Smoking and sleep disorders (population-based study under the WHO "MONICA-psychosocial" program)

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Objective: *to study the connection between smoking and sleep disorders in the open population of 45–64 year old in Novosibirsk.*
Patients and methods. *IV screening of the population was carried out in 2003–2005, 1650 persons were examined (576 men, mean age – 54.23±0.2 years, response – 61%; 1074 women, mean age – 54.27±0.2 years, response – 72%). Attitudes towards smoking were studied using the scale "Knowledge and attitude to one's health" of the WHO "MONICA-psychosocial" program. To study sleep disorders and sleep duration, a standard Jenkins questionnaire was used.*
Results and discussion. *In an open population of 45–64 years of age, 65.8% of men experienced sleep problems (satisfactory sleep – 53.6%, poor sleep – 12.2%) and 78.6% of women (satisfactory sleep – 58.9%, poor sleep – 19.7%; χ^2=38.553; df=2; p<0.001). 78.9% of men and 34.7% of women smoked (χ^2=313.175; df=5; p<0.001). Men who smoke more often rated sleep as "bad" (82.9%) than "good" (76.2%; χ^2=32.267; df=10; p<0.001). Women who tried to quit smoking were more likely to have "bad" sleep (4.7%) than "good" sleep (2.6%; χ^2=69.747; df=10; p<0.001). Among male smokers, the duration of sleep was 5–6 hours (76.9%) more often than 9–10 hours (67.6%; χ^2=3.696; df=2; p>0.05). Women who smoke were more likely to report 5–6 hours of sleep (30%) than 9–10 hours (18.2%).*
Conclusion. *It has been established that smoking men and women aged 45–64 are more likely to experience both sleep disorders and lack of sleep.*

Keywords: *smoking; sleep; sleep disorders; sleep duration; population; men; women.*
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For reference: *Gafarov VV, Gromova EA, Panov DO, et al. Smoking and sleep disorders (population-based study under the WHO "MONICA-psychosocial" program). Nevrologiya, neiropsikhiatriya, psikhosomatika = Neurology, Neuropsychiatry, Psychosomatics. 2022;14(4):33–37.*
DOI: *10.14412/2074-2711-2022-4-33-37*

Introduction

Cigarette smoking remains a serious health burden and causes significant morbidity and mortality around the world. In 2015 there were 933.1 million daily smokers in the world, and 6.4 million deaths (11.5% of world deaths) were associated with cigarette smoking. More than three quarters of deaths associated with smoking were among men, and 52.2% of these deaths occurred only in four countries (China, India, the USA, and Russia) [1].

Nicotine, a stimulator in cigarettes which causes addiction, not only makes it difficult to quit smoking, but also causes withdrawal symptoms, including night symptoms associated with poor sleep or even insomnia [2]. Compared with people who do not smoke, smokers are more likely to experience breathing disturbances during sleep, apnea, insomnia, poor sleep quality, shorter sleep duration, daytime drowsiness, and increased difficulty maintaining sleep [3, 4]. Poor sleep causes growing concerns among health care providers all over the world, since it is associated with impaired emotional and cognitive function [5], deterioration in the quality of life [6], nonsuicidal self-harm [7], as well as increased risk of numerous somatic diseases, such as obesity, cardiovascular disease and associated mortality [8]. These conditions are probably exacerbated by cigarette smoking [9, 10]. Thus, the study of the relationship between the quality of sleep and cigarette smoking is crucial for many chronic conditions [10].

Smoking can contribute to insufficient duration of sleep, since smokers need more time to fall asleep, and have a longer latent sleep delay [11]. Night smoking, a common cause of poor and insufficient sleep, occurs in approximately 41% of smokers [12]. Unhealthy sleep before and during smoking cessation is considered an independent cause of relapse, and insomnia is a clinically confirmed symptom of withdrawal [13].

