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ORIGINAL RESEARCH

Correlates of COPD and chronic bronchitis in nonsmokers: data from a cross-sectional study

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Purpose: Our objective was to assess the prevalence of chronic bronchitis and chronic obstructive pulmonary disease (COPD) and their correlates among a Lebanese nonsmoker group.

Material and methods: A cross-sectional study was conducted between October 2009 and September 2010, using a multistage cluster sample throughout Lebanon including Lebanese residents aged 40 years and above with no exclusion criteria. Pre- and postbronchodilator spirometry measurements were performed and carbon monoxide level was measured in exhaled air. COPD was defined and classified according to the Global Initiative for Chronic Obstructive Lung Disease guidelines or according to the lower limit of normal (forced expiratory volume in 1 second/forced vital capacity postbronchodilator < 5th percentile of the healthy population having the same age and sex). Chronic bronchitis was defined by the declaration of morning cough and expectorations for more than 3 months a year over more than 2 years in individuals with normal spirometry.

Results: Out of 2201 individuals, 732 were never-smokers: 25 (3.4%) of them had COPD, and 86 (11.75%) fulfilled the definition of chronic bronchitis. Correlates of COPD included a childhood respiratory disease, house heated by diesel, and older age. On the other hand, correlates of chronic bronchitis included childhood respiratory diseases, living in southern Lebanon versus other regions, heating home by gas, older age, number of smokers at work, and lower height.

Conclusion: A substantial percentage of the nonsmoking population may exhibit chronic bronchitis or COPD. The significant correlates mentioned above should be taken into consideration in order to reduce the risk of developing such chronic and debilitating respiratory diseases.

Keywords: never-smokers, chronic bronchitis, COPD, passive smoking

Introduction

By 2020, chronic obstructive pulmonary disease (COPD) is expected to rank third in terms of global burden of disease (GBD).[1] The rise of the number of smokers around the world and the development of diagnostic tools has allowed COPD to be more frequently diagnosed within smokers nowadays.[2] Chronic bronchitis is one COPD phenotype of many[2–4] as well as a predictor of the disease's severity[3,5] and can also be a precursor of COPD.[3,5] Smoking remains the strongest risk factor for COPD and chronic bronchitis, but this does not preclude that both diseases can be found in nonsmokers as well.[2] Though few studies among nonsmokers have been conducted regarding the prevalence of chronic bronchitis and COPD and their predictors all over the world,[6–10] the need to profile such a nonsmoker population for the risk of COPD and chronic bronchitis has become a matter of increasing interest.[9] However, the debate is still

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ongoing concerning the predictors. Aging, childhood respiratory diseases, and asthma are definitely the most established risk factors,[9–11] but the controversy on the role of passive smoking[7,9–12] and other occupational exposures,[7,13–16] as well as diet[17] and sex, is not yet resolved.[9,14,16,18]

On the other hand, to our knowledge, no such study has been conducted in the Middle East, particularly in Lebanon, where there are numerous toxic exposure specificities for nonsmokers: despite the ban of smoking in public places in 2011,[19] there is no reinforcement of the law in Lebanon, leading to many nonsmoking individuals exposed to passive smoking, from both cigarettes and, specifically, trendy water pipes.[20] Not to mention that Lebanese individuals who are smokers and heavy users of wood and diesel for heating and cooking are responsible for indoor pollution at home, especially in remote rural areas known for agricultural activities. Furthermore, Lebanese are massively exposed to private local power plants' diesel exhausts, due to frequent ruptures of the public electrical supply as a consequence of wars and recurrent disturbances in the country.[21] These environmental exposures in Lebanon seem to be linked to higher rates of respiratory diseases.[22,23]

The objective of our study was to assess the prevalence of chronic bronchitis and COPD among nonsmoking adult Lebanese individuals and evaluate their correlates.

Methods

Study design

Data for this analysis were taken from a cross-sectional study carried out between October 2009 and September 2010, using a multistage cluster nationally representative sample all over Lebanon. Lebanese residents aged 40 years and above were enrolled in the study, with no exclusion criteria. The total of males in this specific population was 614,564, while the total of females was 653,751.[24]

The Institutional Review Board (IRB) of the Lebanese University stated that an approval was not necessary in this case, since the study was an observational one (neither interventional nor clinical). No approval number was allocated for this statement.

