Original papers

Spirometry testing among the homeless

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Abstract

Background. Many literature reports have indicated the fact that the percentage of active smokers among the homeless is high, often several times higher than that of the general population. The homeless are known to have worse spirometric parameters than the general population.

Objectives. The question of what the principal and exclusive cause of airway obstruction among the homeless is remains unanswered. Verification of the above-mentioned hypothesis is possible by comparing the spirometric parameters in homeless people with those in the general population, based on the data related to subgroups with similar tobacco smoke exposure, which are homogenous in terms of sex, race and age.

Material and methods. The spirometric parameters in 58 homeless male smokers were compared with those in 55 male smokers living normal lives. Neither group differed in age, duration of smoking or the number of pack-years. All of the subjects were Caucasian.

Results. The mean values of forced expiratory volume in 1 s (FEV1), forced vital capacity (FVC) and FEV1/FVC, both corrected and expressed as absolute figures, were lower amongst the smoking homeless men than amongst men living normal lives. In 27.59% of the homeless subjects not receiving treatment for lung diseases, airway obstruction was identified.

Conclusions. Our results suggest that smoking is not the only cause of the worse spirometric parameters found among the homeless.

Key words: homeless, spirometry, smoking

Introduction

In the 21st century, diseases of the respiratory system have become a worldwide challenge for the medicine. Commonly known environmental factors are causing the problem to grow, and because most of these diseases are incurable, an increasing emphasis is being placed on their prevention. Atypical subpopulations, ones that exaggerate the extent of the problem, can be useful in the assessment of the effectiveness of preventive measures. Homeless people are such a subpopulation when it comes to many disease entities. Leaving aside the ethical and social aspects, the homeless population attracts the interest of researchers from a medical point of view due to the unique epidemiology of diseases of social significance. Given the limited access to medical assistance and the poor care for homeless people's own health, certain diseases are particularly prevalent among them and their diagnosis is often delayed.[1,2] Homeless people are characterized by a very high incidence of tuberculosis, an increased risk of HIV infection, a risk of various types of dependence syndromes (alcohol, illicit drugs, nicotine), a high percentage of individuals with mental problems, and high mortality.[3–5]

Apart from certain shared features which are independent of the geographical location of a study (such as the marked predominance of males among the homeless), there are also certain differences.[6] American and Western European authors most commonly deal with younger populations than authors from Central European countries do.[7] Drug dependence is more commonly reported by American authors, while alcohol dependence prevails in European publications.[3] Racial differences are also significant. American authors report that 70–90% of the homeless population is made up of African Americans, while this particular ethnicity is practically non-existent in the Eastern European countries.[6]

Authors of multiple publications also observe that the percentage of active smokers among the homeless is high. Being estimated at 70–90%, irrespective of where the particular study was conducted, this percentage is several times higher than that in the general population.[8–10] Smoking is the strongest risk factor for the development of chronic obstructive pulmonary disease (COPD).[11] Taken together, these 2 facts clearly imply that COPD must be more prevalent among the homeless.

This was noticed by Snyder and Eisner, who performed spirometry in 67 homeless people in San Francisco (USA) and showed that obstructive lung disease (OLD) was twice as prevalent in this subpopulation as compared to the general population.[12] A report by Badiaga et al. from Marseilles (France) presented a similar conclusion suggesting an obvious pathophysiological association with smoking, which in this study was declared by 78% of the homeless compared to 30% of the members of the general population.[13] The problem is that such a combination of facts suggests a causal relationship, with homeless people developing OLD more often, because they smoke more. Meanwhile, this relationship has not been proven or, more precisely, the fact that there is a well-documented relationship between smoking and OLD does not make it the only reason why this highly smoke-exposed subpopulation develops OLD more often. Verification of this hypothesis is possible by comparing the spirometric parameters in homeless people with those in the general population and by studying the data related to subgroups with a similar exposure to tobacco smoke (homogenous in terms of sex, race and age).

Material and methods

Study population

A total of 53 homeless males from the city of Olsztyn (Poland) were included in the analysis. Olsztyn has a population of approx. 175,000; that – according to the 2014 data published by the Regional Center for Social Policy in Olsztyn – includes 153 homeless people falling within the European Typology on Homelessness and Housing Exclusion (ETHOS) operational categories: 1 – people living rough; 2 – people in emergency accommodation (a night shelter); and 3 – people living in accommodation for the homeless, in our case in a homeless hostel.[14] A set of basic demographic and medical data was collected from each of the subjects. Participation in the study was entirely voluntary and each subject was free to refuse to answer any of the questions, without providing a reason, at any stage of the study. The study protocol was approved by the Bioethics Committee of the University of Warmia and Mazury in Olsztyn, Poland (No. 38/2013).

