ORIGINAL ARTICLE

Risk factors and early clinical and functional signs of chronic obstructive pulmonary disease in military personnel

Sanzharbek S. Kosimov[1*], Zarina A. Pulatova[2]

[1]*Fergana Regional Center of Phthisiology and Pulmonology, Fergana, Republic of Uzbekistan*
[2]*Military Medical Institute, University of Military Security and Defense of the Republic of Uzbekistan, Tashkent, Republic of Uzbekistan*

*Corresponding author: Sanzharbek S. Kosimov; e-mail: nagaeva.gulnora@mail.ru

Abstract

Background. Military units retain a high prevalence of tobacco and environmental inhalational exposure, which predisposes to early obstructive respiratory disorders at a relatively young age.

Aim. To assess the prevalence of risk factors, the profile of early respiratory symptoms and lung function parameters, and to identify factors associated with persistent airflow obstruction in military personnel.

Methods. A total of 387 servicemen were examined. The comparison group comprised 143 individuals without significant risk factors or complaints; the main group comprised 244 individuals with risk factors and/or early symptoms. Functional verification included pre- and post-bronchodilator (pre-BD and post-BD) spirometry. Persistent airflow obstruction was defined as post-BD $FEV_1/FVC < 0.70$. Symptoms were assessed with the COPD Assessment Test (CAT) and the modified Medical Research Council (mMRC) dyspnoea scale.

Results. Smoking was found in 52.2% of the whole sample (66.0% in the main group and 28.7% in the comparison group). Exposure to air pollutants was recorded in 50.8% and 29.4%, respectively. Chronic cough was noted in 34.4% of the main group vs. 6.3% of the comparison group, sputum in 28.3% vs. 4.9%, and dyspnoea in 23.8% vs. 7.7%. The mean CAT score was 12.6 ± 5.1 and 5.8 ± 3.2, respectively. Persistent post-BD obstruction was detected in 43 servicemen (17.6% of the risk group; 11.1% of the whole sample). Among those with obstruction, GOLD grades 1–2 predominated (30.2% and 65.1%). Smoking (odds ratio (OR) 2.9), pack-years (OR 1.8), chronic cough (OR 2.1), CAT ≥ 10 (OR 2.6) and air pollutants (OR 1.7) were independently associated with obstruction.

Conclusion. Servicemen with risk factors develop a stable complex of early respiratory symptoms and a statistically significant decline in lung function. Post-BD verification reveals hidden persistent obstruction in one in six individuals of the risk group, which justifies active case-finding strategies for chronic obstructive pulmonary disease in military medicine.

Keywords: *chronic obstructive pulmonary disease; military personnel; smoking; air pollutants; respiratory symptoms; spirometry; early diagnosis.*

MAIN TEXT

Introduction

Chronic obstructive pulmonary disease (COPD) is one of the leading causes of chronic morbidity and premature mortality and imposes a substantial economic burden [1–5]. Underdiagnosis, particularly at early stages, remains a persistent problem related to insufficient use of spirometry and incomplete post-bronchodilator (post-BD) verification [1, 6, 7].

Military populations are characterised by a combination of risk factors: tobacco smoking, exposure to air pollutants and recurrent respiratory tract infections [8–12]. At the same time, the age structure of military personnel is shifted towards young and middle age, which makes clinical recognition of early COPD difficult without functional confirmation [13–15].

Targeted case-finding in risk groups is considered a more rational strategy than mass screening of asymptomatic individuals [6, 16, 17]. From this perspective, it is essential to describe the profile of early clinical and functional abnormalities and to identify predictors of persistent airflow obstruction in a specific population of servicemen.

The aim of the study was to assess the prevalence of risk factors, the profile of early respiratory symptoms and lung function parameters, and to identify factors associated with persistent airflow obstruction in military personnel.

Material and Methods

Study design and setting

Servicemen undergoing routine medical examinations and/or presenting with respiratory complaints were examined. The study was conducted in 2023–2025 at the medical units of the Military Academy of the Republic of Uzbekistan.

Participants

A total of 387 servicemen were included. The comparison group (n = 143) comprised individuals without significant risk factors and without complaints. The main group (n = 244) comprised individuals with risk factors and/or early respiratory symptoms.