Although it is well known that smokers are more vulnerable to unhealthy sleep, the alleged relationship between usual sleep and smoking has been less studied. Population studies are needed to measure a degree of insufficient sleep duration which can be a viable risk factor for continuing smoking. To date, studies of the relationship between the quality of sleep and smoking are limited. Understanding this relationship is crucial for the development of innovative clinical interventions and, as a result, improvement of the outcomes of smoking cessation [11].

Thus, the purpose of our study was to analyze the relationship between smoking and sleep disturbances among residents of Novosibirsk aged 45–64 years.

Materials and methods

Within the framework of Screening IV in 2003–2005, a random representative sample of the population of 45–64 years old permanently residing in the Oktyabrsky district of Novosibirsk

was examined (n=1650; 576 men, mean age – 54.23±0.2 years, response rate 61%; 1074 women, mean age 54.27±0.2 years, response rate 72%) [15].

Smoking status was studied using the scale "Knowledge and Attitude to One's Health". To study sleep disturbances and duration of sleep, the standard Jenkins Sleep Questionnaire was used. The scales were adapted during a large-scale epidemiological study performed as part of the WHO program Monica (Multinational Monitoring of Trends and Determinants of Cardiovascular Disease) and subprograms of the Monica-Psychosocial Option Study (MOPSI). [16]. The questionnaires were filled by the participants on their own.

Table 1. *Self-reported sleep quality in an open population among the people aged 45–64 years, n (%)*

Self-assessment of sleep	Men	Women	Total
Good sleep	197 (34.2)	229 (21.3)	426 (25.8)
Satisfactory sleep	309 (53.6)	633 (58.9)	942 (57.1)
Bad sleep	70 (12.2)	212 (19.7)	282 (17.1)
Total	576 (100)	1074 (100)	1650 (100)
$\chi 2$=38.553, df=2, p<0.001			

Table 2. *Sleep duration in the open population aged 45–64 years, n (%)*

Sex	Sleep duration			Total
	⩽5–6 h	7–8 h	⩾9–10 h	
Men	121 (34.8)	418 (34.5)	37 (40.2)	576 (34.9)
Women	227 (65.2)	792 (65.5)	55 (59.8)	1074 (65.1)
Total	348 (100)	1210 (100)	92 (100)	1650 (100)
χ^2=1.214, df=2, p>0.05				

Table 3. *Smoking status in the open population aged 45–64 years, n (%)*

Smoking status	Men	Woman	Total
I have never smoked	122 (21.2)	700 (65.2)	822 (49.8)
I smoked, but I have quit	217 (37.7)	220 (20.5)	437 (26.5)
I still smoke, but less	46 (8.0)	52 (4.8)	98 (5.9)
I still smoke, but I quit for some time in the past	61 (10.6)	37 (3.4)	98 (5.9)
I tried to change my smoking behavior, but unsuccessfully	70 (12.2)	39 (3.6)	109 (6.6)
I smoke, I have never tried to quit smoking	60 (10.4)	26 (2.4)	86 (5.2)
Total	576 (100)	1074 (100)	1650 (100)
χ^2=313.175, df=5, p<0.001			

Statistical analysis was carried out using a package of computer programs SPSS 19 [15]. To check the statistical significance of the differences between the groups, the chi-squared criterion was used. The values p⩽0.05 were considered statistically significant [17].

Results

In the open population aged 45–64 years, 74.2% experienced problems with sleep: 65.8% of men (satisfactory sleep – 53.6%, poor sleep – 12.2%) and 78.6% of women (satisfactory sleep – 58.9%, poor sleep – 19.7%) (χ^2=38.553, df=2, p<0.001) (Table 1).

Significant differences in the duration of sleep between men and women in the open population of 45–64 years old have not been found (χ^2=1.214, df=2, p>0.05) (Table 2).

In the studied population, 50.1% of people smoked: men – 78.9%, women – 34.7%; Moreover, 12.2% of men and 3.6% of women tried to change their smoking behavior, but without success, and 10.6% of men and 3.4% of women tried to quit smoking for a while. 21.2% of men and 65.2% of women never smoked (χ^2=313.175, df=5, p<0.001) (Table 3).