The control group consisted of 578 individuals who had been examined during routine prophylactic campaigns carried out as part of Polish Spirometry Day. The examinations were performed at several different locations in Olsztyn (such as Old Market Square, City Hall, the Provincial Governor's Office, the Pulmonology Hospital, and others). Participation in the study was entirely voluntary and free. Each of the subjects completed a questionnaire which included questions about the subject's sociodemographic data, risk factors and respiratory symptoms. The volunteers were free to refuse to answer any of the questions. For the purposes of the study, all male current and ever-smokers over 35 years of age were selected, making a total of 55 people.

The reason why we chose 35 years as the lower age limit was because it was necessary to enable comparisons in the analogous age groups. This way, only 1 much younger person was excluded from the study group (the homeless group). Both groups consisted of subjects who considered themselves healthy and had never been treated for COPD or asthma.

Spirometry

Measurements of vital capacity (VC) and the flow – volume curve were carried out by medical staff experienced in performing spirometry, in accordance with the ATS/ERS 2005 guidelines.[15] Testing was performed using a Microlab CareFusion MK8 spirometer (Medicom, Zabrze, Poland); it was calibrated each day before the testing.

Before the start of the study, each subject was informed about the spirometry testing procedure. The spirometry was carried out with the patient in a sitting position. Only the results that met the criteria of a correctly conducted test according to ATS/ERS were included in the statistical analysis.

Statistical analysis

Statistical analysis was performed using STATISTICA software v. 12 (StatSoft Inc., Tulsa, USA). The Shapiro-Wilk test was used to check for normality. The homogeneity of variance in the groups being compared was assessed using the Levene's test. Where the assumptions of normality and homogeneity of variance were met, the Student's t-test for independent samples was used. Otherwise, the nonparametric alternative, namely the Mann-Whitney U test, was employed. A significance level of 0.05 was adopted as the borderline value of acceptable error level.

Results

Of the total of 58 homeless individuals examined, 53 homeless ever-smokers were included in the analysis. This group was compared with 55 male ever-smokers leading a normal lifestyle.

Table 1 summarizes the mean values in the homeless and control groups.

This was followed by an analogous comparison among current smokers; the results of the comparison are given in Table 2.

Furthermore, in our homeless group, we identified 11 cases with mild, 1 case with moderate, 2 cases with moderately severe, and 2 cases with severe airway obstruction (i.e., a total of 16 cases). We did not identify any case with very severe obstruction. In the control group, on the other hand, we only identified 8 cases with mild obstruction.

Table 1. Mean values and their comparison among ever-smokers in the homeless group and the control group

Variable	Homeless group			Control group			p-value
	mean	SD	n	mean	SD	n	
FEV1 [dm³/s]	2.82	0.73	53	3.41	0.75	55	0.000
FEV1 [%]	84.83	17.79	53	99.75	17.20	55	0.000
FVC [dm³/s]	3.71	0.80	53	4.43	0.86	55	0.000
FVC [%]	89.23	15.53	53	102.78	17.70	55	0.000
FEV1/FVC	75.76	11.36	53	79.53	11.50	55	0.090
Age [years]	57.21	9.83	53	57.84	12.12	55	0.768
Years of smoking	35.65	13.11	51	27.94	12.42	50	0.003
Pack/days	0.85	0.34	51	1.12	0.71	55	0.014
Pack/years	29.60	16.72	52	30.30	23.04	55	0.860

FEV1 – forced expiratory volume in 1 s; FVC – forced vital capacity.

Table 2. Mean spirometry values in the current smokers group

Variable	Homeless group			Control group			p-value
	mean	SD	n	mean	SD	n	
FEV1 [dm³/s]	2.77	0.73	48	3.69	0.73	31	0.000
FEV1 [%]	82.65	16.84	48	103.06	14.96	31	0.000
FVC [dm³/s]	3.69	0.80	48	4.69	0.87	31	0.000
FVC [%]	87.94	15.39	48	104.32	18.92	31	0.000
FEV1/FVC	75.07	11.49	48	80.35	10.77	31	0.044
Age [years]	56.90	9.19	48	53.84	13.36	31	0.232
Years of smoking	36.25	11.81	48	30.48	13.25	29	0.051
Pack/days	0.82	0.31	48	1.05	0.66	31	0.040
Pack/years	30.28	15.89	48	29.44	20.74	31	0.840

FEV1 – forced expiratory volume in 1 s; FVC – forced vital capacity.

