-demographic characteristics (region, gender, age class, education, work status, and marital status) and other potential risk factors of asthma such as living actually close to a road full of cars, ever living close to a road full of cars, ever living close to a local power plant, occupational exposure to toxic gases and fumes, heating home procedures (gas, wood, diesel, electricity, centrally and by hot air), low birth weight, chronic lung problem during childhood, mother and father smoking during pregnancy and childhood, active and passive smoking at home and at work were considered as dependent variables. A backward dependent stepwise likelihood ratio method was used to reach the final parsimonious model, removing variables

that were the least significantly associated with the dependent variable first. After ensuring the final retained model adequacy by Hosmer-Lemeshow test of adequacy to data, adjusted odds ratios (ORa) were calculated.

Similarly, a logistic regression was also carried out taking bronchial hyperreactivity as a dependent variable. The same independent variables and automatic stepwise backward procedure were also used to reach the final model.

TABLE I
SOCIO-DEMOGRAPHIC CHARACTERISTICS
OF THE STUDY POPULATION

CHARACTERISTIC	No HRA* n = 1983 (90.1%)	HRA n = 218 (9.9%)	Total n = 2201 (100%)	p value
REGION				< 0.001
Beirut	95.3%	4.7%	361	
Mount Lebanon	93.5%	6.5%	882	
North Lebanon	84.5%	15.5%	407	
South Lebanon	84.9%	15.1%	299	
Bekaa plain	85.4%	14.6%	407	
GENDER				0.003
Male	92.0%	8.0%	1066	
Female	88.3%	11.7%	1134	
AGE CLASS				0.128
40-44 years	92.9%	7.1%	422	
45-49 years	92.1%	7.9%	343	
50-54 years	87.9%	12.1%	315	
55-59 years	89.4%	10.6%	293	
60-64 years	89.4%	10.6%	274	
≥ 65 years	88.6%	11.4%	554	
EDUCATION				< 0.001
Illiterate	80.8%	19.2%	146	
Primary cycle	84.7%	15.3%	430	
Complementary cycle	89.2%	10.8%	463	
Secondary cycle	92.3%	7.7%	574	
University degree	95.1%	4.9%	566	
WORK STATUS				0.047
Currently working	91.7%	8.3%	1127	
Retired	90.0%	10.0%	320	
Not finding a job	84.6%	15.4%	26	
Never worked	87.9%	12.1%	726	
MARITAL STATUS				0.060
Married	90.8%	9.2%	1786	
Single	88.7%	11.3%	213	
Widowed or divorced	85.5%	14.5%	179	
CARDIAC PROBLEM				0.328
No	90.4%	9.6%	1828	
Yes	88.7%	11.3%	372	
OBESITY				0.266
No	90.3%	9.7%	1693	
Yes	88.4%	11.6%	389	

* **HRA** : Hyperreactive airway disease, being the sum of asthmatic patients and those with bronchial hyperreactivity. Individuals showing a reversible obstruction on spirometry (an increase in FEV1 of 12% or more and 200 mL or more after a bronchodilator administration) were considered with “bronchial hyperreactivity”; individuals with “physician diagnosed asthma” with or without reversibility on spirometry were considered with “asthma”.

RESULTS

Socio-demographic characteristics

Out of 2201 individuals, 117 (5.3%; 95% CI [4.4%; 6.2%]) had a reversible obstruction on spirometry. Added to them, 101 individuals (4.6%; 95% CI [3.7%; 5.5%]) declared they had asthma previously diagnosed by a physician. Thus, a total of 218 individuals (9.9%; 95%CI [8.7%; 11.1%]) were considered to have "HRA".

In table I, we present the sociodemographic characteristics of HRA individuals, compared with the rest of the population sample: HRA has a lower prevalence in Beirut and Mount Lebanon versus other regions; the majority of clusters were homogeneous with variances below 0.1, and five clusters had variances higher than the total variances for both asthma and HRA.