Population and procedure

From the list of communities in Lebanon (includes a total of 2782 villages, towns and cities),[25] 100 communities were randomly selected with randomization performed on computerized software. Afterwards, through a representative of local authorities, individuals were randomly chosen to be interviewed, from a provided list of dwelling households aged 40 years and above. All individuals of the household were solicited, if they were eligible.

After an oral informed consent, subjects underwent a baseline spirometry (Micro Lab; Micro Medical Ltd, Rochester, UK), conducted by a previously trained technician. Calibration of the spirometer was performed at the beginning of every session. After the baseline spirometry measurement, the subjects answered a standardized questionnaire, including sections about sociodemographic characteristics and respiratory diseases and symptoms, and a thorough smoking history evaluation. Thirty minutes after the inhalation of two puffs of combined ipratropium bromide (18 µg/actuation) and albuterol sulfate (103 µg/actuation) (Combivent®; Boehringer, Ingelheim, Germany) in a pressurized metered-dose aerosol unit, a post-bronchodilator spirometry was performed. Only the best result out of three trials was taken into account. Overall, each individual participated in the study for a mean duration of 60 minutes.

Questionnaire development

The questionnaire of the American Thoracic Society (ATS) was used for evaluation of chronic pulmonary diseases;[26] this questionnaire included questions about all respiratory symptoms that constitute features of COPD, such as chronic cough, sputum production, and wheezing. The Medical Research Council (MRC) score was also applied to evaluate dyspnea.[27]

The questionnaires were administered in the local Arabic dialect; the translation process was as follows: first, two of the researchers, both bilingual, translated the questions into Arabic. Instructions about the approach to translation were provided such as in emphasizing conceptual rather than literal translations and in using familiar and easy language to target the broadest audience. Second, discrepancies were resolved by consensus between those researchers and two others: this panel thus included the original translators and experts in health, as well as experts who had experience in instrument development and translation. Third, an independent translator with no knowledge of the questionnaire translated the questions back into English. Again, translation divergences were resolved by consensus between the researchers and the translator. Fourth, the questionnaire was pilot-tested on 20 individuals; all questions were deemed clear by these individuals, and no further changes were made to these questions.

Definitions of variables

COPD was firstly defined as an forced expiratory volume in 1 second (FEV_1)/forced vital capacity (FVC) lower than 70%

according to Global Initiative for Chronic Obstructive Lung Disease (GOLD) guidelines,[2] and secondly according to the lower limit of normal (FEV_1/FVC postbronchodilator < 5th percentile of the healthy population having the same age and sex of the individual;[28,29] in the latter case, the used equation was: $FEV_1/FVC = -0.003 \times age + 0.923$; $R^2 = 0.81$).[30] Individuals were eventually classified as having COPD if they fulfilled one of the definitions described above. Spirometric quality was checked, and FEV_6/FVC was ≤100% in more than 99.2% of measurements.

Chronic bronchitis was defined by the declaration of morning cough and expectorations for more than 3 months a year over more than 2 years in individuals with no COPD.[2] Moreover, an individual was considered "healthy" if he had not declared respiratory symptoms or diseases, and had a normal spirometry. On the other hand, carbon monoxide level was measured in exhaled air, using a portable carboxymeter; values in ppm were reported.

The following variables were also used: level of education, divided into "Never been to school," "Primary school or less," "Complementary school or less," "Secondary school or less," and "University degree"; and age categories being 40–44 years, 45–49 years, 50–54 years, 55–59 years, 60–64 years, and 65 years and more. Further methodology details are presented in another publication.[22]

Sample size calculation

A minimal simple random sample size of n = 1015 was required to measure the prevalence of COPD in Lebanon, in the adult population aged 40 years and above, knowing that other studies in the world showed a variation of COPD prevalence around 9%–12%,[31,32] and taking a least acceptable result of ±2% difference with the above-mentioned prevalence and a 95% confidence interval. To further take into account the multistage sampling design, a minimal sample size of 2030 individuals was thus necessary. We decided to target 3000 individuals if the response rate was to be at least 67%.[22]

Statistical analysis

SPSS software (version 17.0; IBM, Armonk, NY) was used to enter and analyze data. Weighting was performed according to the numbers published by the Lebanese Central Administration of Statistics in 2007, considering sex, age, and dwelling region.[25] Cluster effect was also taken into account, according to Rumeau-Rouquette and collaborators.[33]

A *P*-value of 0.05 was considered significant. Student's *t*-test was used to compare between means of continuous variables, after checking distribution normality and homoscedasticity. Chi-square test was used for cross-tabulation of qualitative variables in bivariate analysis, and odds ratios (OR) were calculated. Trend tests were used for dichotomous variables cross-tabulation along with ordinal variables.

