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Original article

COPD IN A SAMPLE OF GENERAL ADULT POPULATION FROM THE SKOPJE REGION

Minov Jordan[1], Stoleski Sasho[1], Stikova Elisaveta[2], Mijakoski Dragan[1], Atanasovska Aneta[1], Bislimovska Karadzinska Jovanka[1]

[1]Institute for Occupational Health of RN Macedonia, Skopje
[2]Institute for Public Health of RN Macedonia, Skopje
Faculty of Medicine, Ss. Cyril and Methodius University in Skopje, Republic of North Macedonia
e-mail: jordan.minov@medf.ukim.edu.mk

Abstract

Introduction. Chronic obstructive pulmonary disease (COPD) is one of the leading causes of morbidity, disability and mortality in the last decades worldwide.

Aim of the study. To determine the COPD prevalence in a sample of general adult population from the Skopje region and its distribution by sex, age, smoking status, working status, family history of chronic bronchitis/asthma, and mode of household heating and cooking.

Methods. A cross-sectional study (prevalence study) including 2,348 participants (1,239 males and 1,109 females, aged 18 to 86 years) from the Skopje region was performed at the Institute for Occupational Health of RN Macedonia, Skopje, in the period 2018-2021. The study protocol included completion of a questionnaire and spirometric measurements (pre- and post-bronchodilator spirometry). COPD was defined by spirometric finding of persistent airflow limitation in symptomatic study subjects.

Results. COPD prevalence in the whole study sample was 4.6%, being non-significantly higher in men (5.1%) than in women (4.1%). Fourfold higher prevalence of COPD was registered in the study subjects aged over 45 years as compared to the younger ones (6.7% *vs.* 1.6%; $P = 0.000$). COPD prevalence was significantly higher in active smokers as compared to non-smoking study subjects (9.4% *vs.* 1.9%; $P = 0.000$). In regard to working status, COPD prevalence among active workers was 3.9%, in the group of retired persons 8.7%, while in the group of students there was not a single subject with COPD. In addition, COPD prevalence in the workers occupationally exposed to noxious particles or gases was significantly higher than in unexposed workers (4.7% *vs.* 2.4%; $P = 0.021$). There was no statistically significant difference in the COPD prevalence between study subjects with positive and negative family history of asthma/chronic bronchitis (4.8% *vs.* 4.5%), as well as between study subjects who used biomass fuels for heating and cooking (6.2%) and those who did not use traditional fuels for household needs (4.0%).

Conclusion. Our findings have indicated the age, active smoking and occupational exposures to noxious particles or gases as the factors significantly related to COPD prevalence in the examined sample of general adult population from the Skopje region.

Keywords: age, family history of chronic bronchitis/asthma, occupational exposures, solid and liquid biomass fuels, prevalence, questionnaire, sex, smoking, spirometry

Introduction

Chronic obstructive pulmonary disease (COPD) remains one of the most important public health problems in the last decades worldwide due to the high levels of morbidity, disability and mortality, as well as to the substantial and increasing economic and social burden. According to the Burden of Obstructive Lung Diseases (BOLD) and other large scale epidemiological studies, the estimated number of COPD cases worldwide in 2010 was 384 million and around three million deaths annually. With increasing prevalence of smoking in low-income countries and aging population in high-income countries, it is expected that the prevalence of the disease should rise in the next period and by 2060 there should be more than 5.4 million deaths annually from COPD. According to the current evidence, COPD results from a complex interaction between genes and the environment. Although cigarette smoking is the most important and the best studied COPD risk factor, there is consistent evidence that non-smokers may also develop persistent and progressive airflow limitation. Factors that influence disease development and progression include genetic factors, age and sex, lung growth and development, exposure to noxious particles or gases, i.e., tobacco smoke, certain occupational exposures, urban air pollution, indoor air pollution emitted by traditional biomass fuels used for heating, cooking and other household needs, socioeconomic status, asthma and bronchial hyperreactivity, chronic bronchitis, and history of previous respiratory infections[1-6].