HRA has a decreasing prevalence with increasing education level ($p < 0.001$). Moreover, the mean age in the sample was 56.22 (SD: 11.74; Median: 55); age ranged from 40 to 93 years.

Respiratory symptoms and allergies in asthmatic individuals

In individuals with physician diagnosed asthma, chronic respiratory symptoms were reported as follows: 38.3% of chronic cough, 43% of chronic sputum production, 51.4% of wheezing, 32.6% of wheezing with cold episodes. In 45.6% of cases, the cold turns into a lung problem. Moreover, 48.1% have a chronic allergy: 7.7% dermatologic, 26.8% allergic rhinitis, and 23.3% lung symptoms. Twenty-nine percent declared that there were specific periods of the year where their allergic symptoms exacerbated, mainly upon seasonal change (spring and autumn). On the other hand, 18% of these individuals declared having been absent from work due to respiratory problems in the pre-

vious three years, 18.3% declared having been emergently hospitalized at least once due to respiratory problems, 25.5% visited their doctor at least once for respiratory problems, and 14.3% were hospitalized this year at least once for respiratory problems.

Asthma risk factors distribution

In table II, we found that living in a polluted environment (whether at home or at work), having a family history of chronic respiratory disease, being of low birth weight, having had a chronic lung problem during childhood were all associated with higher risk of hyperactivity and asthma.

As for active and passive smoking history, having at least one smoker at work was the only factor associated with a higher risk of both reversibility and probable asthma (Table III).

Multivariate analyses

Using the backward stepwise likelihood ratio logistic regression procedure, the following factors were associated with asthma in the Lebanese population (Table IV): *female gender* (ORa: 1.81 [1.28; 2.55]; $p = 0.001$), *lower education* (ORa: 1.20 [1.06; 1.37]; $p = 0.006$), *region* (North [ORa: 3.54] & Bekaa plain [ORa: 2.44] versus others; $p < 0.001$), *heating home with wood* (ORa: 1.75 [1.24; 2.45]; $p = 0.001$), having a *family history of chronic respiratory disease* (ORa: 2.19 [1.54; 3.12]; $p < 0.001$), having a *history of childhood lung problem* (ORa: 5.53 [2.78; 11.00]; $p < 0.001$), *father smoking during childhood* (ORa: 1.47 [1.05; 2.06]; $p = 0.024$), and being *occupationally exposed to toxic gases and fumes* (ORa: 2.08 [1.46; 2.95]; $p < 0.001$).

For bronchial hyperreactivity, the following factors were retained: *female gender* (ORa: 2.02 [1.29; 3.16];

TABLE II
RISK FACTORS FOR HYPERREACTIVE AIRWAYS AND ASTHMA DISTRIBUTION

POTENTIAL RISK FACTORS	Total n = 2201 (100%)	Bronchial hyperreactivity ¹	Asthma ²
Lives actually close to a road full of cars	892 (40.5%)	0.393 ; 0.85 [0.58; 1.24]	0.690 ; 0.94 [0.71; 1.26]
Ever lived close to a road full of cars	1098 (49.9%)	0.944 ; 0.99 [0.68; 1.43]	0.544 ; 1.09 [0.82; 1.44]
Ever lived close to a power plant	675 (30.7%)	0.983 ; 1.00 [0.67; 1.50]	0.744 ; 1.05 [0.78; 1.42]
Occupational exposure to toxic gases and fumes	615 (28.0%)	< 0.001 ; 1.96 [1.34; 2.87]	< 0.001 ; 2.17 [1.63; 2.89]
Heats home by gas	721 (32.8%)	0.103 ; 0.70 [0.46; 1.08]	0.004 ; 0.63 [0.46; 0.87]
Heats home with wood	524 (23.8%)	< 0.001 ; 2.17 [1.48; 3.19]	< 0.001 ; 2.68 [2.01; 3.57]
Heats home by diesel	602 (27.4%)	0.401 ; 1.19 [0.79; 1.78]	0.022 ; 1.42 [1.05; 1.91]
Heats home electrically	801 (36.4%)	0.022 ; 0.62 [0.40; 0.94]	0.001 ; 0.57 [0.42; 0.79]
Heats home by hot air	194 (8.8%)	0.917 ; 0.97 [0.50; 1.88]	0.280 ; 0.74 [0.43; 1.28]
Heats home by central heating	325 (14.8%)	0.013 ; 0.41 [0.20; 0.85]	< 0.001 ; 0.34 [0.19; 0.61]
Family history of respiratory disease	448 (20.4%)	0.016 ; 1.65 [1.09; 2.50]	< 0.001 ; 1.87 [1.37; 2.54]
Low birth weight	61 (2.8%)	0.004 ; 2.95 [1.25; 6.66]	0.130 ; 1.74 [0.78; 3.73]
Chronic lung problem during childhood	50 (2.3%)	0.431 ; 1.51 [0.45; 4.49]	< 0.001 ; 5.55 [2.93; 10.45]