Methods

Clinical and anamnestic assessment (including tobacco exposure in pack-years and exposure to air pollutants), symptom assessment with the COPD Assessment Test (CAT) and the modified Medical Research Council (mMRC) dyspnoea scale, and spirometry before and after bronchodilator testing with quality control of manoeuvres were performed [7, 18–20].

Persistent airflow obstruction was defined as post-BD $FEV_1/FVC < 0.70$ [21–23]. The severity of FEV_1 impairment in individuals with confirmed obstruction was graded according to the GOLD spirometric classification.

Statistical analysis

Data are presented as mean ± standard deviation (M ± SD) or n (%). Associations of factors with obstruction were assessed with logistic regression (odds ratio (OR), 95% confidence interval (CI)); $p < 0.05$ was considered statistically significant.

Results

The characteristics of the sample are shown in Table 1. The mean age of the examined servicemen was 30.2 ± 5.0 years, which reflects the active-duty population and allows early forms of obstructive impairment to be analysed.

Table 1. Main characteristics of the groups (M ± SD)

Parameter	Comparison group	Main group
Age, years	28.4 ± 4.6	31.2 ± 5.1
Length of service, years	6.1 ± 3.4	8.3 ± 4.2
Body mass index, kg/m²	24.1 ± 2.3	25.4 ± 2.8
Smokers, n (%)	41 (28.7)	161 (66.0)
Smoking duration, years*	5.4 ± 2.8	9.1 ± 4.3
Pack-years*	4.6 ± 2.3	11.2 ± 5.7
CAT, points	5.8 ± 3.2	12.6 ± 5.1

** Smoking duration and pack-years are given for smokers (n = 41 in the comparison group; n = 161 in the main group).*

Inhalational exposures were markedly concentrated in the main group (Table 2; Figure 1): 66.0% of servicemen smoked vs. 28.7% in the comparison group, and exposure to air pollutants was found in 50.8% vs. 29.4%. Mean smoking duration and pack-years among smokers of the main group were substantially higher (Table 1).

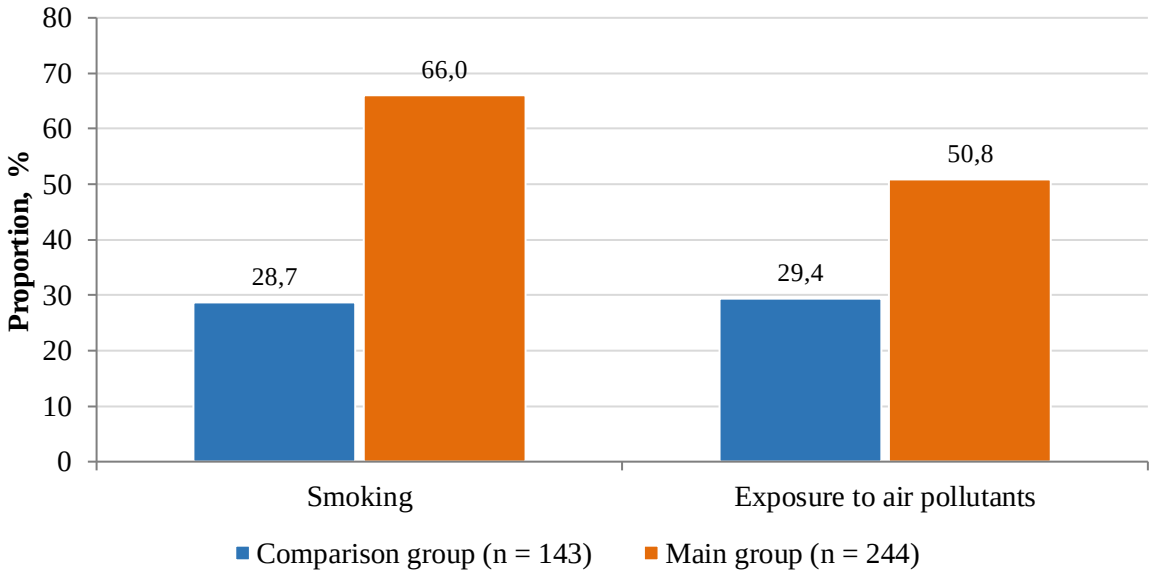


Figure 1. Prevalence of the key inhalational risk factors in the comparison and main groups.

