Family Medicine & Primary Care Review 2020; 22(3): 228–234 https://doi.org/10.5114/fmpcr.2020.98251

ORIGINAL PAPERS

ISSN 1734-3402, eISSN 2449-8580

Analysis of the relationship between insomnia and adult chronic diseases with regard to working conditions

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A – Study Design, **B** – Data Collection, **C** – Statistical Analysis, **D** – Data Interpretation, **E** – Manuscript Preparation, **F** – Literature Search, **G** – Funds Collection

Summary **Background.** Sleep is one of the most important physiological needs of man. It ensures health, regeneration and the concentration necessary to fulfil professional roles.
Objectives. The aim of this study was to determine the relationship between insomnia and selected adult chronic diseases, taking into account working conditions and employment status.
Material and methods. The study involved 597 individuals, including 360 (60.3%) women and 237 (39.7%) men, as well as 396 (66.33%) employed and 201 (33.67%) unemployed subjects. The instruments used in the study were the Athens Insomnia Scale (AIS) and a self-developed sociodemographic questionnaire.
Results. The most common disease was hypertension (116; 19.43%). There was a statistically significant relationship between hypertension and employment status ($p \leq 0.001$), as well as between asthma/COPD and employment status ($p = 0.012$). COPD was more prevalent in unemployed subjects. Every fourth person with hypertension suffered from insomnia. Insomnia was observed in every fifth person working shifts, and one-third of them was at risk of insomnia.
Conclusions. Unemployed respondents more often suffered from various diseases. The age factor and working and living conditions (contract work, shift work, unemployment) are factors contributing to the occurrence or worsening of insomnia and chronic diseases. Insomnia and a lack of depth and quality of sleep can be due to the level of professional and life stress, working and living conditions, social instability and chronic diseases.
Key words: sleep initiation and maintenance disorders, chronic disease, adult.

Wolińska W, Brzeźniak H, Mroczek B. Analysis of the relationship between insomnia and adult chronic diseases with regard to working conditions. *Fam Med Prim Care Rev* 2020; 22(3): 228–234, doi: https://doi.org/10.5114/fmpcr.2020.98251.

Background

Sleep is one of the most important physiological needs of man. It ensures health, regeneration and the concentration necessary to fulfil professional roles [1]. According to the Diagnostic and Statistical Manual of Mental Disorders, Fifth Edition (DSM-5), insomnia is diagnosed when one or more symptoms occur, such as difficulty falling asleep, difficulty in maintaining sleep continuity (frequent waking up at night and being unable to fall asleep again) and waking up early in the morning and being unable to fall asleep. These symptoms must occur for at least three nights a week and last for at least three months [2].

Insomnia is determined by many factors, among them chronic diseases, age and gender. Studies have shown that insomnia is related to cardiovascular and metabolic disorders, such as coronary thrombosis, stroke, hypertension, diabetes, obesity, atherosclerosis, heart failure, arrhythmia and others [3]. Insufficient time of sleep and its low quality can contribute to hypertension [4]. Changes in sleep structure and phases are more often observed in people suffering from hypertension than in those who have not been diagnosed with this disease. Hypertensive patients more often wake up in the middle of the night, and sleep does not give them the opportunity to regenerate and rest [5].

The circadian rhythm of sleep plays a significant role in diabetes [6]. The following changes in sleep phases were observed in a group of people with type 2 diabetes: a decreased amount of non-rapid eye movement (NREM) sleep, a larger amount of rapid eye movement (REM) sleep, as well as more frequent awakening during the night with an inability to fall asleep again [7]. In the course of chronic insomnia, reduced sleep is manifested by glucose intolerance in the body, which in the long term can lead to a decrease in the amount of insulin in the pancreas [8].

Thyroid diseases also affect human sleep. Both hypothyroidism and hyperthyroidism cause difficulty in falling asleep and maintaining sleep, as well as delayed or early slow-wave sleep [9, 10]. What is more, intravenous administration of thyrotropin-releasing hormone (TRH) can affect some of the sleep parameters: it can shorten sleep time, cause daytime sleepiness and extend nocturnal awake times [11].

Objectives

The aim of this study was to determine the relationship between insomnia and selected adult chronic diseases, taking into account working conditions and employment status.

Hypotheses:

1) chronic diseases are more common in unemployed people,
2) insomnia is often related to chronic diseases,
3) sleep problems are related to employment status.