The aim of the present study was to determine the COPD prevalence in a sample of general adult population from the Skopje region and its distribution by sex, age, smoking status, working status, family history of chronic bronchitis/asthma, and mode of household heating and cooking.

Methods

Study design and setting

A cross-sectional epidemiological study (prevalence study) was carried out at the Institute for Occupational Health of RN Macedonia, Skopje, in the period 2018-2021. The study was performed within the scientific projects of all departments of the Faculty of Medicine, Ss. Cyril and Methodius University in Skopje, based on the Decision of the Faculty Management (29.01.2018). In addition, the Ethics Committee of the Institute for Occupational Health of RN Macedonia, Skopje gave approval for performing the study and publishing the results obtained (0302-236/20.03.2018).

All study subjects were informed about the study and their written consent was obtained.

Study population

The study population included 2,348 “healthy” adults (1,239 males and 1,109 females, aged 18 to 86 years) from the Skopje region recruited during their check-ups for different purposes (preventive check-ups of workers, check-ups for driving license, check-ups for weapon license, check-ups for travelling abroad, etc.) at the Institute for Occupational Health of RN Macedonia, Skopje.

Study protocol

The study was performed following the actual recommendations of European Respiratory Society (ERS) and American Thoracic Society (ATS) for epidemiological studies on COPD[7].

The study protocol included completion of a questionnaire and spirometric measurements.

An interviewer-led questionnaire was based on two standardized questionnaires, i.e., *Population-based screening questionnaire for COPD* and *Symptom-based questionnaire for identifying COPD*, and it consisted of three parts[8,9].

The first part included questions on demographics of the study subjects, personal and family history of chronic bronchitis and asthma, the fuels used for heating, cooking and other household needs, as well as questions on actual or/and previous occupational exposures. Occupational exposures in the working population were assessed also by the Risk assessment report of the company in which they were employed.

The second part included questions on smoking status of the study subjects. The smoking status (active smoker, ex-smoker, and non-smoker) was defined by the World Health Organization (WHO) criteria[10]. Due to the small number of ex-smokers in the study sample (5.8% i.e., 138/2,348), as well as to the heterogeneity in their duration of smoking experience (four months to 23 years), we added the ex-smokers with smoking duration less than five years to the group of non-smokers, while the ex-smokers with longer smoking experience were added to the group of active smokers.

The third part of the questionnaire included questions on respiratory symptoms in the last 12 months (nasal symptoms, cough, phlegm, dyspnea, wheezing and chest tightness). In the subjects with dyspnea, its severity was assessed according to the criteria of Modified British Medical Council (mMRC)[11].

Spirometric measurements included baseline (pre-bronchodilator) spirometry which was performed in all study subjects, and post-bronchodilator spirometry which was performed in subjects with value of the ratio between forced expiratory volume in 1 second (FEV1) and forced vital capacity (FVC) less than 0.70.

The baseline spirometry, including measures of FVC, FEV_1, FEV_1/FVC, and maximal expiratory flow at 75%, 50%, 25%, and 25-75% of FVC (MEF_{75}, MEF_{50}, MEF_{25}, and MEF_{25-75}, respectively), was performed in all subjects using spirometer Ganshorn SanoScope LF8 (Ganshorn Medizin Electronic GmbH, Germany) with recording the best result from three measurements the values of FEV_1 of which were within 5% of each other. The results of spirometry were expressed as percentages of the predicted values according to the actual recommendations of ERS and ATS. The post-bronchodilator spirometry was performed according to the actual recommendations, i.e., spirometric measurements were performed 20 minutes after administration of 400 μg salbutamol by metered dose inhaler through spacer. Fixed airflow narrowing characteristic for COPD was considered if post-bronchodilator FEV_1/FVC remained less than 0.70[12-14].

COPD was diagnosed in symptomatic subjects with spirometric confirmation of persistent airflow limitation[1,7].

Statistical analysis

Statistical analysis was performed using the Statistical Package for the Social Sciences (SPSS), version 11.0 for Windows. Continuous variables were expressed as mean values with standard deviation (SD), and the nominal variables as numbers and percentages. In line with the aim of the study, for analyses of the data we used univariate statistical models for testing the differences in prevalence and comparison of the means. Chi-square test (or Fisher's exact test where appropriate) was used for testing difference in the prevalence. Comparison of spirometric measurements was performed by independent-samples *T*-test. A *P*-value less than 0.05 was considered as statistically significant.

