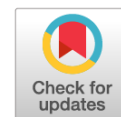# Распространенность хронической обструктивной болезни легких и факторов риска ее развития в Санкт-Петербурге и Архангельске (по данным исследования РЕСПЕКТ)

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Обоснование. Изучение истинной распространенности хронической обструктивной болезни легких остается значимой областью исследований, так как по-прежнему сохраняется большой разрыв между результатами официального учета выявленных случаев заболевания и эпидемиологическими данными.

Цель исследования — изучить распространенность хронической обструктивной болезни легких и факторов риска ее развития в двух городах Северо-Западного федерального округа России.

Материалы и методы. В случайной выборке респондентов (2121 житель Санкт-Петербурга, 1012 — Архангельска) у 2974 человек получены качественные результаты спирометрии (в том числе у 2388 — с бронхолитической пробой). С помощью анкетирования изучены демографические, социально-экономические показатели и факторы риска развития хронической обструктивной болезни легких.

Результаты. Средний возраст ($54,9 \pm 9,2$ и $52,3 \pm 9,2$ лет) и доля респондентов с высшим образованием (37,4 и 29,7 %) были выше в Санкт-Петербурге, чем в Архангельске ($p < 0,0001$) соответственно. Доля когда-либо куривших (49,5 и 44,4 %; $p = 0,008$), а также распространенность хронической обструктивной болезни легких (7,6 и 5,4 %; $p = 0,044$) были выше в Санкт-Петербурге. В Архангельске чаще отмечали использование биоорганического топлива и воздействие вредных производственных факторов. Распространенность хронической обструктивной болезни легких была выше у курильщиков и увеличивалась с возрастом, а показатели распространенности курения и хронической обструктивной болезни легких были выше у мужчин.

Заключение. Анализ факторов риска развития хронической обструктивной болезни легких позволяет лучше понять не только ее распространенность, но и ее структуру, а также значение каждого фактора риска в разных популяциях, что поможет повысить качество ранней диагностики заболевания.

Ключевые слова: распространенность хронической обструктивной болезни легких; курение; использование биоорганического топлива; вредные производственные факторы; спирометрия.

Prevalence of chronic obstructive pulmonary disease and its risk factors among residents of Saint Petersburg and Arkhangelsk (based on the RESPECT project)

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BACKGROUND: The study of the prevalence of chronic obstructive pulmonary disease remains a significant area of research, as there is still a large gap between the official record of detected the disease cases and epidemiological data.

AIM: To study the prevalence of chronic obstructive pulmonary disease and its risk factors in two cities in the North-West region of Russia.

MATERIALS AND METHODS: A random sample of respondents (2121 residents of Saint Petersburg, 1012 residents of Arkhangelsk); 2974 received qualitative results of spirometry (including 2388 with a bronchodilator test). The questionnaire included demographic, socioeconomic indicators, and risk factors for chronic obstructive pulmonary disease.

RESULTS: The average age (54.9 ± 9.2 and 52.3 ± 9.2 years) and the proportion of respondents with higher education (37.4% and 29.7%) were higher in Saint Petersburg (compared to Arkhangelsk, $p < 0.0001$). The proportion of ever smokers (49.5% and 44.4 %, $p = 0.008$), as well as the prevalence of chronic obstructive pulmonary disease (7.6% and 5.4%, $p = 0.044$), were higher in Saint Petersburg. In Arkhangelsk, exposure to biomass fuel and occupational hazards was noted more frequently. The prevalence of chronic obstructive pulmonary disease was higher in smokers and increased with age; the prevalence of smoking and chronic obstructive pulmonary disease was higher in men.

CONCLUSIONS: The analysis of chronic obstructive pulmonary disease risk factors allows us to better understand not only the prevalence but also the structure and significance of each risk factor in different populations, improving the early diagnosis of the disease.

Keywords: chronic obstructive pulmonary disease prevalence; smoking; exposure to biomass fuel; exposure to occupational hazards; spirometry.