Material and methods

Study design

This was a cross-sectional retrospective study.

Table 1. Characteristics of the study sample

Variable		Total *n* (%)	Employed *n* (%)	Unemployed *n* (%)
Gender	women men	360 (60.3) 237 (39.7)	230 (63.89) 166 (70.04)	130 (36.11) 71 (29.96)
Age	up to 25 years 26–35 36–45 46–55 over 56 years	171 (28.64) 157 (26.3) 80 (13.4) 93 (15.58) 96 (16.08)	99 (57.9) 128 (81.53) 69 (86.25) 72 (77.42) 28 (29.17)	72 (42.1) 29 (18.47) 11 (13.75) 21 (22.58) 68 (70.83)
BMI	underweight normal weight overweight obesity	24 (4.02) 312 (52.26) 210 (35.18) 51 (8.54)	16 (66.67) 219 (70.19) 132 (62.86) 29 (56.86)	8 (33.33) 93 (29.81) 78 (37.14) 22 (43.14)
Form of employment	employment contract yes no	–	 277 (69.95) 119 (30.05)	–
	freelance agreement yes no	–	 73 (18.43) 323 (81.57)	–
	contract for a specific task yes no	–	 5 (1.26) 391 (98.74)	–
	contract yes no	–	 20 (5.05) 376 (94.95)	–
	other yes no	–	 34 (8.61) 361 (91.39)	–
Years worked	one year or less 1–3 years 3–8 years 9–18 years over 18 years	–	103 (26.01) 92 (23.23) 84 (21.21) 64 (16.16) 53 (13.38)	– – – – –
Shift work	yes no not given	201 (33.67) 385 (64.49) 11 (1.84)	137 (68.16) 259 (67.27) –	64 (31.84) 126 (32.73) 11 (100)
Self-assessed financial standing	very good good satisfactory bad	62 (10.39) 299 (50.08) 208 (34.84) 28 (4.69)	51 (82.26) 208 (69.57) 125 (60.1) 12 (42.86)	11 (17.74) 91 (30.43) 83 (39.9) 16 (57.14)

Setting and ethical consideration

The study was conducted in Poland. The criteria for inclusion in the study were being 18 to 65 years of age, residing in West Pomeranian Voivodeship and consent to participate in the study. Respondents were selected using quota sampling based on gender, place of residence and employment status.

The project was approved by the Bioethical Commission of the Pomeranian Medical University, Szczecin (KB-0012/63/16).

Participants

The study involved 597 individuals, including 360 (60.3%) women and 237 (39.7%) men. 396 (66.33%) respondents were employed, and 201 (33.67%) were unemployed. The majority of the participants were up to 25 years of age (n = 171, 28.64%), most of whom were employed (n = 99, 57.9%). The predominant form of employment was an employment contract (n = 277, 69.95%). In the case of over one-fourth of the participants, the number of years worked was one year or less (n = 103, 26.01%) (Table 1).

Data sources

This survey-based study was performed using the Athens Insomnia Scale (AIS) and a self-developed sociodemographic questionnaire.

The AIS consists of eight questions concerning the frequency and severity of insomnia symptoms. A given symptom should be marked if it occurred at least three times a week for at least a month. Responses are rated on a four-point scale and scored 0–3. The AIS total scores are interpreted as follows: < 5 points – no insomnia, 6–10 points – borderline insomnia, > 10 points – insomnia.

Statistical analysis

Statistical analysis was performed using Statistica 13. The normality of the distribution was assessed by the Shapiro–Wilk W test. The incidence of insomnia with regard to the adopted variables was determined using the chi-square test for independence. Statistical significance was set at $p \leq 0.05$.

Results

Hypothesis 1: Chronic diseases are more common in unemployed people

The majority of the respondents had hypertension (116; 19.43%) – the percentage of employed and unemployed sub-

jects was the same – 58 (50%). There was a statistically significant relationship between hypertension and employment status ($p \leq 0.001$) and between asthma/COPD and employment status ($p = 0.012$) – COPD was more common in unemployed respondents ($n = 19$; 52.78%) (Table 2). 23 (3.85%) respondents had other cardiovascular diseases: varicose veins, tachycardia, valve diseases, low blood pressure, anaemia, arrhythmia, coronary thrombosis, neuropathy. 35 (5.86%) respondents had digestive diseases. The multimorbidity rate was 0.52. The person with the largest number of diseases indicated five disease entities.