Results

Characteristics of the study subjects are shown in Table 1.

Table 1. Demographic and other characteristics of the study subjects

Characteristics	Study subjects (N = 2,348)
Sex	
Male	52.8% (1,239)
Female	47.2% (1,109)
Age	
Range	18-86
Mean age	47.7 ± 16.8
Aged < 45	40.6% (954)
Aged ≥ 45	59.4% (1,394)
Smoking status	
Active smokers	37.8% (887)
Non-smokers	62.2% (1,461)
Working status	
Working population	79.5% (1,867)
Occupational exposure to noxious particles or gases	
Exposed	68.9% (1,287)
Unexposed	31.1% (580)
Retired persons	16.7% (392)
Students	3.8% (89)
Family history of asthma/ chronic bronchitis	
Positive	22.7% (535)
Negative	77.3% (1,813)
Indoor exposure to traditional fuels for heating and cooking	
Exposed	27.3% (641)
Unexposed	72.7% (1,707)

The most frequent respiratory symptom in the last 12 months in the study population was cough (Figure 1).

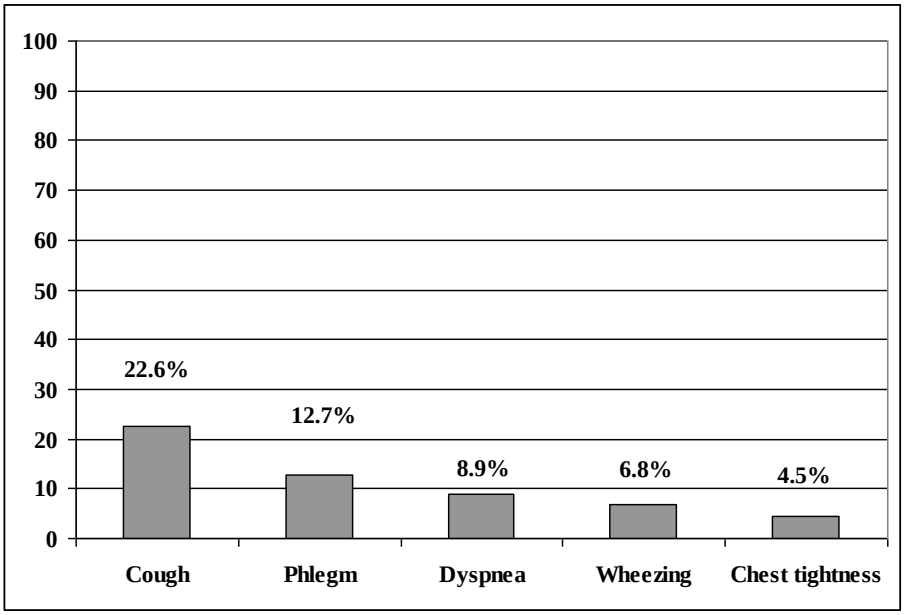

Fig. 1. Frequency of respiratory symptoms in the last 12 months in study subjects

Mean values of the spirometric parameters in the whole study group were within the range of their reference values (Table 2).

Table 2. Mean values of the spirometric parameters of study subjects

Spirometric parameter	Mean value (% predicted value)
FVC	103.8 ± 18.6
FEV1	92.2 ± 10.1
FEV1/ FVC ratio	0.87 ± 0.03

Prevalence of COPD in the whole study sample was 4.6% (108/2,348) (Figure 2).