Discussion

The current Global Initiative for Chronic Obstructive Pulmonary Disease (GOLD) criteria require post-bronchodilator spirometry for the diagnosis of COPD.[11] A simple spirometry test allows for the identification of obstruction or restriction, but is not sufficient for establishing a diagnosis of a specific disease. The specific nature of work with the homeless makes it very difficult to satisfy the GOLD criteria and is very likely to be one of the reasons why, to the best of our knowledge, no such studies have been conducted. In one of the published studies, which was based on spirometry results among the homeless, Snyder and Eisner reported a much higher percentage of subjects meeting the criteria of airway obstruction than would be expected in the general population.[12] Another study, already mentioned in the introduction, was conducted by measuring the peak flow, a tool that is much easier to use in this group of people.[13] Our study is therefore eligible for comparison with the report by Snyder and Eisner. In such a comparison, despite the fact that our study group was much older (p = 0.000), the mean values of forced expiratory volume in 1 s (FEV1), forced vital capacity (FVC) and FEV1/FVC in our study were not significantly different from those reported by Snyder and Eisner .[12]

Our study material, however, allowed us to make a more interesting comparison, namely a comparison between homeless males and males living normal lives.

Our results demonstrated much worse spirometric parameters among the homeless than in the control group (Tables 1, 2), even though these 2 groups did not differ significantly in age or in exposure to tobacco smoke expressed in pack-years.

In their report, Snyder and Eisner considered several explanations for the poorer spirometric parameters observed in the homeless. Some of them, such as the considerable percentage of African Americans among the homeless, who usually have worse spirometric parameters, can be directly negated.[16] In our database, both in the study group and in the control group, 100% of the subjects were Caucasian. It is also questionable that such considerable differences can be explained by the statement that OLD may be one of the causes of homelessness. Spirometric parameters physiologically decline with age. Our database primarily included chronically homeless subjects (98%), aged 57 years on average, while only few of them (5.17%) met the criterion of severe obstruction (even before checking the reversibility criterion).

What we agree with is the statement regarding delayed diagnosis or no diagnosis of OLD among the homeless and the impact of respiratory tract infections. We are likely to be dealing here with a similar situation to that with the course of tuberculosis. The poor care for one's own health is one of the reasons for delayed diagnosis.[17] In our database, which included subjects considering themselves to be healthy, we identified a total of 16 cases of airway obstruction among the homeless (27.59%), with only 8 such cases in the control group (15.55%). And although this difference was borderline

significant (p = 0.0506; n = 53 vs 55 homeless vs control group, respectively), the quantitative comparison did not take into account the severity of the obstruction. A total of 5 cases of more than moderate obstruction (including 2 cases of severe obstruction) were identified among the homeless compared to 0 in the control group. This difference is best reflected by comparing the mean values (Tables 1, 2).

The issue that is most interesting here, however, is smoking. Our results negate the hypothesis according to which spirometric parameters among the homeless are worse, because homeless individuals smoke more. It is very likely that the high cost of tobacco products limits their availability to this group of people, so that despite the longer duration of smoking (Table 1 – current and ex-smokers), the number of pack-years in both groups is the same. The analysis of current smokers (Table 2) showed that the total duration of exposure to tobacco smoke in both groups was the same. Without negating the already proven relationship between smoking and OLD, it seems that in this case, this relationship is not responsible for the differences observed.[18]

It should, however, be kept in mind that it is not possible to objectively – quantitatively or qualitatively – assess the exposure to passive smoking. It may be assumed to be particularly high in this group (especially during the winter months, when survival of the homeless depends on their stay at various types of night shelters). On the other hand, we did not attempt to assess the exposure to passive smoking in the control group, either. This unconfirmed suggestion concerning the impact of passive smoking among the homeless requires further studies, especially since this is an area in which prophylactic activities are feasible and would require appropriate training to be provided to social workers employed in night shelters.

Limitations

Our sample size of homeless people is too small to allow a reliable statistical analysis of the subgroup of homeless male non-smokers and the subgroups of female smokers and female non-smokers, who were not included in our study. For this reason, we limited the focus of the analysis to smoking males. This limitation results from the demographic regularities already mentioned in the introduction. The inclusion of females, due to their considerably lower proportion (approx. 10%), would require a multicenter study assessing approx. 1,000 homeless subjects, which still would not include a subgroup of non-smoking females, whose number would be too small for statistical analysis.