Other cardiovascular diseases were statistically significantly related to gender (they were significantly more common in women) ($n = 20$, $p = 0.007$) and to hyperthyroidism ($n = 32$, $p \leq 0.001$). Chronic diseases were mainly noted in people over 56 years of age. Diabetes was statistically significantly related to BMI (it was more common in overweight individuals) ($n = 23$, $p \leq 0.001$) and to atherosclerosis ($n = 12$, $p = 0.035$) (Table 3).

Table 2. Structure of widespread of chronic diseases

Variable		Total *n* (%)	Employed *n* (%)	Unemployed *n* (%)	Chi² *p* *Fi
Chronic diseases	diabetes yes no	 42 (7.04) 555 (92.96)	 19 (45.24) 377 (67.93)	 23 (54.76) 178 (32.07)	9.000 **0.003** *0.122
	hypertension yes no	 116 (19.43) 481 (80.57)	 58 (50) 338 (70.27)	 58 (50) 143 (29.73)	17.195 **≤ 0.001** *0.169
	asthma/COPD yes no	 36 (6.04) 560 (93.96)	 17 (47.22) 378 (67.5)	 19 (52.78) 182 (32.5)	6.222 **0.012** *0.102
	atherosclerosis yes no	 22 (3.69) 575 (96.31)	 3 (13.64) 393 (68.35)	 19 (86.36) 182 (31.65)	28.400 **≤ 0.001** *0.218
	other cardiovascular diseases yes no	 23 (3.85) 574 (96.15)	 10 (43.48) 386 (67.25)	 13 (56.52) 188 (32.75)	5.594 **0.018** *0.096
	hyperthyroidism yes no	 37 (6.2) 560 (93.8)	 25 (67.57) 371 (66.25)	 12 (32.43) 189 (33.75)	0.269 0.869 –
	digestive diseases yes no	 35 (5.86) 562 (94.14)	 13 (37.14) 188 (33.45)	 22 (62.86) 374 (66.55)	0.200 0.653 –

* Fi – Fi coefficient.

Table 3. Relationship between chronic diseases and work-related factors with regard to sociodemographic data

Variable	Chi² *p* *V/ **Fi	Diabetes	Hypertension	Asthma/ /COPD	Atherosclerosis	Other cardiovascular diseases	Hyperthyroidism	Digestive diseases
Gender women men	Chi² *p* *V/ **Fi	3.035 0.081 –	0.169 0.680 –	3.413 0.057 –	1.012 0.314 –	7.099 **0.007** *0.108	11.297 **0.000** *0.136	0.101 0.750 –
Age up to 25 years 26–35 36–45 46–55 over 56 years	Chi² *p* *V/ **Fi	65.243 **0.000** *0.330	202.403 **0.000** *0.582	12.490 **0.014** *0.144	60.216 **0.000** *0.317	21.436 **0.000** *0.189	6.452 0.167 –	3.183 0.527 –
BMI underweight normal weight overweight obesity	Chi² *p* *V/ **Fi	32.750 **0.000** *0.234	75.707 0.000 *0.356	5.934 0.114 –	8.568 **0.035** *0.119	1.057 0.787 –	6.655 0.083 –	1.038 0.791 –
Form of employment	Chi² *p* *V/ **Fi	11.079 **0.049** *0.136	19.935 **0.001** *0.182	6.843 0.232 –	28.581 **0.000** *0.218	6.255 0.282 –	5.393 0.369 –	4.608 0.465 –

Table 3. Relationship between chronic diseases and work-related factors with regard to sociodemographic data								
Variable	**Chi² *p* *V/ **Fi**	**Diabetes**	**Hypertension**	**Asthma/ /COPD**	**Atherosclerosis**	**Other cardiovascular diseases**	**Hyperthyroidism**	**Digestive diseases**
Years worked one year or less 1–3 years 3–8 years 8–18 years over 18 years	Chi² *p* *V/ **Fi	3.338 0.502 –	40.907 **0.000** *0.321	4.392 0.3555 –	8.461 0.076 –	12.882 **0.011** *0.180	1.988 0.737 –	1.199 0.878 –
Shift work yes no	Chi² *p* *V/ **Fi	0.436 0.508 –	0.370 0.542 –	0.000 0.992 –	0.443 0.505 –	1.358 0.243 –	0.000 0.998 –	0.382 0.536 –
Self-assessed financial standing very good good satisfactory bad	Chi² *p* *V/ **Fi	10.465 **0.015** *0.132	6.943 0.073 –	12.252 **0.006** *0.143	14.265 **0.002** *0.154	8.830 **0.031** *0.121	10.653 **0.013** *0.133	5.497 0.138 –

V – Cramer's V coefficient; ** Fi – Fi coefficient.