BACKGROUND

Chronic obstructive pulmonary disease (COPD) ranks third among the causes of death in the world [1] and accounts for about 20% of the healthcare cost of respiratory diseases in Russia. However, problems remain in identifying and registering these patients in Russia [2], as evidenced by the large difference between the number of officially-registered COPD patients (i.e., about 2.4 million) and the calculated prevalence of COPD in epidemiological studies (i.e., at least 7 million). Timely detection of COPD helps reduce the rate of progression and improve the prognosis of these patients by eliminating the main risk factors (e.g., smoking) and providing optimal treatment.

This study aimed to perform early diagnosis of COPD in residents of two cities in the Northwestern Federal District of Russia, specifically St. Petersburg and Arkhangelsk, and to identify risk factors for its development.

MATERIALS AND METHODS

The Research on the prevalence and the diagnosis of COPD and its Tobacco-related etiology (RESPECT) study was developed jointly by departments of family medicine of the North-Western State Medical University named after I.I. Mechnikov (St. Petersburg) and the Northern State Medical University (Arkhangelsk) in collaboration with the Catholic University of Leuven (Brussels, Belgium). This study was registered in the ClinicalTrials.gov database (NCT02307799) and was approved by the local ethics committees of both medical universities. The study's three main stages (cross-sectional single-step, cohort, and case-control) and their objectives were presented previously [3].

A random sample of 4419 individuals aged 35 to 70 years old were recruited from a database of compulsory health insurance funds. A total of 3133 (70.9% response rate) signed an informed consent. This final sample included 2121 participants from St. Petersburg (664 men and 1457 women) and 1012 participants from Arkhangelsk (332 men and 680 women), registered at 10 polyclinics in St. Petersburg and 5 polyclinics in Arkhangelsk. Among 2974 participants who agreed to spirometry and achieved acceptable and reproducible results as required by the American Thoracic Society/European Respiratory Society (ATS/ERS) [4], 2388 had a bronchodilatory test. This publication presents the results of the epidemiological phase of the study (cross-sectional single-step design) based on the respondents' place of residence.

The *questionnaire* developed by the project team included demographics (e.g., age and gender) and socioeconomic indicators (e.g., marital status, education level, income, and profession) based on the W. Cockerham questionnaire [5] [6].

The *risk factors* for COPD, namely smoking (both active and passive), indoor air pollution, and occupational hazards were assessed. Meanwhile, the assessment of smoking included the age onset, the intensity as determined by the smoking index in pack-years (i.e., the number of packs of cigarettes smoked per day multiplied by the number of years of smoking), and smoking status/ experience. A smoking index threshold of least 10 pack-years was set to categorize heavy smokers. Smoking status was further distinguished to never- and ever-smokers, the latter including current and ex-smokers (i.e., those who have quit for more than six months). Passive smoking implies living in the same apartment and/or working in the same room with smokers for more than 10 years. Smoking status and passive smoking have been considered previously [6]. This publication presents exposure to indoor air pollution, such as frequent (i.e., more than five times a week) use of bio-organic fuel (e.g., wood or coal) for cooking and/or space heating, and work in dusty/smoky conditions for more than 10 years. The impact of occupational hazards were assessed using the ATS questionnaire — the ATS 1978 Adult Questionnaire (ATS-DLD-78) [7].

Pulmonary function was assessed using portable turbine spirometers, specifically the MIR Spirobank (MIR, Rome, Italy, www.spirometry.com). A bronchodilation test was performed with salbutamol (400 μg) or ipratropium bromide (80 μg) assessed after 15 minutes and 45 minutes, respectively. Disorders were considered obstructive if the ratio of forced expiratory volume per second to forced vital capacity (FEV_1/FVC) was below 0.7 [8].