Table 2. Risk factors and symptoms, n (%)

Parameter	Comparison group (n = 143)	Main group (n = 244)
Smoking	41 (28.7)	161 (66.0)
Exposure to air pollutants	42 (29.4)	124 (50.8)
Chronic cough	9 (6.3)	84 (34.4)
Sputum	7 (4.9)	69 (28.3)
Dyspnoea	11 (7.7)	58 (23.8)
Wheezing	4 (2.8)	41 (16.8)
mMRC = 0 (no dyspnoea)	118 (82.5)	129 (52.9)
mMRC ≥ 2	4 (2.8)	43 (17.6)

The clinical profile of the main group was characterised by a higher frequency of symptoms (Figure 2): chronic cough 34.4% vs. 6.3%, sputum 28.3% vs. 4.9%, dyspnoea 23.8% vs. 7.7% and wheezing 16.8% vs. 2.8%. The mean CAT score was 12.6 ± 5.1 in the main group and 5.8 ± 3.2 in the comparison group (Table 1).

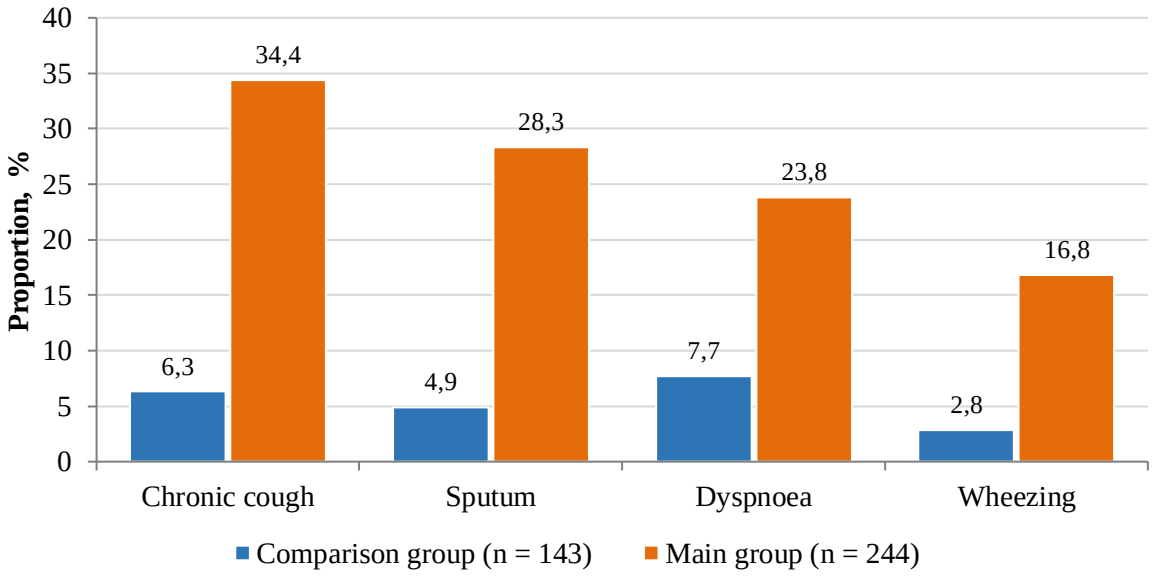


Figure 2. Frequency of the main respiratory symptoms in the comparison and main groups.

Lung function parameters were lower in the main group both before and after bronchodilator (Table 3; Figure 3). Persistent post-BD airflow obstruction was detected in 43 servicemen of the main group (17.6% of the risk group; 11.1% of the whole sample). Spirometric parameters within the main group according to the presence of obstruction are given in Table 4.