Hypothesis 2: Insomnia is often related to chronic diseases

We analysed the relationship between insomnia and chronic diseases reported by the respondents. A statistically significant relationship was observed between insomnia and hypertension ($p \leq 0.001$) – every fourth person with hypertension suffered from insomnia (n = 30; 25.86%) and had chronic diseases not included in the questionnaire ($p \leq 0.001$) (Table 4).

The largest group with insomnia included those who had chronic diseases not mentioned in the questionnaire (p = 0.009). Insomnia was observed in 30 individuals (8.02%), and borderline insomnia in 68 subjects (25.76%) (Table 5).

In the group of unemployed subjects (n = 396), insomnia was statistically significantly related to diseases other than those mentioned above (p = 0.037) (Table 6).

Table 4. Relationship between insomnia assessed by the AIS and chronic diseases (n = 597)					
Chronic diseases	**Athens Insomnia Scale (AIS)**			**Chi²**	***p* *V**
	no insomnia *n* (%)	**borderline insomnia *n* (%)**	**insomnia *n* (%)**		
Diabetes yes no	14 (33.33) 287 (51.71)	17 (40.48) 173 (31.17)	11 (26.19) 95 (17.12)	5.488	0.064
Hypertension yes no	38 (32.76) 263 (54.68)	48 (41.38) 142 (29.52)	30 (25.86) 76 (15.8)	18.363	**≤ 0.001** *0.175
Asthma/COPD yes no	13 (36.11) 287 (51.25)	15 (41.67) 175 (31.25)	8 (22.22) 98 (17.5)	3.115	0.210
Atherosclerosis yes no	7 (31.82) 294 (51.13)	8 (36.36) 182 (31.65)	7 (31.82) 99 (17.22)	4.259	0.118
Other cardiovascular diseases yes no	7 (30.43) 294 (51.22)	11 (47.83) 179 (31.18)	5 (21.74) 101 (17.6)	4.032	0.133
Hyperthyroidism yes no	11 (29.73) 290 (51.79)	13 (35.14) 177 (31.61)	13 (35.14) 93 (16.61)	10.194	0.006
Digestive diseases yes no	17 (48.57) 284 (50.53)	13 (37.14) 177 (31.49)	5 (14.29) 101 (17.97)	0.607	0.738
Other diseases yes no	215 (57.33) 86 (38.74)	104 (27.73) 86 (38.74)	56 (14.93) 50 (22.52)	19.393	**≤ 0.001** *0.180

* V – Cramer's V coefficient.

Table 5. Relationship between insomnia assessed by the AIS and chronic diseases in the group of employed subjects (*n* = 396)

Chronic diseases	Athens Insomnia Scale (AIS)			Chi²	*p* *V
	no insomnia *n* (%)	borderline insomnia *n* (%)	*insomnia* *n (%)*		
Diabetes					
yes	10 (52.63)	5 (26.32)	4 (21.05)	1.012	0.602
no	218 (57.82)	110 (29.18)	49 (13)		
Hypertension					
yes	23 (39.66)	22 (37.93)	13 (22.41)	9.779	**0.007**
no	205 (60.65)	93 (27.51)	40 (11.83)		*0.157
Asthma/COPD					
yes	9 (52.94)	4 (23.53)	4 (23.53)	1.607	0.447
no	218 (57.67)	111 (29.37)	49 (12.96)		
Atherosclerosis					
yes	1 (33.33)	–	2 (66.67)	7.598	**0.022**
no	227 (57.76)	115 (29.26)	51 (12.98)		*0.138
Other cardiovascular diseases					
yes	4 (40)	5 (50)	1 (10)	2.190	0.334
no	224 (58.03)	110 (28.5)	52 (13.47)		
Hyperthyroidism					
yes	9 (36)	8 (32)	8 (32)	9.147	**0.010**
no	219 (59.03)	107 (28.84)	45 (12.13)		*0.151
Digestive diseases					
yes	12 (54.55)	9 (40.9)	1 (4.55)	2.526	0.282
no	216 (57.75)	106 (28.34)	52 (13.9)		
Other diseases					
yes	166 (62.88)	68 (25.76)	30 (8.02)	9.222	**0.009**
no	62 (46.97)	47 (35.61)	23 (17.42)		*0.152

* V – Cramer's V coefficient.