Statistical analysis was performed using the SPSS 22 program (SPSS Inc., Chicago, Illinois, USA). Continuous variables were presented as means (M), standard deviations (SD), and 95% confidence intervals (CI), while categorical variables were presented as numbers and frequencies. To compare data, Pearson's χ^2 test for categorical variables and one-sample *t*-test for continuous variables were used.

RESULTS

Participant characteristics detailed smoking status were presented earlier [6]; additional indicators are summarized in Table 1. Average age (54.9 ± 9.2 and 52.3 ± 9.2 years; $p < 0.0001$), and those with higher education (37.4% and 29.7%; $p < 0.0001$) were higher in the samples in St. Petersburg than in Arkhangelsk. Socioeconomic and marital status [6], and the proportion of men between the cities did not differ. Ever-smokers were more prevalent in St. Petersburg than in Arkhangelsk, both in the general population (49.5% and 44.4%, respectively, $p = 0.008$) and among women (38.3% and 30.7%, respectively, $p = 0.0008$). Men were 2.0–2.4 times more likely to be ever-smokers, who smoked 3.1–4.8 times

more intensely than women in both St. Petersburg and Arkhangelsk.

Respondents in Arkhangelsk had a significantly higher exposure to bio-organic fuel and occupational hazards in the general population ($p < 0.0001$) and among men and women ($p < 0.05$).

The calculated COPD prevalence for participants who performed a bronchodilation test, according to place of residence, gender, age, and smoking status and intensity, are presented in Table 2. The St. Petersburg sample had higher COPD rates in both the general population (7.6% and 5.4%, respectively; $p = 0.044$) and in men (15.9% and 9.5%, respectively; $p = 0.014$), but not in women.

Those aged 55–70 years had higher COPD prevalence than ages 35–54 years in the RESPECT study total sample (by 2.7 times; $p < 0.0001$), the St. Petersburg and Arkhangelsk samples (by 2.5 and 2.9 times, respectively; $p < 0.0001$), the male respondents (2.7 times higher in the group of 55–70 years old for St. Petersburg and 4 times higher

for Arkhangelsk; for all patients, $p < 0.0001$) and female respondents in St. Petersburg ($p = 0.039$). In general, for the two cities, COPD prevalence was higher in men than in women (3.9 times in St. Petersburg and 2.8 times in Arkhangelsk; for all patients, $p < 0.001$), reaching a difference of 4.1 and 3.5 times in St. Petersburg and Arkhangelsk, respectively ($p = 0.0001$) among respondents aged 55–70.

Compared to ever-smokers, COPD was less prevalent in never-smokers by 3.6 times in the total RESPECT study sample, by 3.7 times in the St. Petersburg sample, and by 3.3 times in the Arkhangelsk sample (for all $p < 0.0001$). However, in the men and women of the two cities, this relationship was not always significant. COPD was less prevalent by 5.3 times for non-smoking men in St. Petersburg ($p < 0.0001$) and by 3 times for non-smoking women in Arkhangelsk ($p = 0.015$).

In the general population, heavy smokers had higher rates of COPD by 3.7 and 4.4 times in St. Petersburg

Таблица 1. Характеристика участников исследования в зависимости от места проживания, пола и факторов риска развития хронической обструктивной болезни легких

Table 1. Participant characteristics by place of residence, gender, and chronic obstructive pulmonary disease risk factors