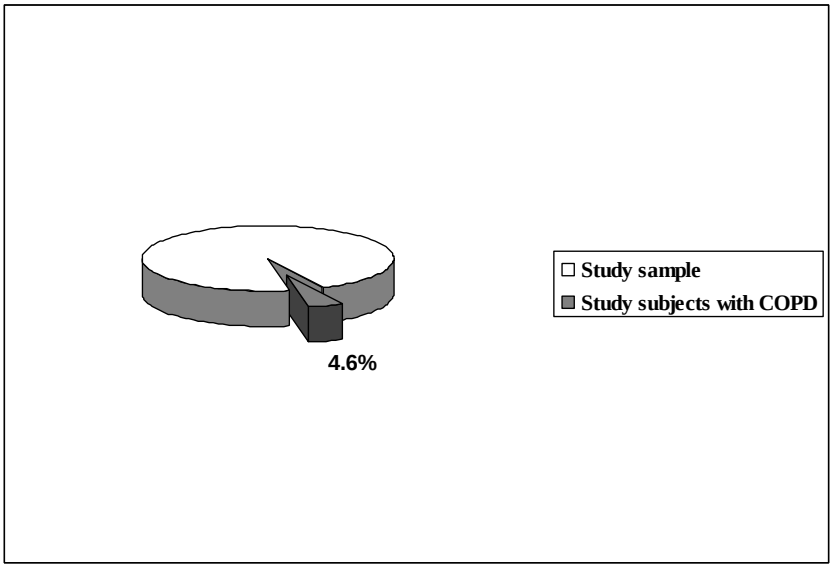

Fig. 2. Prevalence of COPD in the whole study sample

COPD prevalence was higher in men (5.1%) than in women (4.1%), but the difference was not statistically significant (Figure 3).

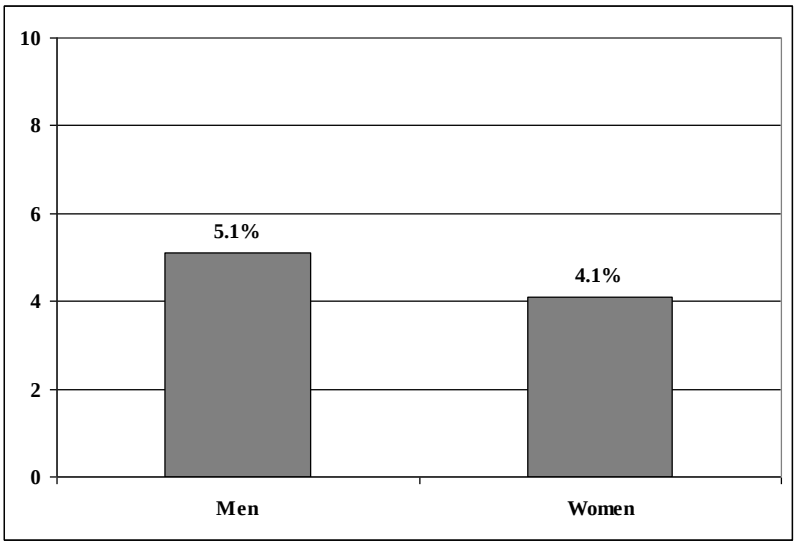

Fig. 3. COPD distribution by sex

COPD prevalence in the study subjects aged equal and more than 45 years was significantly higher than its prevalence in the study subjects aged less than 45 years (P = 0.000) (Figure 4).

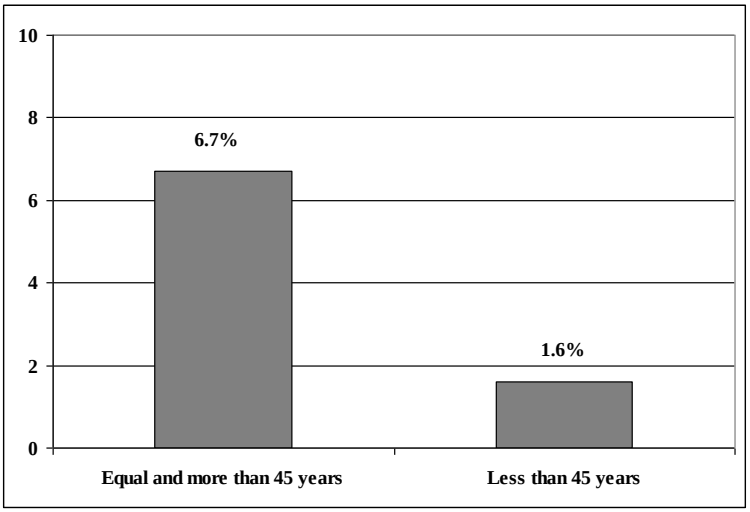

Fig. 4. COPD distribution by age

The highest COPD prevalence was registered in the age groups 61-75 and over 75 years (Figure 5).