Table 6. Relationship between insomnia assessed by the AIS and chronic diseases in the group of the unemployed (*n* = 201)

Chronic diseases	Athens Insomnia Scale (AIS)			Chi²	*p* *V
	no insomnia *n* (%)	borderline insomnia *n* (%)	insomnia *n* (%)		
Diabetes					
yes	4 (17.39)	12 (52.17)	7 (30.43)	4.261	0.118
no	69 (38.76)	63 (35.39)	46 (25.84)		
Hypertension					
yes	15 (25.86)	26 (44.83)	17 (29.31)	3.955	0.138
no	58 (40.56)	49 (34.27)	36 (25.17)		
Asthma/COPD					
yes	4 (21.05)	11 (57.89)	4 (21.05)	3.953	0.138
no	69 (37.91)	64 (35.16)	49 (26.92)		
Atherosclerosis					
yes	6 (31.58)	8 (42.11)	5 (26.32)	0.258	0.878
no	67 (36.81)	67 (36.81)	48 (26.37)		
Other cardiovascular diseases					
yes	3 (23.08)	6 (46.15)	4 (30.77)	1.064	0.587
no	70 (37.23)	69 (36.7)	49 (26.92)		
Hyperthyroidism					
yes	2 (16.67)	5 (41.67)	5 (41.67)	2.554	0.278
no	71 (37.57)	70 (37.04)	48 (25.4)		
Digestive diseases					
yes	5 (38.46)	4 (30.77)	4 (30.77)	0.279	0.869
no	68 (36.17)	71 (37.77)	49 (26.06)		
Other diseases					
yes	49 (44.14)	36 (32.43)	26 (23.42)	6.578	**0.037**
no	24 (26.67)	39 (43.33)	27 (30)		*0.180

* V – Cramer's V coefficient.

Table 7. Relationship between insomnia and work-related factors

Variable	Athens Insomnia Scale (AIS)			Chi²	*p*	*V
	no insomnia *n* (%)	borderline insomnia *n* (%)	insomnia *n* (%)			
Employment status						
employed	228 (57.58)	115 (29.04)	53 (13.38)	27.476	**≤ 0.001**	*0.214
unemployed	73 (36.32)	75 (37.31)	53 (26.37)			
Shift work						
yes	95 (47.26)	66 (32.84)	40 (19.9)	1.701	0.427	–
no	200 (51.95)	123 (31.95)	62 (16.1)			
Form of employment						
employment contract	162 (58.48)	80 (28.88)	35 (12.63)	2.083	0.352	–
freelance agreement	36 (49.32)	24 (32.88)	13 (17.81)	1.958	0.375	–
contract for a specific task	–	2 (40)	3 (60)	10.792	**0.004**	*0.160
contract	12 (60)	6 (30)	2 (10)	0.281	0.868	–
other	25 (73.53)	7 (20.59)	2 (5.88)	4.861	0.087	–
Years worked						
one year or less	57 (55.34)	34 (33.01)	12 (11.65)			
1–3 years	64 (69.57)	20 (21.74)	8 (8.7)			
3–8 years	46 (54.76)	23 (27.38)	15 (17.86)	10.178	0.252	–
8–18 years	31 (48.44)	23 (35.94)	10 (15.62)			
over 18 years	30 (56.6)	15 (28.3)	8 (15.09)			
Self-assessed financial standing						
very good	42 (67.74)	11 (17.74)	9 (14.52)			
good	165 (55.18)	87 (29.1)	47 (15.72)	40.349	**≤ 0.001**	*0.183
satisfactory	90 (43.27)	82 (39.42)	36 (17.31)			
bad	4 (14.29)	10 (35.71)	14 (50)			

* V – Cramer's V coefficient.

Hypothesis 3: Sleep problems are related to employment status

Insomnia was significantly more common among unemployed subjects ($p \leq 0.001$). A statistical relationship was demonstrated between insomnia and work under a contract for a specific task ($p = 0.004$) (Table 7).