Indicator	Total sample $n = 3133$	St. Petersburg			Arkhangelsk		
		total $n = 2121$	men $n = 664$ (31.3%)	women $n = 1457$ (68.7%)	total $n = 1012$	men $n = 332$ (32.8%)	women $n = 680$ (67.2%)
Age, M ± SD, years	54.0 ± 9.3	54.9 ± 9.2	54.6 ± 9.6	55.0 ± 9.0	52.3 ± 9.2*	52.2 ± 9.2	53.2 ± 9.2
Education defined, n	3114	2103	660	1443	1011	331	680
• higher, n (%)	1097 (35.4)	797 (37.9)	247 (37.4)	550 (38.1)	300 (29.7)**	87 (26.3)	213 (31.3)
Smoking status determined, n	3114	2103	660	1443	1011	331	680
• ever-smokers, n (%)	1489 (47.8)	1040 (49.5)	487 (73.8)$^\alpha$	553 (38.3)	449 (44.4)**	240 (72.5)$^\alpha$	209 (30.7)
Smoking intensity determined, n	3115	2108	656	1452	1007	328	679
• smoking index ≥10 pack-years, n (%)	935 (30.0)	641 (30.4)	474 (57.0)$^\alpha$	267 (18.4)	294 (29.2)	205 (62.5)$^\alpha$	89 (13.1)$^\beta$
Exposure to indoor air pollution determined, n	3113	2102	660	1442	1011	331	680
• frequent use of bio-organic fuels, n (%)	253 (8.1)	15 (0.7)	7 (1.1)	8 (0.6)	238 (23.5)**	75 (22.7)$^\beta$	163 (24.0)$^\beta$
Impact of occupational hazards determined, n	2912	1901	603	1298	1011	331	680
• work in dusty conditions for 10 years or more, n (%)	490 (16.8)	283 (14.9)	125 (20.7)$^\alpha$	158 (12.2)	207 (20.5)**	90 (27.2)	117 (17.2)
• work under conditions of gas contamination for 10 years or more, n (%)	500 (17.2)	283 (14.9)	123 (20.4)$^{\alpha, \beta}$	160 (12.3)	217 (21.5)**	106 (32.0)$^\alpha$	111 (16.3)$^\beta$

Note. M — mean; SD — standard deviation. * Significant differences for all St. Petersburg and Arkhangelsk participants ($p < 0.0001$ for one-sample t-test); ** significant differences for all participants of St. Petersburg and Arkhangelsk ($p < 0.0001$ for Pearson's χ^2 test); $^\alpha$ significant differences for groups of men and women ($p < 0.0001$ for Pearson's χ^2 test); $^\beta$ significant differences for same-gender groups in St. Petersburg and Arkhangelsk ($p < 0.001$ for Pearson's χ^2 test).

Таблица 2. Распространенность хронической обструктивной болезни легких в зависимости от места проживания, пола, возраста и индекса курения

Table 2. Chronic obstructive pulmonary disease prevalence of the sample by place of residence, gender, smoking, and obstruction criteria

Prevalence	Total sample	St. Petersburg			Arkhangelsk		
		total	men	women	total	men	women
Number of respondents, n (including with obstruction, n)	2388 (162)	1451 (111)	441 (70)	1010 (41)	937 (51)	317 (30)	620 (21)
Overall prevalence, %, (95% CI)	6.8 (5.8–7.9)	7.6 (6.9–9.2)	15.9 (12.4–20.0)	4.1[α] (2.9–5.5)	5.4* (4.0–7.2)	9.5 (6.4–13.5)	3.4[α] (2.1–5.2
Prevalence by age groups							
• 35–54 years, %, (95% CI)	3.6 (2.6–4.9)	4.1[c] (2.7–6.1)	8.1 (4.5–13.3)	2.4 (1.1–4.4)	2.9[c] (1.6–4.8)	4.0 (1.6–8.3)	2.4 (1.0–4.7)
• 55–70 years, %, (95% CI)	9.6 (8.0–11.4)	10.2 (8.1–12.5)	21.6[β] (16.2–28.1)	5.2[α, β] (3.6–7.4)	8.5 (5.9–11.7)	16.0[β] (10.1–24.0)	4.6[α] (2.4–7.9)
Prevalence by smoking status and intensity							
Smoking status							
Never-smokers, %, (95% CI)	3.0 (2.1–4.1)	3.2[c] (2.0–4.8)	3.7 (1.1–9.6)	3.1 (1.9–4.9)	2.7[c] (1.5–4.5)	5.6 (1.8–13.1)	2.1 (0.9–4.0)
Ever-smokers, %, (95% CI)	10.8 (9.0–12.9)	12.0 (9.6–14.7)	19.6[β] (15.1–24.9)	5.6[α] (3.5–8.4)	8.9 (6.3–12.3)	11.0 (7.1–16.3)	6.3[β] (3.3–11.1)
Smoking intensity (for ever-smokers)							
Smoking index <10 pack-years, %, (95% CI)	3.6 (2.7–4.6)	4.2[c] (3.0–5.6)	7.4 (3.9–12.7)	3.5 (2.3–4.9)	2.7[c] (1.6–4.4)	5.9 (2.4–12.2)	2.0 (1.0–3.7)
Smoking index ≥10 pack-years, %, (95% CI)	14.1 (11.5–17.1)	15.4 (12.0–19.4)	21.9[β] (16.6–28.4)	6.7[α] (3.5–11.4)	12.0 (8.2–16.8)	11.8 (7.5–17.7)	12.3[β] (5.9–22.7)