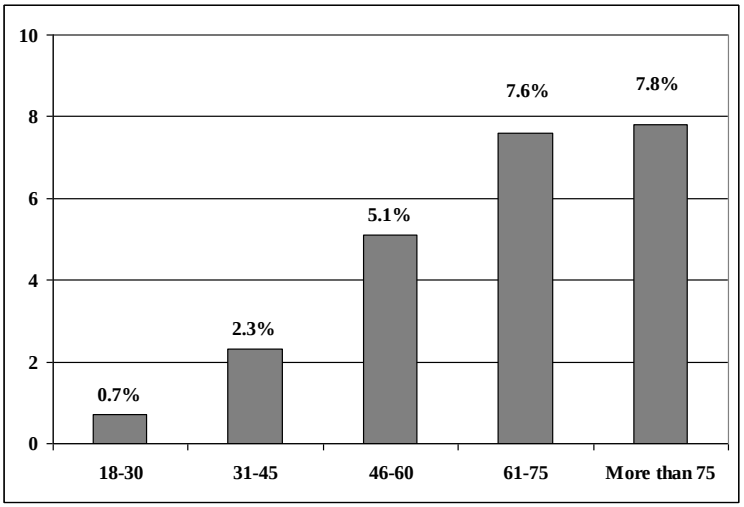

Fig. 5. COPD prevalence in certain age groups

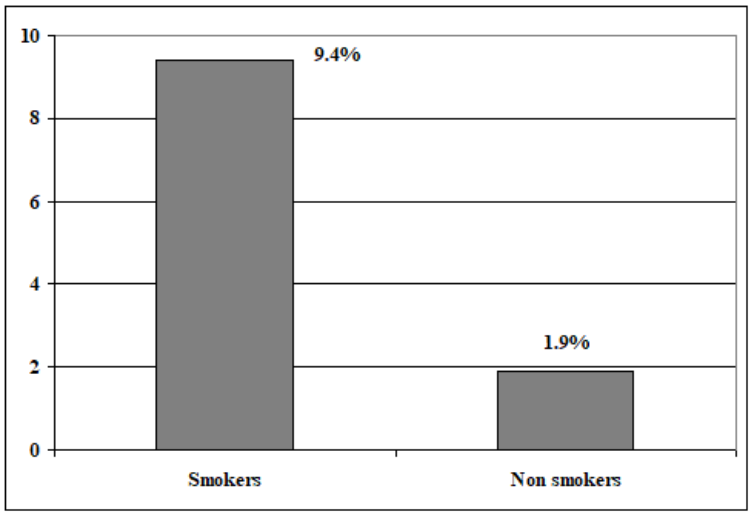

Fig. 5. Distribution of study subjects with COPD by smoking status

Proportion of the study subjects with COPD who were active smokers was significantly higher than proportion of non-smoking study subjects ($P = 0.000$) (Figure 5).

In regard to working status of the study subjects, we did not register any subject with COPD among students; its prevalence in the working population was 3.9%, while among the retired persons the prevalence of COPD was 8.7% being significantly higher than its prevalence among active workers ($P = 0.000$) (Figure 6).