Discussion

It was found in our analysis that people in the non-working group more often had borderline insomnia ($n = 75$; 37.31%). A study of over forty thousand respondents conducted by Vancampfort et al. demonstrated that people having sedentary jobs and lifestyles (8–11 hours per day) were at a 1.75 times higher risk (95% CI: 1.21–2.40) of developing sleep disorders than those who spent less than four hours per day in a sedentary life [12]. Based on these results, it can be assumed that insomnia is not only a matter of employment status, but also concerns lifestyle and physical activity.

We observed insomnia in 19.9% and borderline insomnia in 32.84% of shift workers. The association between shift work and insomnia was also confirmed by Vallières et al., who reported that night-shift workers had worse quality of sleep than those working day shifts. In addition, night-shift workers were overexcited and needed more time to fall asleep [13]. This corresponds with the results of another study, in which insomnia was more common among people who started shifts in the middle of the night [14].

Our investigation also revealed a statistically significant relationship between insomnia and work under a contract for a specific task – three out of five subjects declaring this form of employment led to insomnia ($p = 0.004$). Żołnierczyk-Zreda, who reviewed literature concerning the impact of the form of an employment contract on employees' health and professional functioning, concluded that lack of permanent employment leads to overall deterioration of mental and physical health and, consequently, to sleep problems [15].

In our study, insomnia was noted in over 26.19% of respondents with diabetes; however, it was more common among those unemployed (30.43%). The relationship between these variables has been confirmed by many studies. In 2018, Hein et al. conducted a study on 1,300 individuals with and without type 2 diabetes, finding that insomnia sufferers with type 2 diabetes had a shorter duration of sleep, and their sleep was less regenerative [16].

Another important contributor to insomnia is hypertension. We noted a statistically significant relationship ($p \leq 0.001$) between hypertension and insomnia, both in the whole study sample and in the subgroup of employed respondents ($p = 0.007$). According to Vgontzas et al., insomnia entails a substantially higher risk of increased blood pressure. These authors claimed that the co-existence of insomnia and short sleep duration (less than 5 hours) raised the risk of hypertension by about 500% (OR = 5.12, 95% CI: 2.2–11.8) compared with the group without insomnia and with a sleep duration > 6 h [5]. Based on their study of over 1,000 people, Błaszczyk et al. informed that the most numerous subjects in the group with severe insomnia were those with third-degree hypertension (77.3%; $p \leq 0.001$) [17].

Although our study did not demonstrate any association between asthma and insomnia, such a relationship has been reported by other researchers [18–20]. Patients with asthma were also found to have poorer quality of sleep than the control group [19]. The fact that asthma symptoms exacerbate at night may explain the link between these two disorders [19].

In our study, hyperthyroidism was statistically significantly related to gender ($p = 0.000$) – it was considerably more common among women (8.89%). Caputo et al. conducted a study of 4,400,000 residents of Piedmont in Italy. They found that in 2012–2018, 33,257 people were diagnosed with hyperthyroidism, including 9,165 men and 24,092 women. The general inci-

dence rate was 756 per 100,000 residents (95% CI: 748–764). A detailed analysis with regard to gender showed that both the incidence and prevalence rates were higher for women than for men – the incidence rate for women was 2.18 (95% CI: 2.10––2.26), and the prevalence rate was 2.77 (95% CI: 2.71–2.82) [20]. Considering that Caputo et al. carried out their research in a mountain terrain, these results might have been associated with the lower level of iodine in the air.

Limitations of the study

- The majority of unemployed individuals were in the age bracket of over 56 years, which might have had an effect on the incidence of chronic diseases.
- The study sample included more employed individuals.

Conclusions

1. Diseases were more common in unemployed respondents, which might have been due to the fact that they were mainly people over 56 years of age.
2. Insomnia itself can be the cause of the onset or deepening of diseases. Insomnia and chronic diseases, in many respects, are a consequence of lifestyle and hypokinesia.
3. The age factor and working and living conditions (contract work, shift work, unemployment) are factors contributing to the occurrence or worsening of insomnia and chronic diseases. Insomnia and a lack of depth and quality of sleep can be due to the level of professional and life stress, working and living conditions, social instability and chronic diseases.

Source of funding: This work was funded from the authors' own resources.
Conflicts of interest: The authors declare no conflicts of interest.

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Received: 16.04.2020
Reviewed: 02.05.2020
Accepted: 04.06.2020

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