Table 3. Spirometric parameters in the groups (M ± SD)

Parameter	Comparison group	Main group
FEV_1, % predicted, pre-BD	96.3 ± 7.4	82.7 ± 12.1
FVC, % predicted, pre-BD	101.4 ± 8.1	94.6 ± 10.7
FEV_1/FVC, pre-BD	0.81 ± 0.04	0.73 ± 0.07
FEV_1, % predicted, post-BD	97.8 ± 7.0	84.1 ± 12.5
FVC, % predicted, post-BD	102.2 ± 8.3	95.1 ± 10.9
FEV_1/FVC, post-BD	0.82 ± 0.04	0.74 ± 0.08

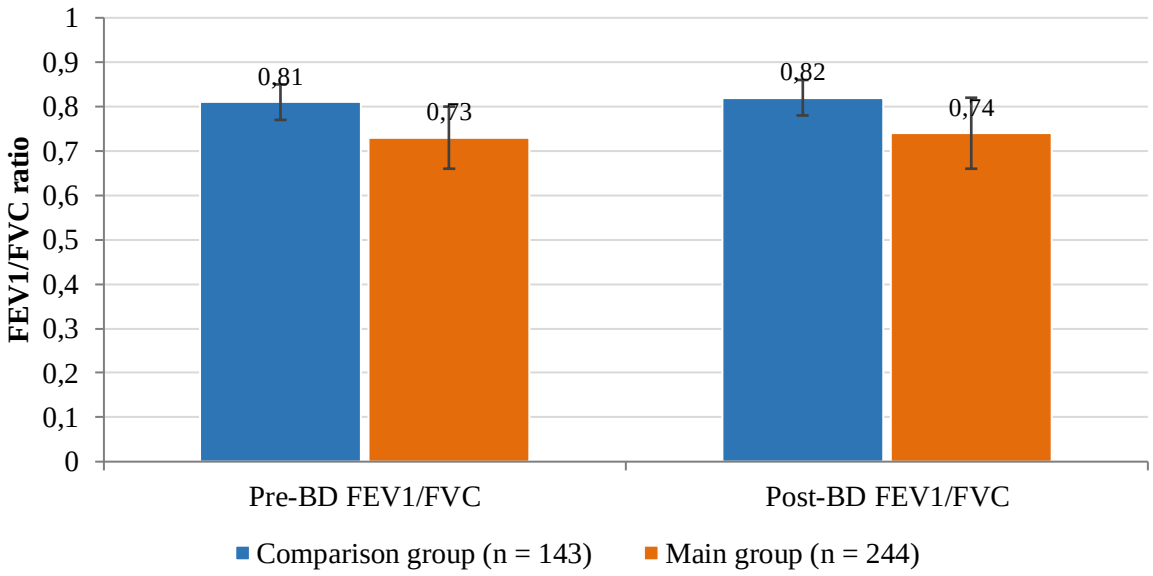


Figure 3. FEV_1/FVC ratio before and after bronchodilator in the comparison and main groups (mean ± SD).

Table 4. Spirometric parameters within the main group (M ± SD)

Parameter	No obstruction (n = 201)	Obstruction (n = 43)
FEV_1, % predicted, pre-BD	86.1 ± 8.7	66.8 ± 9.4
FVC, % predicted, pre-BD	96.2 ± 9.1	87.1 ± 9.8
FEV_1/FVC, pre-BD	0.76 ± 0.04	0.60 ± 0.05
FEV_1, % predicted, post-BD	87.3 ± 8.5	69.1 ± 9.8
FVC, % predicted, post-BD	96.6 ± 9.0	88.1 ± 9.6
FEV_1/FVC, post-BD	0.77 ± 0.04	0.61 ± 0.05

Among individuals with obstruction, GOLD grades 1–2 predominated (30.2% and 65.1%, respectively), corresponding to early or moderate stages (Figure 4): 13, 28, 2 and 0 servicemen had GOLD grades 1, 2, 3 and 4.