Among men who have never smoked, good quality of sleep prevailed (23.9%); only 17.1% assessed their sleep as bad. Smoking men more often rated their sleep as bad (82.9%) than good (χ^2=32.267, df=10, p<0.001). Non-smoking women did not have a significant difference in sleep self-assessment. However, those women who tried to quit smoking more often reported having bad sleep than good sleep (4.7% vs 2.6%) (χ^2=69.747, df=10, p<0.001) (Table 4).

Smoking men reported sleep duration of 5–6 hours more often than 9–10 hours (76.9% vs 67.6%); non-smokers, on the contrary, more often had sleep duration of 9–10 hours (32.4 %) than 5–6 hours (23.1%) (χ^2=3.696, df=2, p>0.05). Smoking women also noted sleep duration of 5–6 hours more often than 9–10 hours (30% vs 18.2%). Among non-smoking women, on the contrary, women who reported a 9–10-hour sleep (81.8%) prevailed over those with a 5–6-hour sleep (70%) (Table 5).

Discussion

Sleep is necessary to strengthen and maintain health, development and functioning at all stages of life. Insufficient amount and quality of sleep is associated with disorders of mental health, poor sociability, behavioral problems, development of obesity and its concomitant diseases, such as cardiovascular disease and diabetes [18]. In addition, sleep problems are associated with an increased frequency of depression, anxiety, worsening of attention, and aggressive behavior, [19]. Epidemiological studies show that about 26–35% of adults have poor sleep quality [19, 20]. In our population, sleep problems turned out to be the most significant: two-thirds of men and women experienced some kind of sleep disturbances.

It is well known that tobacco smoking is harmful to health in general and is one of the main causes of death

and disease [19]. Although the association between smoking and sleep disorders is described in the world literature [21–23], there are some studies in which the authors did not find any connection between smoking and symptoms of insomnia or other sleep problems [21], which motivated us to study this topic.

In our population sample (45 to 64 years old), two – thirds of men and one third of women were smokers. One fifth of men (20.1%) and two – thirds of women (65.2%) have never smoked, and among men who have never smoked, good sleep predominated. Most smoking men rated their sleep as "bad" (82.9%). Although among non-smoking women there was no significant difference in the self-assessment of sleep, those women who tried to quit smoking more often noted that they had bad sleep (4.7%). In the world literature there are studies in which sleep disturbances are regarded as a clinically confirmed symptom of nicotine withdrawal [24]. For example, at least 42% of people who abstain from smoking [25] (in some studies up to 80% of smokers [26]) usually experience sleep disturbances which are further aggravated after smoking cessation [27].

As for the differences in the duration and time of sleep, smokers report a shorter sleep duration and more time needed to fall asleep than non-smokers [28]. Although we did not reveal significant differences in the duration of sleep in the studied population, a certain tendency to prevalence of 5–6-hour sleep (76.9%) was observed among smoking men. Smoking women more often had sleep duration of 5–6 hours (30%) than 9–10 hours (18.2%). Our data is consistent with the results found in the world literature. For example, population data obtained from the National Health and Nutrition Examination Survey (NHANES) showed that the average duration of sleep for smokers is 6.6 hours compared with 6.9 hours for non-smokers and those who never smoked [29]. According to The United Kingdom Biobank in a sample of 34401 smokers, 30.8% reported a short sleep (⩽6 hours), and 9.3% reported a sleep duration of ⩾9 hours [28]. In another study, it was shown that the duration of sleep was much shorter in adult smokers than in non-smokers, and this correlation was significant even for "light" smokers (<15 cigarettes per day) compared to non-smokers [30].