¹Individuals showing a reversible obstruction on spirometry (an increase in FEV1 of 12% or more and 200 mL or more after a bronchodilator administration) were considered with "bronchial hyperreactivity".

²Individuals with "physician diagnosed asthma" with or without reversibility on spirometry were considered with "asthma".

$p = 0.002$), Northern Lebanon versus others (ORa: 2.69 [1.24; 5.82]; $p = 0.012$), higher age class (ORa: 1.28 [1.14; 1.44]; $p < 0.001$), heating house with wood (ORa: 1.72 [1.12; 2.64]; $p = 0.013$), family history of lung disease (ORa: 2.03 [1.30; 3.18]; $p = 0.002$), low birth weight (ORa: 3.14 [1.32; 7.48]; $p = 0.010$), and being occupationally exposed to toxic gases and fumes (ORa: 2.12 [1.34; 3.34]; $p < 0.001$) (Table IV). Other potential risk factors were not retained in the final model.

DISCUSSION

This cross-sectional study found a considerable prevalence of asthma and HRA in the Lebanese population. While performed among adults, this study finds almost the same prevalence of asthma as reported in Lebanese children [11]. This finding is pertinent to asthma which starts mainly in childhood and results from host and environmental factors interdependence with no known impact till now of any measure or treatment that could change the natural history of the disease [2-4].

In individuals with physician diagnosed asthma, the most frequently reported symptom was wheezing and this is also in alignment of the disease where the wheezing is a typical feature of asthma [2-4]. Interestingly enough in almost half of the cases, it is reported that the cold turns into a lung problem and this is again a feature of hyperreactive airway disease [2-3]. Moreover, an atopy was found in almost half of the cases of asthma in our population with typical seasonal (spring and autumn) exacerbations: allergic rhinitis was the most reported association with asthma in our population and this is known as upper and lower airways are commonly the target – concomitantly in some cases – of the same immunologic inflammation [3]. On the other hand, individuals declared having been absent from work due to respiratory problems, hospitalized for respiratory problems, in a