Forward stepwise (likelihood ratio) logistic regressions were performed for multivariable analyses, with COPD and chronic bronchitis as the dependent variables, the healthy individuals as the comparison group, and sociodemographic characteristics and other exposures as the independent variables; no threshold was used for initially introducing variables in this procedure. Forward stepwise (likelihood ratio) automatic selection served to keep significant variables in the model ($P < 0.05$) and establish the final model. After ensuring model adequacy to the data by Hosmer–Lemeshow test, the final model was reported with adjusted odds ratios (ORa), their confidence intervals, and *P*-values.

Results

Sample description

Out of 3000 selected individuals, 2201 (73.4%) participated in the study. Among 2201 individuals, 732 were never-smokers (33.3%; 95% confidence interval [CI]: 31.3%–35.3%). The latter group members (n = 732) were classified into 478 (65.3%; 95% CI: 63.3%–67.3%) healthy individuals, 25 (3.4%; 95% CI: 2.1%–4.5%) with COPD, and 229 (31.3%; 95% CI: 27.9%–34.7%) with other respiratory problems. Among these 229 individuals, 86 fulfilled the definition of chronic bronchitis without COPD, making a total of 11.8% of never-smokers (95% CI: 9.5%–14.1%); the rest were individuals with asthma (n = 77; 10.5% with 95% CI: 8.3%–12.7%) and miscellaneous chronic respiratory symptoms (n = 66; 9.0% with a 95% CI: 6.9%–11.1%).

Sociodemographic characteristics

In Table 1, we present the sociodemographic characteristics of individuals with COPD and chronic bronchitis compared with healthy individuals. There were significantly higher percentages of COPD in southern Lebanon (12.5%) and Beirut (8%) versus other regions (2.3% to 3.5%; $P = 0.030$), and there were significantly lower percentages of chronic bronchitis in Beirut (6%) and Mount Lebanon (7%) versus other regions (12.7% to 28.3%; $P < 0.001$). There was also increased prevalence of COPD and chronic bronchitis with higher age classes of 5-year increments ($P < 0.001$ for both of the trend tests). Moreover, there was a trend toward a higher prevalence of COPD in widowed and divorced individuals versus married (10% versus 4.9%; $P = 0.076$), similar to a

Table 1 Frequency (%) of chronic respiratory diseases in never-smokers by sociodemographic characteristics

Characteristic	Total N = 732 (100%)	COPD N = 25 (3.4%)	*P*-value	Chronic bronchitis N = 86 (11.8%)	*P*-value
Region			0.030		<0.001
Beirut	89	8.0%		6.0%	
Mount Lebanon	308	2.8%		7.0%	
North Lebanon	149	3.5%		15.1%	
South Lebanon	105	12.5%		28.3%	
Bekaa Plain	81	2.3%		12.7%	
Sex			0.178		0.184
Male	248	3.3%		9.9%	
Female	482	6.0%		13.4%	
Age			<0.001*		<0.001*
40–44 years	160	1.5%		5.1%	
45–49 years	130	2.9%		2.4%	
50–54 years	101	5.5%		13.4%	
55–59 years	90	6.7%		11.5%	
60–64 years	78	15.4%		14.1%	
65 years and more	173	2.9%		24.9%	
Marital status			0.076		0.001
Married	570	4.9%		10.0%	
Single	75	0		17.3%	
Widow/divorced	80	10%		23.7%	
Education			0.141		<0.001
Never been to school	77	6.3%		30.7%	
Primary or less	132	8.2%		17.5%	
Complementary or less	140	3.5%		11.8%	
Secondary or less	150	7.6%		9.2%	
University degree	226	2.6%		5.4%	
Work status			0.373		0.001
Currently working	378	3.7%		7.6%	
Retired	81	5.7%		14.1%	
Not finding a job	5	0		20.0%	
Does never work	266	6.8%		17.6%	
Height in cm M (SD)**	732	161.86 (9.02)	0.030	160.51 (10.43)	<0.001

Notes: *Trend tests were used; **student's *t*-test was used to compare between healthy and unhealthy individuals. In healthy individuals, M = 165.94 and SD = 8.84.
Abbreviations: COPD, chronic obstructive pulmonary disease; M, mean; SD, standard deviation.

higher prevalence in single and widowed/divorced versus married individuals for chronic bronchitis (23.7% versus 10%; $P = 0.001$). Besides, individuals currently working had a lower prevalence of COPD (3.7%) and chronic bronchitis (7.6%) versus others (14.1% to 20%; $P = 0.001$). Healthy individuals also had a significantly higher height compared to those with COPD ($P = 0.030$) and those with chronic bronchitis ($P < 0.001$).