Thus, the existing relationship between sleep and smoking can lead to understanding of how normalization of sleep can contribute to smoking cessation and, on the other hand, smoking cessation can improve the quality of sleep. Currently, sleep remains poorly understood and is insufficiently used to promote smoking cessation and prevent relapses in smokers who seek medical help to stop smoking. It is hoped that the totality of evidence that sheds light on the relationship between sleep, tobacco use and the results of smoking cessation will ultimately allow to identify a certain phenotype of sleep, which may increase the risk of continuing smoking. This base of knowledge, in turn, will serve as the basis for targeted approaches to interventions aimed at promoting smoking cessation in smokers who are most vulnerable to sleep deficit [28].

Table 4. *Self-reported sleep quality and smoking status in an open population aged 45–64 years, n (%)*

Self-reported sleep quality and smoking status	Sleep: good	satisfactory	bad	Total
Men				
I have never smoked	47 (23.9)	63 (20.4)	12 (17.1)	122 (21.2)
I smoked, but I have quit	64 (32.5)	126 (40.8)	27 (38.6)	217 (37.7)
I still smoke, but less	13 (6.6)	25 (8.1)	8 (11.4)	46 (8.0)
I still smoke, but I quit for some time in the past	17 (8.6)	30 (9.7)	14 (20.0)	61 (10.6)
I tried to change my smoking behavior, but unsuccessfully	20 (10.2)	43 (13.9)	7 (10.0)	70 (12.2)
I smoke, I have never tried to quit smoking	36 (18.3)	22 (7.1)	2 (2.9)	60 (10.4)
Total	197 (100)	309 (100)	70 (100)	576 (100)
χ^2=32.267, df=10, p<0.001				
Women				
I have never smoked	166 (72.5)	374 (59.1)	160 (75.5)	700 (65.2)
I smoked, but I have quit	18 (7.9)	180 (28.4)	22 (10.4)	220 (20.5)
I still smoke, but less	17 (7.4)	26 (4.1)	9 (4.2)	52 (4.8)
I still smoke, but I quit for some time in the past	12 (5.2)	19 (3.0)	6 (2.8)	37 (3.4)
I tried to change my smoking behavior, but unsuccessfully	6 (2.6)	23 (3.6)	10 (4.7)	39 (3.6)
I smoke, I have never tried to quit smoking	10 (4.4)	11 (1.7)	5 (2.4)	26 (2.4)
Total	229 (100)	633 (100)	212 (100)	1074 (100)
χ^2=69.747, df=10, p<0.001				

Table 5. *Relationship between smoking status and sleep duration in an open population aged 45–64 years, n (%)*

Self-reported sleep quality and smoking status	Sleep duration: 5–6 h	7–8 h	9–10 h	Total
Men				
Non-smokers	28 (23.1)	82 (19.6)	12 (32.4)	122 (21.2)
Smokers	93 (76.9)	336 (80.4)	25 (67.6)	454 (78.8)
Total	121 (100.0)	418 (100.0)	37 (100.0)	576 (100.0)
χ^2=3.696, df=2, p>0.05				
Women				
Non-smokers	159 (70.0)	496 (62.6)	45 (81.8)	700 (65.2)
Smokers	68 (30.0)	296 (37.4)	10 (18.2)	374 (34.8)
Total	227 (100)	792 (100)	55 (100)	1074 (100)
χ^2=11.350, df=2, p<0.05				

Conclusions

1. In the open population aged 45–64 years, sleep problems were reported by 65.8% of men (satisfactory sleep 53.6%, poor sleep – 12.2%) and 78.6% of women (satisfactory sleep – 58.9%, bad sleep – 19.7%).
2. 78.9% of men and 34.7% of women were smokers; 21.2% of men and 65.2% of women never smoked.
3. Smoking men more often characterized their sleep as "bad" than "good" (82.9%). Non-smoking women did not have a significant difference in self-assessment of sleep.
4. Among smoking men, there was a tendency to a shorter sleep duration – 5–6 hours (76.9%). Smoking women also more often reported the duration of sleep of 5–6 hours (30%).

REFERENCES

1. GBD 2015 Tobacco Collaborators. Smoking prevalence and attributable disease burden in 195 countries and territories, 1990–2015: a systematic analysis from the global burden of disease study 2015. *Lancet*. 2017 May 13;389(10082):1885-906. doi: 10.1016/S0140-6736(17)30819-X. Epub 2017 Apr 5.