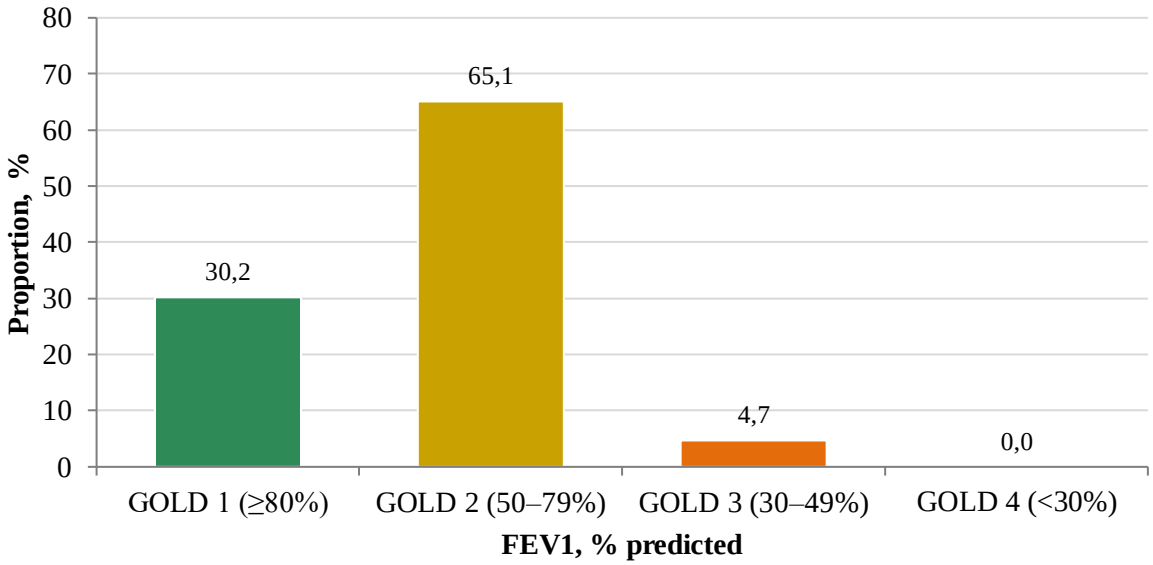


Figure 4. Distribution of FEV_1 impairment grades (GOLD) in servicemen with confirmed obstruction (n = 43).

In the logistic model, smoking (OR 2.9), pack-years (OR 1.8), chronic cough (OR 2.1), CAT ≥ 10 (OR 2.6) and exposure to air pollutants (OR 1.7) were independently associated with persistent obstruction (Table 5).

Table 5. Factors associated with persistent obstruction (logistic regression)

Factor	OR	95% CI	p
Smoking	2.9	1.4–5.8	0.003
Pack-years	1.8	1.2–2.6	0.005
Chronic cough	2.1	1.1–3.9	0.021
CAT ≥ 10	2.6	1.3–4.7	0.006
Exposure to air pollutants	1.7	1.0–2.9	0.048

Correlation analysis showed negative associations between tobacco exposure and lung function parameters, and positive associations of symptom severity (CAT) with risk factors (Table 6).

Table 6. Correlations of risk factors and symptoms with lung function parameters (coefficients)

Parameter	FEV_1, % predicted	FEV_1/FVC	CAT
Pack-years	−0.42	−0.39	0.36
Chronic cough	−0.31	−0.28	0.34
mMRC	−0.37	−0.33	0.41
CAT	−0.45	−0.40	—
Air pollutants	−0.26	−0.22	0.24

Discussion

The results show that even in a relatively young military population a substantial proportion of individuals with risk factors and moderate symptoms develop persistent airflow obstruction. The predominance of GOLD grades 1–2 emphasises the early nature of the detected pathology, which might have remained undiagnosed without active case-finding [1, 6, 13].

The set of independent predictors of obstruction (smoking, pack-years, chronic cough, CAT ≥ 10 and air pollutants) is consistent with the multifactorial nature of early COPD and confirms the value of combined assessment of risk factors and symptoms [6, 8, 21–24].

When interpreting the results, the limitations of the fixed $FEV_1/FVC < 0.70$ threshold in young individuals should be taken into account [16, 21]. In this population, the standard criterion should be combined with follow-up and repeated assessment of individuals with borderline values and a high-risk profile.

The practical conclusion for military medicine is the need for a systematic case-finding strategy: active detection in risk groups with mandatory post-BD verification and quality-assured spirometry [7, 18, 25].

Limitations

The cross-sectional design of the risk factor analysis and the lack of external validation of the identified associations limit the generalisability of the results. Longitudinal studies assessing FEV_1 decline and the risk of exacerbations are required.

Conclusion

Servicemen with risk factors and early symptoms showed a high prevalence of smoking and exposure to air pollutants, accompanied by more frequent cough, sputum and dyspnoea and higher CAT scores. Post-BD spirometry revealed persistent airflow obstruction in 17.6% of the risk group (11.1% of the whole sample), with a predominance of GOLD grades 1–2. Smoking, pack-years, chronic cough, CAT ≥ 10 and air pollutants were independently associated with obstruction and may be used for initial triage and prioritisation of functional testing.