Passive smoking and concomitant diseases history

Individuals with cardiac disease and a low birth weight had a significantly higher prevalence of chronic bronchitis (19% and 18.8%, respectively), while those with a history of a chronic lung disease and pneumonia during childhood had a significantly higher prevalence of COPD (57.1% and 33.3%, respectively) and of chronic bronchitis (46.7% and 29.4%, respectively). Factors relative to previous exposure to passive smoking did not show substantial associations with COPD and chronic bronchitis (Table 2).

Environmental toxic exposure

Individuals heating their houses by gas or wood had a considerable higher prevalence of chronic bronchitis (18.1% and 17.2%), compared to those heating houses electrically (8.4%). For COPD, differences did not reach statistical significance ($P > 0.05$ for all exposures) (Table 3). Moreover, carbon monoxide measurement was found to be higher in COPD individuals versus healthy and chronic bronchitis; however, the difference did not reach statistical significance (Table 3).

Multivariable analysis

In Table 4, we report the correlates of COPD and chronic bronchitis by logistic regressions, compared to healthy individuals.

Table 2 Frequency (%) of chronic respiratory diseases in never-smokers in relation to passive smoking and concomitant disease history

Characteristic	Total N = 732 (100%)	COPD N = 25 (3.4%)	*P*-value	Chronic bronchitis N = 86 (11.8%)	*P*-value
At least one smoker in the family			0.600		0.540
No	448	4.6%		11.5%	
Yes	284	5.6%		13.1%	
At least one smoker at work			1.000		0.892
No	653	4.9%		12.2%	
Yes	79	3.7%		11.7%	
Cardiac problem			0.185		0.019
No	622	4.3%		10.9%	
Yes	110	8.5%		19.0%	
Low birth weight			0.262		0.002
No	639	4.4%		10.5%	
Yes	17	10%		18.8%	
Unknown*	76	8.1%		24.7%	
Childhood chronic lung problem			<0.001		<0.001
No	670	4.2%		10.6%	
Yes	19	57.1%		46.7%	
Unknown*	43	0%		23.3%	
Pneumonia during childhood			<0.001		0.002
No	653	4.1%		10.7%	
Yes	20	33.3%		29.4%	
Unknown*	60	8.6%		22.8%	
Mother smoked during pregnancy			0.330		0.743
No	617	3.2%		11.5%	
Yes	78	5.0%		10.5%	
Unknown*	38	5.6%		25.0%	
Father smoked during pregnancy			0.105		0.987
No	352	3.8%		12.0%	
Yes	328	6.3%		11.8%	
Unknown*	51	3.6%		16.0%	
Mother smoked during childhood			0.913		0.955
No	610	5.0%		11.2%	
Yes	97	5.8%		11.8%	
Unknown*	25	0		34.6%	
Father smoked during childhood			0.327		0.896
No	335	4.3%		11.7%	
Yes	362	5.8%		11.2%	
Unknown*	35	0		23.5%	

Note: *The "does not know" modality was not included in statistical testing.
Abbreviation: COPD, chronic obstructive pulmonary disease.

The retained models had acceptable adequacy to the data and explained some percentages of the total variance (19.2% for COPD and 23.8% for chronic bronchitis).

Significant correlates of COPD included childhood respiratory diseases (ORa = 44.30), heating house by diesel (ORa = 2.96), and older age (ORa = 1.39 per 5-year increment). These factors were associated with higher risk of COPD.

On the other hand, significant correlates of chronic bronchitis included childhood respiratory diseases (ORa = 5.08), living in southern Lebanon versus other regions (ORa = 5.87), heating home by gas (ORa = 1.90), older age (ORa = 1.44 per 5-year increment), number of smokers at work (ORa = 1.11 for every additional smoker) and lower height in cm (ORa = 1.03) are all significantly associated with higher risk of chronic bronchitis (Table 4).