TABLE IV
LOGISTIC REGRESSIONS FOR ASTHMA
AND BRONCHIAL HYPERREACTIVITY PREDICTORS

PREDICTORS	ORa	[95% CI]	p-value
DEPENDENT VARIABLE • Asthma¹			
Female gender	1.81	1.28; 2.55	0.001
Lower education level	1.20	1.06; 1.37	0.006
North Lebanon vs other regions ²	3.54	2.11; 5.64	< 0.001
Bekaa plain vs other regions ²	2.44	1.26; 4.21	< 0.001
Heating home by burning wood	1.75	1.24; 2.45	0.001
Family history of chronic respiratory disease	2.19	1.54; 3.12	< 0.001
History of childhood lung problem	5.53	2.78; 11.00	< 0.001
Father smoking during childhood	1.47	1.05; 2.06	0.024
Occupational exposure to toxic gases and fumes	2.08	1.46; 2.95	< 0.001
DEPENDENT VARIABLE • Bronchial Hyperreactivity³			
Female gender	2.02	1.29; 3.16	0.002
North Lebanon vs other regions ²	2.69	1.24; 5.82	0.012
Higher age class	1.28	1.14; 1.44	< 0.001
Heating home by burning wood	1.72	1.12; 2.64	0.013
Family history of lung disease	2.03	1.30; 3.18	0.002
Low birth weight	3.14	1.32; 7.48	0.010
Occupational exposure to toxic gases and fumes	2.012	1.34; 3.34	< 0.001

¹ Individuals with "physician diagnosed asthma" with or without reversibility on spirometry were considered with "asthma".

² Other regions include: Beirut, Mount Lebanon and South Lebanon.

³ Individuals showing a reversible obstruction on spirometry (an increase in FEV1 of 12% or more and 200 mL or more after a bronchodilator administration) were considered with "bronchial hyperreactivity".

TABLE III
PASSIVE AND ACTIVE SMOKING HISTORY

POTENTIAL RISK FACTORS	Total n = 2201 (100%)	Bronchial hyperreactivity ¹	Asthma ²
Mother smoked during pregnancy	301 (13.7%)	0.305 ; 0.73 [0.37; 1.38]	0.020 ; 0.56 [0.33; 0.94]
Father smoked during pregnancy	1197 (54.4%)	0.374 ; 0.84 [0.55; 1.26]	0.619 ; 1.08 [0.79; 1.47]
Mother smoked during childhood	375 (17.0%)	0.233 ; 0.71 [0.39; 1.28]	0.025 ; 0.61 [0.39; 0.96]
Father smoked during childhood	1280 (58.2%)	0.344 ; 0.83 [0.55; 1.24]	0.414 ; 1.13 [0.83; 1.54]
Actual cigarette smoker	822 (37.3%)	0.596 ; 0.90 [0.61; 1.33]	0.127 ; 0.79 [0.59; 1.07]
Actual waterpipe smoker	224 (10.2%)	0.235 ; 0.64 [0.31; 1.34]	0.009 ; 0.44 [0.24; 0.83]
Previous cigarette smoker	528 (24.0%)	0.169 ; 1.34 [0.88; 2.02]	0.010 ; 1.49 [1.10; 2.02]
Previous waterpipe smoker	147 (6.7%)	0.152 ; 0.49 [0.18; 1.33]	0.192 ; 0.65 [0.34; 1.25]
At least one smoker in the family	1219 (55.4%)	0.475 ; 1.15 [0.79; 1.68]	0.080 ; 1.29 [0.97; 1.72]
At least one smoker at work	427 (19.4%)	0.003 ; 1.84 [1.22; 2.78]	0.035 ; 1.42 [1.02; 1.97]

¹ Individuals showing a reversible obstruction on spirometry (an increase in FEV1 of 12% or more and 200 mL or more after a bronchodilator administration) were considered with "bronchial hyperreactivity".

² Individuals with "physician diagnosed asthma" with or without reversibility on spirometry were considered with "asthma".

percentage that reflects the impact of asthma on quality of life with a burden on economy and health care resources [2-3, 13-14].

Our study also replicated many results found through research done previously on different populations: asthma is more prevalent with decreasing education level [24], older age [24] and female gender in developing countries [25-26]. This reflects the impact of poverty and low socioeconomic status on chronic diseases because of lower screening for disease, lower accessibility to treatment and to doctors and lower capacity to cope with the sustained treatments [13, 24-25]. Many other factors seemed to affect current asthma status, such as having a family history of chronic respiratory disease, low birth weight and chronic lung problems during childhood [7, 24]. This, apart from being a reflection of the asthma pattern evolution, also reflects the host genetic predisposition to develop asthma.