Additional information

Author contributions. All authors contributed to the compilation and layout of this material.

References

1. Buist A.S., McBurnie M.A., Vollmer W.M., Gillespie S., Burney P., Mannino D.M., et al. International variation in the prevalence of COPD (the BOLD Study): a population-based prevalence study. *Lancet*. 2007;370(9589):741–750. https://doi.org/10.1016/S0140-6736(07)61377-4

2. Adeloye D., Song P., Zhu Y., Campbell H., Sheikh A., Rudan I.; NIHR RESPIRE Global Respiratory Health Unit. Global, regional, and national prevalence of, and risk factors for, chronic obstructive pulmonary disease (COPD) in 2019: a systematic review and modelling analysis. *Lancet Respir Med*. 2022;10(5):447–458. https://doi.org/10.1016/S2213-2600(21)00511-7
3. GBD 2015 Chronic Respiratory Disease Collaborators. Global, regional, and national deaths, prevalence, disability-adjusted life years, and years lived with disability for chronic obstructive pulmonary disease and asthma, 1990–2015: a systematic analysis for the Global Burden of Disease Study 2015. *Lancet Respir Med*. 2017;5(9):691–706. https://doi.org/10.1016/S2213-2600(17)30293-X
4. Christenson S.A., Smith B.M., Bafadhel M., Putcha N. Chronic obstructive pulmonary disease. *Lancet*. 2022;399(10342):2227–2242. https://doi.org/10.1016/S0140-6736(22)00470-6
5. Lange P., Celli B., Agustí A., Boje Jensen G., Divo M., Faner R., et al. Lung-function trajectories leading to chronic obstructive pulmonary disease. *N Engl J Med*. 2015;373(2):111–122. https://doi.org/10.1056/NEJMoa1411532
6. Haroon S., Jordan R., Takwoingi Y., Adab P. Diagnostic accuracy of screening tests for COPD: a systematic review and meta-analysis. *BMJ Open*. 2015;5(10):e008133. https://doi.org/10.1136/bmjopen-2015-008133
7. Stanojevic S., Kaminsky D.A., Miller M.R., Thompson B., Aliverti A., Barjaktarevic I., et al. ERS/ATS technical standard on interpretive strategies for routine lung function tests. *Eur Respir J*. 2022;60(1):2101499. https://doi.org/10.1183/13993003.01499-2021
8. Morris M.J., Dodson D.W., Lucero P.F., Haislip G.D., Gallup R.A., Nicholson K.L., et al. Study of active duty military for pulmonary disease related to environmental deployment exposures (STAMPEDE). *Am J Respir Crit Care Med*. 2014;190(1):77–84. https://doi.org/10.1164/rccm.201402-0372OC
9. King M.S., Eisenberg R., Newman J.H., Tolle J.J., Harrell F.E. Jr., Nian H., et al. Constrictive bronchiolitis in soldiers returning from Iraq and Afghanistan. *N Engl J Med*. 2011;365(3):222–230. https://doi.org/10.1056/NEJMoa1101388
10. Falvo M.J., Osinubi O.Y., Sotolongo A.M., Helmer D.A. Airborne hazards exposure and respiratory health of Iraq and Afghanistan veterans. *Epidemiol Rev*. 2015;37:116–130. https://doi.org/10.1093/epirev/mxu009
11. Eisner M.D., Anthonisen N., Coultas D., Kuenzli N., Perez-Padilla R., Postma D., et al. An official American Thoracic Society public policy statement: novel risk factors and the global burden of chronic obstructive pulmonary disease. *Am J Respir Crit Care Med*. 2010;182(5):693–718. https://doi.org/10.1164/rccm.200811-1757ST
12. Salvi S.S., Barnes P.J. Chronic obstructive pulmonary disease in non-smokers. *Lancet*. 2009;374(9691):733–743. https://doi.org/10.1016/S0140-6736(09)61303-9
13. Martinez F.J., Han M.K., Allinson J.P., Barr R.G., Boucher R.C., Calverley P.M.A., et al. At the root: defining and halting progression of early chronic obstructive pulmonary disease. *Am J Respir Crit Care Med*. 2018;197(12):1540–1551. https://doi.org/10.1164/rccm.201710-2028PP