Discussion

In this study, we found a prevalence of 3.4% of COPD and 11.75% of chronic bronchitis in Lebanese nonsmoker residents aged 40 years and above. In addition, we were able to find correlates for these diseases within the same population. This study has several strong points: this is the first epidemiological study to be performed in Lebanon, a developing

Table 3 Frequency (%) of chronic respiratory diseases in never-smokers in relation to toxic exposure

Characteristic	Total N = 732 (100%)	COPD N = 25 (3.4%)	*P*-value	Chronic bronchitis N = 86 (11.8%)	*P*-value
House close to a road full of cars			0.148		0.870
No	453	3.7%		12.0%	
Yes	279	6.5%		12.4%	
Ever lived close to a local power plant			0.637		0.178
No	536	5.1%		13.2%	
Yes	196	4.1%		9.4%	
Heating house by gas			0.241		0.002
No	524	5.4%		9.7%	
Yes	208	2.9%		18.1%	
Heating house by wood			0.133		0.018
No	550	4.0%		10.5%	
Yes	182	7.5%		17.2%	
Heating house by diesel			0.151		0.996
No	541	4.0%		12.2%	
Yes	191	7.1%		12.2%	
Heating house electrically			0.241		0.029
No	487	5.9%		14.1%	
Yes	245	3.6%		8.4%	
Heating house by hot air			0.154		0.589
No	669	5.4%		12.0%	
Yes	63	0		14.3%	
Heating house centrally			0.400		0.116
No	634	5.2%		12.9%	
Yes	98	2.5%		7.3%	
Cook on wood			1.000		0.190
No	681	5.1%		11.7%	
Yes	51	3.1%		18.0%	
Carbon monoxide in ppm M (SD)*	732	10.65 (4.48)	0.172	7.25 (4.39)	0.101

Note: *Mean for healthy individuals is 8.51 (SD = 5.40).
Abbreviations: COPD, chronic obstructive pulmonary disease; M, mean; SD, standard deviation.

country in the Middle East. We were also able to explain a significant percentage of the data variability within the retained model of COPD and chronic bronchitis prediction in nonsmokers, although genetic constitution was not taken into account. The disease correlates we found were in line with those of other researchers; added to these, there were some specific exposures of the Lebanese environment that were found to be associated with the diseases.

First, our prevalence results are lower than those of other areas in the world:[14,34] in a study performed in the United States in 2005, a prevalence of 6.6% ± 0.6% of COPD cases among nonsmokers was found.[11] A study conducted in China showed also almost the same prevalence of COPD among nonsmokers as in ours (5.2%),[6] as well as in Switzerland.[9] On the other hand, remarkably, a higher prevalence of COPD in nonsmokers (14%) was found recently in a study in The Netherlands.[35] One explanation for the differences in all the above findings could be the younger demographic structure of the Lebanese population, since developing countries harbor lower rates of elderly individuals, leading to relatively lower rates of aging-associated chronic diseases. In fact, we found also that the prevalence of COPD and chronic bronchitis increased with age, which is a reasonable finding since those two diseases need a cumulative dose of toxic exposures for them to manifest. Similar results were found by other researchers who mentioned the increase of COPD with age among nonsmokers.[6,9,11,13,34] Again, reasonable findings pertaining to low socioeconomic status and higher risk for COPD and chronic bronchitis were aligned to what is reported in the literature.[6,11,13,14] Concerning chronic bronchitis in nonsmokers, our prevalence results are also comparable to other studies.[13]

Although parents' smoking during fetal life and childhood have been shown to be associated with deleterious effect on pulmonary mucosa, thus involving COPD[36,37] causation and increased severity,[36] we were not able to find significant correlations in our population. Previous passive smoking did not reach significance as a predictor for COPD: this could be partially explained by recall bias since the study addressed adults of 40 years and above. Whereas being in

Table 4 Logistic regressions for correlates of COPD and chronic bronchitis versus healthy individuals

Characteristic	ORa	95% CI	*P*-value
Correlates of COPD*			
Childhood respiratory diseases	44.30	8.84–221.96	<0.001
Heating house by diesel	2.96	1.16–7.55	0.023
Higher age class**	1.39	1.08–1.79	0.011
Correlates of chronic bronchitis†			
Height in cm	0.97	0.94–0.99	0.021
Childhood respiratory diseases	5.08	1.52–17.00	0.008
Higher age class**	1.44	1.24–1.68	<0.001
Number of smokers at work	1.11	1.00–1.24	0.050
Southern region versus others	5.87	1.70–20.31	0.005
Heat house by gas	1.90	1.09–3.29	0.023