Conclusions

The apparently obvious conclusion that homeless people have worse spirometric parameters, because they smoke too much seems incorrect. Our results have demonstrated

much worse spirometric parameters among male homeless smokers than in the control group including male smokers leading normal lives, in spite of the fact that these 2 groups did not differ significantly in terms of age or exposure to tobacco smoke. Our study does not explain this fact, but points to the existence of other causes in addition to exposure to tobacco smoke.

The considerable percentage (27.59%) of homeless male subjects with airway obstruction not receiving treatment for lung diseases suggests the need to place this group under detailed observation and to provide them with treatment.

References

1. Tan de Bibiana J, Rossi C, Rivest P, et al. Tuberculosis and homelessness in Montreal: A retrospective cohort study. *BMC Public Health*. 2011;11:833.
2. Romaszko J, Buciński A, Kuchta R, Bednarski K, Zakrzewska M. The incidence of pulmonary tuberculosis among the homeless in north-eastern Poland. *Cent Eur J Med*. 2013;8(2):283–285.
3. Fazel S, Khosla V, Doll H, Geddes J. The prevalence of mental disorders among the homeless in western countries: Systematic review and meta-regression analysis. *PLoS Med*. 2008;5(12):e225.
4. Romaszko J, Siemaszko A, Bodzioch M, Buciński A, Doboszyńska A. Active case finding among homeless people as a means of reducing the incidence of pulmonary tuberculosis in general population. *Adv Exp Med Biol*. 2016;911:67–76.
5. Krausz RM, Clarkson AF, Strehlau V, Torchalla I, Li K, Schuetz CG. Mental disorder, service use, and barriers to care among 500 homeless people in 3 different urban settings. *Soc Psychiatry Psychiatr Epidemiol*. 2013;48(8):1235–1243.
6. Busch-Geertsema V, Benjaminsen L, Hrast MF, Pleace N. Extent and profile of homelessness in european member states: A statistical update: FEANTSA; 2014. https://pure.sfi.dk/ws/files/294722/Feantsa_Studies_04_WEB.pdf. Accessed December 27, 2016.
7. Rhoades H, Wenzel SL, Golinelli D, et al. The social context of homeless men's substance use. *Drug Alcohol Depend*. 2011;118(2):320–325.
8. Baggett TP, Rigotti NA. Cigarette smoking and advice to quit in a national sample of homeless adults. *Am J Prev Med*. 2010;39(2):164–172.
9. Chen Q, Wan M, Ban C, Gao Y. Retrospective assessment of the prevalence of cardiovascular risk factors among homeless individuals with schizophrenia in Shanghai. *Shanghai Arch Psychiatry*. 2014;26(3):149–156.
10. Wincup E, Buckland G, Bayliss R. *Youth Homelessness and Substance Use: Report to the Drugs and Alcohol Research Unit*. London: Home Office Research, Development and Statistics Directorate; 2003.
11. Vestbo J, Hurd SS, Agusti AG, et al. Global strategy for the diagnosis, management, and prevention of chronic obstructive pulmonary disease: GOLD executive summary. *Am J Respir Crit Care Med*. 2013;187(4):347–365.
12. Snyder LD, Eisner MD. Obstructive lung disease among the urban homeless. *Chest*. 2004;125(5):1719–1725.
13. Badiaga S, Richet H, Azas P, et al. Contribution of a shelter-based survey for screening respiratory diseases in the homeless. *Eur J Public Health*. 2009;19(2):157–160.
14. Amore K, Baker M, Howden-Chapman P. The ETHOS definition and classification of homelessness: An analysis. *Europ J Homeless*. 2011;5(2)19–37.
15. Miller MR, Hankinson J, Brusasco V, et al. Standardisation of spirometry. *Eur Respir J*. 2005;26(2):319–338.
16. Hankinson JL, Odencrantz JR, Fedan KB. Spirometric reference values from a sample of the general U.S. population. *Am J Respir Crit Care Med*. 1999;159(1):179–187.
17. Villa L, Trompa IM, Montes FN, Gomez JG, Restrepo CA. Analysis of mortality caused by tuberculosis in Medellin, Colombia, 2012. *Biomedica*. 2014;34(3):425–432.
18. Forey BA, Thornton AJ, Lee PN. Systematic review with meta-analysis of the epidemiological evidence relating smoking to COPD, chronic bronchitis and emphysema. *BMC Pulm Med*. 2011;11:36.