In addition, methods by which people heated their homes were found to affect asthma and HRA status. Heating home with wood increased the odds of asthma, similar to what is found in other studies [10]. Moreover, father smoking during childhood was associated with asthma, similar to what is found in other studies too [26-27]. This is again an important finding that consolidates the message about the deleterious effect of passive smoking on asthma [1-4], knowing indeed that tobacco smoke is classified as a major irritant in asthma and not a causal agent like for COPD [1-4, 28]. However, personal cigarette or waterpipe smoking were not associated with asthma or reversible obstruction; this may go in parallel with the fact that asthmatics smoke less frequently, and smoking asthmatics either cut down or stop smoking [26].

We also found correlates unique to the Lebanese population; asthma and HRA disease had a higher prevalence in the Northern and Bekaa regions compared to other regions. This is similar to what was found in previous studies performed by our team on children [29] and adults [30]; the involved regions are mainly agricultural, with extensive use of pesticides and exposure to other environmental toxicants related to rural life, which may increase the risk of asthma as shown in other studies [31-32]. Northern and Bekaa regions also include rural areas of frequent status of poverty which may further explain the higher level of asthma versus other regions, since lower socioeconomic status is associated with higher prevalence of asthma [8, 33]. However, since we relied on a cluster sampling method, it is likely that differences in prevalence rates across regions may also reflect cluster sampling variance, particularly since clusters tends to be homogeneous, with high inter-cluster difference in prevalence rates; this remains to be further studied in specifically designed studies.

Furthermore, occupational exposure to toxic gases and fumes was reported as significant risk factors for asthma; this illustrates the classical relationship between some occupations and asthma development in adults [34]. On another hand, although living close to a motorway with

busy traffic causes deleterious effects on chronic respiratory symptoms as well as sensitization to outdoor allergens [9], and although outdoor pollution was shown to cause chronic respiratory symptoms as well as increase inflammation in exposed individuals [15], our current study did not specifically find a significant association between outdoor pollution and asthma. This may be due to the low number of asthmatics in our cross-sectional study, which may have underpowered our analysis; the pollution indicators may not have been accurate enough to determine actual exposure to pollution during daily activities. Further studies that take these weak points into account are necessary to evaluate this issue.

We are aware that our study may be subject to several biases: a selection bias is possible due to the nature of the selected sample. Although we used weighting procedures to make the sample as representative as possible of the general population in Lebanon, there is still a possibility of a selection bias, because we had no means to evaluate the reasons of refusal; they could lead us to overestimate or underestimate the asthma prevalence. We estimate refusals to be linked to non motivation, illiteracy, or maybe due to chronic diseases that individuals did not want to disclose (cancer or other diseases). However, the low refusal rate we had makes this issue of minor importance. There is also a possibility of an information bias in this study: as in all studies involving questionnaires, relying on individuals reporting for several variables may include a recall bias (for childhood exposures) or subjectivity bias (for symptoms reporting, diagnosed asthma declaration and other reported information in the questionnaire); retrospective collection of information might thus be subject to ascertainment biases. Moreover, the portable spirometer we used may not be as sensitive and specific as the ones that are used in hospitals, which may introduce a classification bias. It would also be important to measure indoor and outdoor pollution which may better assess its association with asthma evaluation in future predictive models. Nevertheless, the methods we used are the ones that are used nowadays all over the world for this kind of studies; in the future, improved methods may help to fine tune the results we attained, but we believe that changes will not be of major importance.

CONCLUSION

This is the first epidemiological study in Lebanon that determined asthma prevalence and HRA and associated factors among Lebanese adults. It provides useful contributions that local health organizations may use for national programming and a foundation for health researchers to pursue further studies on asthma. Public awareness about the increased risk of asthma associated with heating homes with wood and exposure to passive smoking should be raised; Lebanese policy makers should also generate higher efforts to implement and reinforce the smoking ban law in public places.

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