Notes: *R^2 = 0.192; *P*-value for Hosmer–Lemeshow test = 0.447; **age classes include: 40–44 years; 45–49 years; 50–54 years; 55–59 years; 60–64 years and 65 years and more; †R^2 = 0.238; *P*-value for Hosmer–Lemeshow test = 0.719.
Abbreviations: CI, confidence interval; COPD, chronic obstructive pulmonary disease; OR, odds ratio.

contact with smokers at work was found to be correlated with chronic bronchitis: the higher the number of smokers, the higher the risk of chronic bronchitis. In this case, it is understandable because such a factual phenomenon can be recalled precisely. However, we can find conflicting results in the literature about passive smoking as a risk factor for COPD and chronic bronchitis among nonsmokers. A study performed on Taiwanese secondhand smokers showed that exposed women were 3.65-fold more likely to have chronic bronchitis than those who had not been exposed. In addition, there was a significant increasing trend between the severity of COPD and exposure years of passive smoking ($P < 0.01$).[7] Canadian researchers also demonstrated that never- and exsmokers exposed to secondhand smoke had significantly higher odds of chronic bronchitis (50%) than those not exposed to secondhand smoke.[38] On the other hand, other studies failed to show a clear association between passive smoking and COPD as well as with chronic bronchitis in nonsmokers.[9–11,39]

Childhood respiratory disease history (chronic lung disease or pneumonia) predisposing to a chronic inflammation and remodeling of the respiratory mucosa were also found to be associated with a higher rate of COPD and chronic bronchitis in our study. These findings were also seen in many studies all over the world where higher prevalence of COPD in nonsmokers was associated with chronic cough and respiratory infections during childhood.[7,9,36,38,39] On the other hand, asthma is found to be a predictor of COPD in nonsmokers.[7,9–11,36,38,39] We note that the group showing clinical and functional features of asthma was excluded from our analysis. Despite this exclusion, the correlation was still strong for childhood respiratory diseases and COPD and chronic bronchitis in nonsmokers.

Concerning environmental toxic exposure, heating the house with diesel was correlated with COPD while heating the house with gas was a good correlate for chronic bronchitis. These findings are compatible with results that were previously published by our team,[23] where CO level was significantly increased in the case of COPD and chronic bronchitis on the one hand, while it was significantly associated with environmental factors such as heating the home with the use of diesel, and being exposed to passive smoking on the other.[23] Indeed, in this analysis, carbon monoxide measurement was found to be higher in COPD individuals versus healthy and chronic bronchitis; however, the difference did not reach statistical significance. Moreover, other studies in many countries incriminated wood smoke,[16,40] biomass smoke,[41] occupational exposure to dust, gases, or fumes[42] and solid fuel[43] in the etiology of chronic bronchitis and COPD. In our study, associations with these factors did not reach statistical significance. This may be due to the low number of individuals in some subgroups, which may have decreased the power to detect significant associations.

Living in southern Lebanon versus other regions was a strong correlate for chronic bronchitis. To explain these results, future research is needed. Lower height was significantly associated with higher risk of chronic bronchitis: this could reflect anatomical reasons predisposing to bronchial obstruction,[16] but the correlate was found only for chronic bronchitis, which is hard to explain based on these data exclusively.

We are aware of the possible biases of this study: although we used a random sample, a selection bias is still possible, particularly due to nonresponders. Moreover, an information bias is also possible, due to the use of a portable spirometer and to the recall bias of some variables, particularly for questions about childhood exposure. Thus, the causality of the associations we found was suggested, but not confirmed. Caution should be exerted during the interpretation of multivariable analyses, given the low number of cases of COPD and of chronic bronchitis that were involved, which may have led to unstable models. Thus, studies with higher numbers of individuals will be required to show more stable results and confirm those results obtained in this analysis. Further analytical studies with a higher propensity to prove causality, such as prospective cohort studies, are also suggested to confirm the results we found. Finally, generalizing the results to other populations should also be performed

with caution, given the specificities of the Lebanese genetics and context.

In conclusion, a considerable percentage of the nonsmoker population may exhibit chronic bronchitis or COPD through their life; thus, the need for taking the previous correlates into consideration especially for passive smoking and of communicating them to the general population in order to reduce the incidence and consequences of chronic respiratory diseases.

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Disclosure

The authors report no conflicts of interest in this work.

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