2. Benowitz NL. Pharmacology of nicotine: addiction, smoking-induced disease, and therapeutics. *Annu Rev Pharmacol Toxicol.* 2009;49:57-71. doi: 10.1146/annurev.pharmtox.48.113006.094742

3. Deleanu OC, Pocora D, Mihalcuta S, et al. Influence of smoking on sleep and obstructive sleep apnea syndrome. *Pneumologia (Bucharest, Romania)*. Jan-Mar 2016;65(1):28-35. Available from: http://www.ncbi.nlm.nih.gov/pubmed/27209838

4. Cohrs S, Rodenbeck A, Riemann D, et al. Impaired sleep quality and sleep duration in smokers – results from the German Multicenter Study on Nicotine Dependence. *Addict Biol.* 2014 May;19(3):486-96. doi: 10.1111/j.1369-1600.2012.00487.x. Epub 2012 Aug 23.

5. Baglioni C, Spiegelhalder K, Lombardo C, Riemann D. Sleep and emotions: a focus on insomnia. *Sleep Med Rev.* 010 Aug;14(4):227-38. doi: 10.1016/j.smrv.2009.10.007. Epub 2010 Feb 6.

6. Schubert CR, Cruickshanks KJ, Dalton DS, et al. Prevalence of sleep problems and quality of life in an older population. *Sleep*. 2002 Dec;25(8):889-93.

7. Liu X, Chen H, Bo Q-G, et al. Poor sleep quality and nightmares are associated with non-suicidal self-injury in adolescents. *Eur Child Adolesc Psychiatry.* 2017 Mar;26(3):271-9. doi: 10.1007/s00787-016-0885-7. Epub 2016 Jul 6.

8. Milrad SF, Hall DL, Jutagir DR, et al. Poor sleep quality is associated with greater circulating pro-inflammatory cytokines and severity and frequency of chronic fatigue syndrome/myalgic encephalomyelitis (CFS/ME) symptoms in women. *J Neuroimmunol.* 2017 Feb 15;303:43-50. doi: 10.1016/j.jneuroim.2016.12.008. Epub 2016 Dec 14.

9. Purani H, Friedrichsen S, Allen AM. Sleep quality in cigarette smokers: Associations with smoking-related outcomes and exercise. *Addict Behav.* 2019 Mar;90:71-6. doi: 10.1016/j.addbeh.2018.10.023. Epub 2018 Oct 17.

10. National Center for Chronic Disease Prevention and Health Promotion (US) Office on Smoking and Health. The Health Consequences of Smoking – 50 Years of Progress: A Report of the Surgeon General. Atlanta (GA): Centers for Disease Control and Prevention (US); 2014.

11. Patterson F, Malone SK, Lozano A, et al. Smoking, screen-based sedentary behavior, and diet associated with habitual sleep duration and chronotype: Data from the UK Biobank. *Ann Behav Med.* 2016 Oct;50(5):715-26. doi: 10.1007/s12160-016-9797-5

12. Scharf DM, Dunbar MS, Shiffman S. Smoking during the night: Prevalence and smoker characteristics. *Nicotine Tob Res.* 2008 Jan;10(1):167-78. doi: 10.1080/14622200701767787

13. Peltier MR, Lee J, Ma P, et al. The influence of sleep quality on smoking cessation in socioeconomically disadvantaged adults. *Addict Behav.* 2017 Mar;66:7-12. doi: 10.1016/j.addbeh.2016.11.004. Epub 2016 Nov 5.

14. Sweitzer MM, Denlinger RL, Donny EC. Dependence and Withdrawal-Induced Craving Predict Abstinence in an Incentive-Based Model of Smoking Relapse. *Nicotine Tob Res.* 2013 Jan;15(1):36-43. doi: 10.1093/ntr/nts080. Epub 2012 Apr 17.