Note. CI — confidence interval. * Significant differences for all St. Petersburg and Arkhangelsk participants ($p < 0.05$ for Pearson's χ^2 test); [α] significant differences for groups of men and women ($p < 0.0001$ for Pearson's χ^2 test); [β] significant differences for same-gender groups ($p < 0.05$ for Pearson's χ^2 test); [c] significant differences for groups of the same city ($p < 0.0001$ for Pearson's χ^2 test).

and Arkhangelsk, respectively ($p < 0.0001$). While COPD prevalence in heavy smokers was 6.1 times higher for women in Arkhangelsk, this was 2.9 times higher for men in St. Petersburg ($p < 0.0001$).

In heavy smokers in St. Petersburg, men had 3.3 times higher rates of COPD than women ($p < 0.0001$). The same tendency was noted in comparing never- and ever-smokers (3 times higher in men; $p < 0.0001$). However, no difference was found in in men and women in Arkhangelsk with the same smoking status and experience.

DISCUSSION

The RESPECT study was the first to obtain data on COPD prevalence and risk factors in two cities of the North Western Federal District of Russia in a random sample 35–70 year-olds using a bronchodilator test. The study results, from which the COPD prevalence in Russia was estimated, were included in a systematic review of 162 population-based studies published recently in the Lancet Respiratory Medicine [9]. This should enable the evaluation of global COPD prevalence depending on gender, age, and region.

It should be noted that data on COPD prevalence and risk factors, primarily smoking, in various studies are difficult to compare due to differences in research methodology and socio-demographic characteristics of the samples. In general, smoking prevalence in the studied populations of the two cities are comparable with previously obtained data, including the sample survey of Rosstat [10] and the results of international studies [11,12]. While smoking is the most studied risk factor for COPD, the Lancet [13] proposed to distinguish five types of this disease based on predominant risk factors, including environmental factors like indoor air pollution and workplace hazards. Furthermore, in Russia, the major risk factor for COPD is smoking (up to 85%) followed by occupational factors (up to 10%) [14], similar to the data of the RESPECT study.

The relationship between smoking and COPD prevalence in the two cities was revealed. Rates of COPD were higher in smokers, especially those with 10 pack-years, and older age groups. Men had higher smoking and COPD prevalence. While smoking was prevalent in St. Petersburg, exposure to other risk factors were more common in Arkhangelsk. Respondents of Arkhangelsk were younger and less likely

to have had higher education. The prevalence of COPD in the RESPECT study is comparable to data from earlier international studies, such as the BOLD study [15], where smoking prevalence was based on gender and age [1].

CONCLUSION

The RESPECT study found smoking as the main risk factor for the development of COPD among the population of St. Petersburg and Arkhangelsk, especially in men, older people, and heavy smokers. Moreover, the RESPECT study demonstrated comparability of international and Russian data. The assessment of risk factors for COPD, primarily smoking, will facilitate timely COPD diagnosis and management, halting its progression, and, thereby, improving long-term prognosis patients.

ADDITIONAL INFORMATION

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