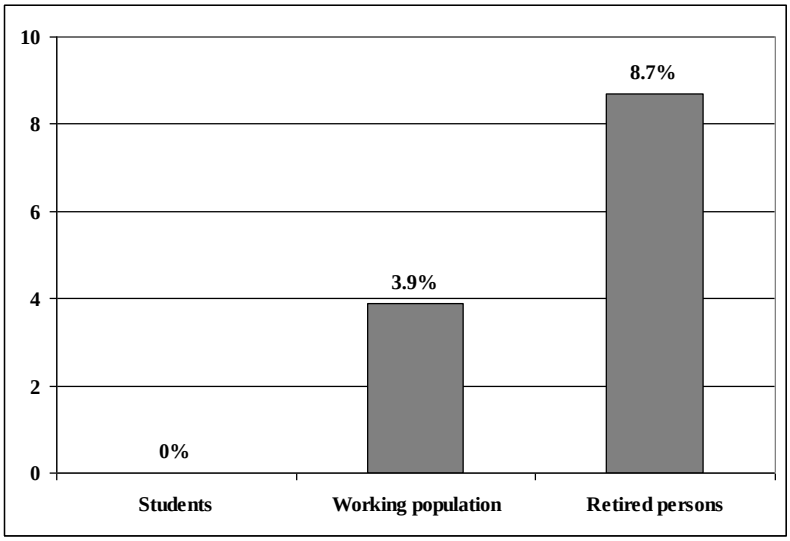

Fig. 6. Distribution of study subjects with COPD by working status

Prevalence of COPD among workers occupationally exposed to noxious particles or gases was significantly higher than its prevalence in workers with no occupational exposure to these agents ($P = 0.021$) (Figure 7).

There was no significant difference between prevalence of the study subjects with COPD with positive family history for asthma/chronic bronchitis and COPD prevalence in the study subjects with negative family history of chronic bronchitis/asthma (Figure 8).

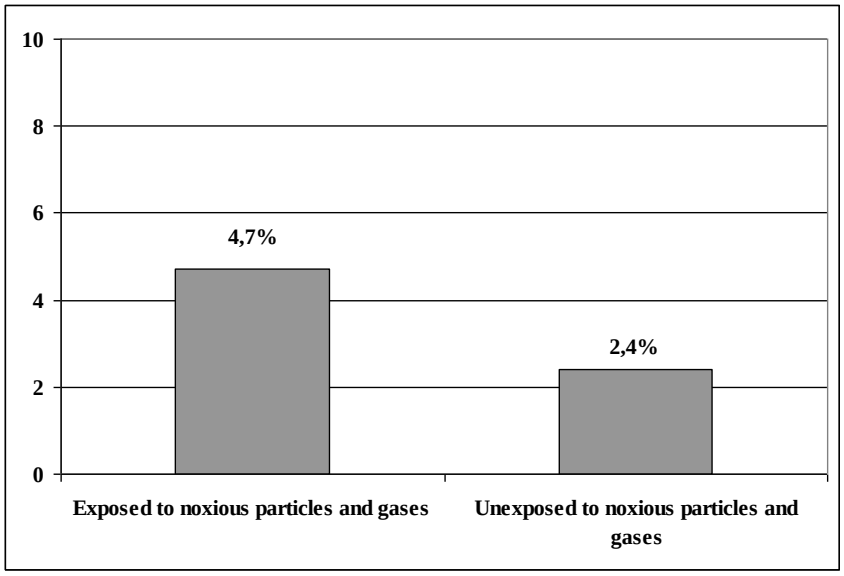

Fig. 7. COPD prevalence in workers with and without occupational exposure to noxious particles and gases