15. UCL department of epidemiology and public health central and eastern europe research group HAPIEE Study [электронный ресурс]. Available from: http://www.ucl.ac.uk/easteurope/hapiee-cohort.htm (заглавие с экрана).

16. MONICA Monograph and Multimedia Sourcebook. Helsinki; 2003. 237 p.

17. Pandis N. The chi-square test. *Am J Orthod Dentofacial Orthop.* 2016 Nov;150(5):898-9. doi: 10.1016/j.ajodo.2016.08.009

18. Zhou B, Ma Y, Wei F, et al. Association of active/passive smoking and urinary 1-hydroxypyrene with poor sleep quality:A cross-sectional survey among Chinese male enterprise workers. *Tob Induc Dis.* 2018 May 22;16:23. doi: 10.18332/tid/90004. eCollection 2018.

19. Ravichandran V, Mohanraj KG, Chaudhary M. Association between active and passive smoking with insufficient sleep in adult and aged male population – a survey based analysis. *Eur J Mol Clin Med.* 2020;7(1):772-84.

20. Tang J, Liao Y, Kelly BC, et al. Gender and Regional Differences in Sleep Quality and Insomnia: A General Population-based Study in Hunan Province of China. *Sci Rep*. 2017 Mar 6;7:43690. doi: 10.1038/srep43690

21. Suzuki K, Ohida T, Yokoyama E, et al. Smoking among Japanese nursing students: nationwide survey. *J Adv Nurs.* 2005 Feb;49(3):268-75. doi: 10.1111/j.1365-2648.2004.03291.x

22. Phillips BA, Danner FJ. Cigarette smoking and sleep disturbance. *Arch Intern Med.* 1995 Apr 10;155(7):734-7.

23. Akerstedt T, Knutsson A, Westerholm P, et al. Sleep disturbances, work stress and work hours: a cross-sectional study. *J Psychosom Res.* 2002 Sep;53(3):741-8. doi: 10.1016/s0022-3999(02)00333-1

24. Patterson F, Grandner MA, Malone SK, et al. Sleep as a Target for Optimized Response to Smoking Cessation Treatment. *Nicotine Tob Res.* 2019 Jan 4;21(2):139-48. doi: 10.1093/ntr/ntx236

25. Okun ML, Levine MD, Houck P, et al. Subjective sleep disturbance during a smoking cessation program: associations with relapse. *Addict Behav.* 2011 Aug;36(8):861-4. doi: 10.1016/j.addbeh.2011.03.001. Epub 2011 Mar 9.

26. Zhang L, Samet J, Caffo B, et al. Power spectral analysis of EEG activity during sleep in cigarette smokers. *Chest*. 2008 Feb;133(2):427-32. doi: 10.1378/chest.07-1190. Epub 2007 Oct 9.

27. Jaehne A, Unbehaun T, Feige B, et al. Sleep changes in smokers before, during and 3 months after nicotine withdrawal. *Addict Biol.* 2015 Jul;20(4):747-55. doi: 10.1111/adb.12151. Epub 2014 May 4.

28. Branstetter SA, Horton WJ, Mercincavage M, Buxton OM. Severity of Nicotine Addiction and Disruptions in Sleep Mediated by Early Awakenings. *Nicotine Tob Res.* 2016 Dec;18(12):2252-9. doi: 10.1093/ntr/ntw179. Epub 2016 Jul 14.

29. Riedel BW, Durrence HH, Lichstein KL, et al. The relation between smoking and sleep: the influence of smoking level, health, and psychological variables. *Behav Sleep Med.* 2004;2(1):63-78. doi: 10.1207/s15402010bsm0201_6

Received/Reviewed/Accepted
20.05.2022/17.06.2022/04.08.2022

Conflict of Interest Statement

The investigation has been conducted within budget financed topic No. 122031700094-5. There are no conflicts of interest. The authors are solely responsible for submitting the final version of the manuscript for publication. All the authors have participated in developing the concept of the article and in writing the manuscript. The final version of the manuscript has been approved by all the authors.

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