14. Woodruff P.G., Barr R.G., Bleecker E., Christenson S.A., Couper D., Curtis J.L., et al. Clinical significance of symptoms in smokers with preserved pulmonary function. *N Engl J Med*. 2016;374(19):1811–1821. https://doi.org/10.1056/NEJMoa1505971

15. Kohansal R., Martinez-Camblor P., Agustí A., Buist A.S., Mannino D.M., Soriano J.B. The natural history of chronic airflow obstruction revisited: an analysis of the Framingham offspring cohort. *Am J Respir Crit Care Med*. 2009;180(1):3–10. https://doi.org/10.1164/rccm.200901-0047OC

16. US Preventive Services Task Force, Siu A.L., Bibbins-Domingo K., Grossman D.C., Davidson K.W., Epling J.W. Jr., et al. Screening for chronic obstructive pulmonary disease: US Preventive Services Task Force recommendation statement. *JAMA*. 2016;315(13):1372–1377. https://doi.org/10.1001/jama.2016.2638

17. Qaseem A., Wilt T.J., Weinberger S.E., Hanania N.A., Criner G., van der Molen T., et al. Diagnosis and management of stable chronic obstructive pulmonary disease: a clinical practice guideline update from the American College of Physicians, American College of Chest Physicians, American Thoracic Society, and European Respiratory Society. *Ann Intern Med*. 2011;155(3):179–191. https://doi.org/10.7326/0003-4819-155-3-201108020-00008

18. Graham B.L., Steenbruggen I., Miller M.R., Barjaktarevic I.Z., Cooper B.G., Hall G.L., et al. Standardization of spirometry 2019 update: an official American Thoracic Society and European Respiratory Society technical statement. *Am J Respir Crit Care Med*. 2019;200(8):e70–e88. https://doi.org/10.1164/rccm.201908-1590ST

19. Jones P.W., Harding G., Berry P., Wiklund I., Chen W.H., Kline Leidy N. Development and first validation of the COPD Assessment Test. *Eur Respir J*. 2009;34(3):648–654. https://doi.org/10.1183/09031936.00102509

20. Bestall J.C., Paul E.A., Garrod R., Garnham R., Jones P.W., Wedzicha J.A. Usefulness of the Medical Research Council (MRC) dyspnoea scale as a measure of disability in patients with chronic obstructive pulmonary disease. *Thorax*. 1999;54(7):581–586. https://doi.org/10.1136/thx.54.7.581

21. Agustí A., Celli B.R., Criner G.J., Halpin D., Anzueto A., Barnes P., et al. Global Initiative for Chronic Obstructive Lung Disease 2023 Report: GOLD executive summary. *Eur Respir J*. 2023;61(4):2300239. https://doi.org/10.1183/13993003.00239-2023

22. Quanjer P.H., Stanojevic S., Cole T.J., Baur X., Hall G.L., Culver B.H., et al. Multi-ethnic reference values for spirometry for the 3–95-yr age range: the global lung function 2012 equations. *Eur Respir J*. 2012;40(6):1324–1343. https://doi.org/10.1183/09031936.00080312

23. Mohamed Hoesein F.A., Zanen P., Lammers J.W. Lower limit of normal or FEV1/FVC < 0.70 in diagnosing COPD: an evidence-based review. *Respir Med*. 2011;105(6):907–915. https://doi.org/10.1016/j.rmed.2011.01.008

24. Lamprecht B., McBurnie M.A., Vollmer W.M., Gudmundsson G., Welte T., Nizankowska-Mogilnicka E., et al. COPD in never smokers: results from the population-based burden of obstructive lung disease study. *Chest*. 2011;139(4):752–763. https://doi.org/10.1378/chest.10-1253

25. Fletcher C., Peto R. The natural history of chronic airflow obstruction. *Br Med J*. 1977;1(6077):1645–1648. https://doi.org/10.1136/bmj.1.6077.1645

Information about the authors

Sanzharbek S. Kosimov — Fergana Regional Center of Phthisiology and Pulmonology, Fergana, Republic of Uzbekistan

Zarina A. Pulatova — Military Medical Institute, University of Military Security and Defense of the Republic of Uzbekistan, Tashkent, Republic of Uzbekistan