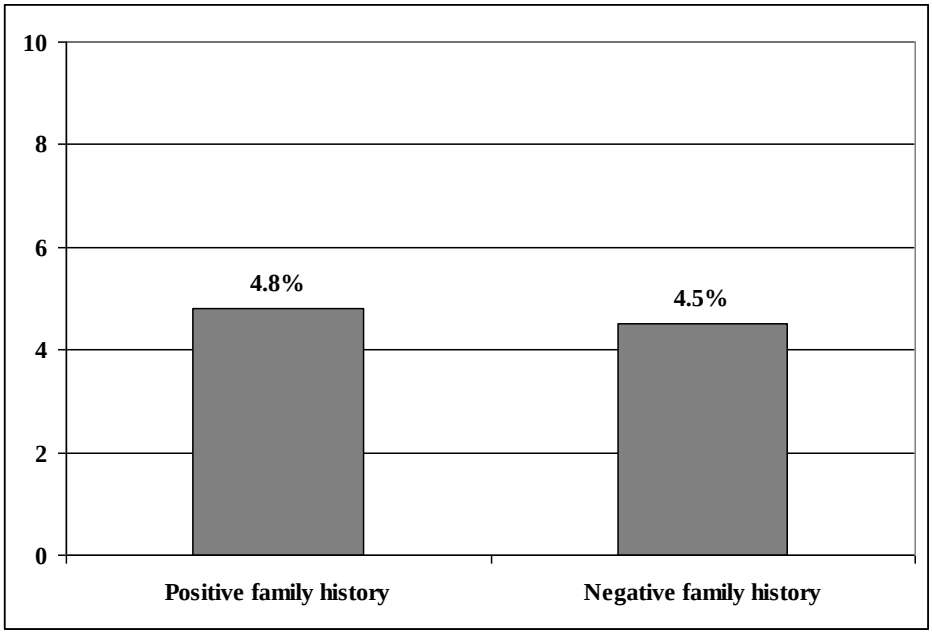

Fig. 8. COPD prevalence in study subjects with positive and negative family history for chronic bronchitis/asthma

There was also no significant difference between prevalence of the study subjects with COPD with indoor exposure to traditional fuels for heating and cooking in their home and COPD prevalence in the study subjects who were not exposed to such indoor air pollution (Figure 9).

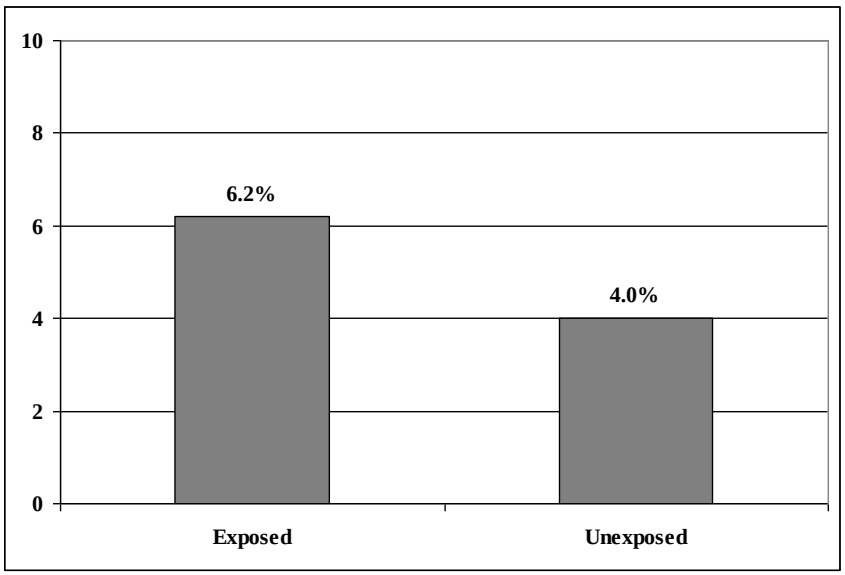

Fig. 9. COPD prevalence in study subjects with and without indoor pollution from traditional fuels for heating and cooking

Discussion

Studies that investigated prevalence of COPD and participation of certain risk factors for its development produced somewhat inconsistent results due to the study type, definition of the disease, study population, study protocol (questionnaire-based or spirometry-based study), etc. On the other hand, COPD prevalence varies across countries and different groups within countries as the influence of some risk factors, e.g. noxious particles and gases, varies

geographically depending on their nature and extent and they may be substantially higher in some regions[15-17].

In the present study, based on completion of a questionnaire and pre- and post-bronchodilator spirometry, we assessed the COPD prevalence in a sample of general adult population from the Skopje region and its distribution by sex, age, smoking status, working status, family history of chronic bronchitis/asthma, and mode of heating and cooking in the home. The study sample included 2,348 adults (1,239 males and 1,109 females, aged 18 to 86 years) from the Skopje region recruited during their check-ups for different purposes, i.e., preventive check-ups of workers, check-ups for driving license, check-ups for weapon license, check-ups for traveling abroad, etc., at the Institute for Occupational Health of RN Macedonia, Skopje. Similarly, to the findings of our previous studies, a large proportion of the study subjects (nearly 40%) were active smokers that indicated still poor results of implemented anti-smoking strategies and activities in general population[18,19].

COPD was registered in 4.6% of all study subjects, and its prevalence was non-significantly higher in men than in women. In addition, COPD prevalence was fourfold higher in the study subjects older than 45 years than in the younger ones, reaching the highest value (nearly 8%) in the study subjects aged 65-75 and older than 75 years. Furthermore, COPD prevalence was more than fourfold higher in active smokers than in non smokers. These findings are similar to the results of the studies performed in the U.S., Europe and Australia in the last two decades. Findings of the mentioned studies indicated COPD prevalence of 4-12% in the general adult population, increasing COPD prevalence in women but still higher prevalence in men, as well as its higher prevalence in the older age groups. The role of exposure to tobacco smoke as a main risk factor for the COPD development and progression was confirmed in a number of studies. As it is mentioned above, smoking-induced airway disease, characterized by the development of small airway disease and parenchymal destruction (centrilobular emphysema), is the best studied form of COPD[20-23].

The highest COPD prevalence in the study subjects classified by their working status was registered among retired persons (nearly 9%), followed by the working population (nearly 4%), while in the group of students there was not a single subject with COPD. In addition, COPD prevalence in the group of workers occupationally exposed to noxious particles or gases was significantly higher than its prevalence in the group of workers who did not have such occupational exposure (e.g. administrative workers). Occupational exposures, including inorganic and organic dusts, chemical agents and fumes, are still an under-appreciated risk factor for COPD. Silica and coal dust, cotton dust, farming dust, wood dust, cadmium dust and fumes, and diesel fume are established risk factors for the development and progression of COPD. According to the analysis of the U.S. population-based survey that included around 10,000 adults, the fraction of COPD attributable to workplace exposures was 19.2% overall and 31.1% in never smokers, that is consistent with ATS statement that concluded that workplace exposures accounted for 10-20% of either symptoms or functional impairment consistent with COPD. In addition, several workplace-based studies performed in RN Macedonia in the last decade also indicated a significantly higher COPD prevalence in subjects occupationally exposed to noxious particles or gases than its prevalence in administrative workers[24-28].

A significant familial risk of airflow limitation was observed in people who were siblings of the subjects with severe airflow limitation, indicating genes/environmental interaction in the COPD development[29,30]. Findings of the present study did not confirm familial predisposition of the COPD development as the COPD prevalence in the subjects with positive family history for chronic bronchitis/asthma in this study was similar to its prevalence of COPD in the study subjects whose parents and siblings did not suffer from chronic bronchitis/asthma.

In this study we did not find a significant difference in the COPD prevalence between the study subjects who used traditional solid and liquid fuels for heating, cooking and other household needs and the study subjects who did not use these fuels for the same purposes. Up to now, there is a lack of research about biomass-related COPD, although there is some evidence that switching to cleaner fuels may reduce risk of COPD in non-smokers[31,32] .

The present study must be interpreted within the context of its limitations which could have certain implications on data obtained and its interpretation. First, the number of the study subjects did not reach the planned one (approximately 3,000 subjects) due to the beginning of the COVID-19 pandemic in March, 2020. Due to the same reason, some planned investigations, e.g. laboratory analyses, occupational exposures assessment by job-exposure matrices, etc., were not realized. In addition, in statistical analyses we used univariate models due to the primary aim of the study. On the other side, the present study is the first study on COPD prevalence in the sample of general adult population performed by actual recommendations (spirometry-based study) and the results obtained should help in the management and prevention of COPD in the population of the Skopje region.

Conclusion

In a sample of general adult population from the Skopje region we found significant age-related increase of the COPD prevalence. Regarding the modifying factors, our findings indicate the active smoking and occupational exposures to noxious particles or gases as the main factors that influence the COPD prevalence. In addition, our findings suggest a need of improvement of preventive activities targeted to modifying factors in order to reduce the burden of COPD.

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Conflict of interest statement. None declared.

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