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"PROF.DR.PARASKEV STOYANOV "-

VARNA DEPARTMENT OPTOMETRY

AND OCCUPATIONAL DISEASE

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SLEEP DISORDERS IN SHIFT WORK

ABSTRACT

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The dissertation is presented on 114 pages and contains 46 figures and 13 tables. The literary references are 197, from which 4 are in cyrillic and 193 in English.

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- The Department of "Optometry and Occupational diseases"
- First Neurological Clinic, St. Marina Hospital-Varna

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ABREVIATIONS

AHI-Apnea-Hypopnea Index
BMAL-Brain and Muscle ARNT-Like protein
CLOCK -Ciracadian Locomotor Output Cycles Kaput
CRY-Cryptochrome
ESC-Epworth Sleepiness Scale
ISI-Insomnia Severity Index
NREM- Non rapid eye movement
$PaCO_2$- Парциално налягане на CO_2
PAI- Plasminogen Activator Inhibitor
PER- Period Circadian Protein Humalog
PLMS-Periodic Limb Movements in Sleep
PSQI-Pittsburgh Sleep Quality Index
REM-Rapid eye movement
RLS- Restless Leg Syndrome
SWD-Shift work disorder

Contents

1. Introduction

In today's industrialized worl 24-hour service has become indispensable to certain services such as public safety, health care and many others. Due to this one in every five workers has shift outside of the regular work hours from 9 AM to 5 PM. Some of these service providers develop Shift Work Disorder(SWD)- a condition, caused by a disruption in the circadian rhythm and presented with insomnia and/or excessive sleepiness. These sleep disorders lead to significant health problems, a worsened quality of life and can hinder the practice of the profession.

Shift work includes working outside of the regular work hours in twelve hour shifts during the day and night. According to certain European studies, conducted in the last 10 years, between 15 and 30% of workers have a shifting work schedule. Almost half of workers in the department of public safety (policemen, firemen) and health care have such a work schedule (*Ståle et al), (McMenamin et al)*. The British Trades Union Congress (TUC) published in 2018 that since 2013 the people who work in shifts have increased with 5%, from which 2/3 are women. According to the International Classification of Sleep Disorders 2-5% of workers have a sleep disorder associated to shift work. People with SWD are at danger of falling asleep involuntary during work or while driving. This has e social-economical value, due to the increased risk of road and work related accidents, disability and danger to the general public.

Shift work is related to certain chronic diseases. Long-term shift work increases the risk of malignant conditions (of the prostate in men, of the breast in women), cardiovascular and gastrointestinal diseases, metabolic disorders and obesity. These worker often suffer from depression (42% of shift workers- *Angerer et al)* or have problems in their social lives due to them working in inconvenient hours, which can lead to social isolation.

2. Objective and tasks

2.1. Objective

To study the quality of sleep and sleep disorders, as well as their effect on the health condition in shift workers.

2.2. Tasks

2.2.1. To study the health quality and the accompanying diseases in shift workers with a questionnaire.

2.2.2. To study the sleep quality in shift workers with specialized scales.

2.2.3. To determine the type of sleep disorders in shift workers

2.2.4. To study the influence of the demographic factors- gender and age, on the prevalence of sleep disorders in shift workers.

2.2.5. To study the influence of the different occupational factors (work experience, type of work, work position) on the sleep disorders.

3. Work hypotheses

1. Shift workers have a significantly worse health quality from the ones with normal working hours
2. Shift workers have a significantly worse sleep quality than the ones with normal working hours
3. Shift workers have severe insomnia and excessive sleepiness
4. There is a connection between the years of work on a shifting schedule and the decline of sleep indicators.

4. Materials and Methods

4.1Materials

In order for us to fulfill the tasks we have examined 100 workers, divided in two groups. The first group is comprised of 50 workers with a shifting schedule. The second group is comprised of 50 workers with normal working hours (from 9 AM to 5 PM)- control group.

The study has been conducted on the territory of "Saint Marina" hospital- Varna, First department of Neurological diseases in the period from 01.2020 to 09.2022.

Including criteria- workers with a shifting schedule

- Shift work for ≥ 2 years
- Workers over 18
- Workers, who have signed informed consent

Excluding criteria- workers with a shifting schedule

- Shift work < 2 years
- A preexisting sleep disorder
- A person not of age
- No signed informed consent

Including criteria-control group

- Workers with normal working hours (from 9 AM to 5 PM)
- Workers over 18
- Workers who have signed an informed consent

Excluding criteria- control group

- A preexisting sleep disorder
- A person not of age
- No signed informed consent

4.2 Methods

4.2.1 Clinical anamnesis-complaints of sleep problems or phenomena during sleep, mentioned by the partner (snoring, talking, etc.), accompanying diseases, harmful habits (smoking, drinking).

4.2.2 Occupational anamnesis- occupational route, length of work experience, type of work, presence of shifts, presence of occupational hazards.

4.2.3 Scoring scales

4.2.3.1 Pittsburgh Sleep Quality Index (PSQI)

PSQI is used to score the quality of sleep. It consists of 9 subsections. Each of them scores a specific part of sleep quality during the last month with points from 0 to 3. The maximal point count is 21. More than 5 point is considered a serious problem.

4.2.3.2 Insomnia Severity Index (ISI)

ISI is used to score the severity of insomnia complaints from the last two weeks. It consists of 7 subsections. The maximal point count is 28.

4.2.3.3 Epworth Sleepiness Scale (ESS)

ESS is used to score the severity of excessive sleepiness during different daily activities. The maximal point count is 24.

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4.2.3.4 Questionnaire

Questionnaires, containing questions pertaining the social-demographic information of the worker, work history, accompanying diseases and complaints from their sleep quality.

4.2.4 Polysomnography

A polysomnography was conducted to all of the participants with a Nox 1 polysomnographic device during their normal sleeping hours.

4.2.5 Statistical analysis

The statistical analysis was conducted on SPSS version 29,00 and GraphPad Prism version 9,51. The data was analized with these statistical methods:

- Variation analysis
- Correlation analysis
- Alternating analysis
- Graphical analysis

5. Results

5.1 Description of the examined population

The study consists of 100 workers, divided into 2 groups (Fig. 1)

- 50 workers with a shifting schedule
- 50 workers with normal working hours (control group)

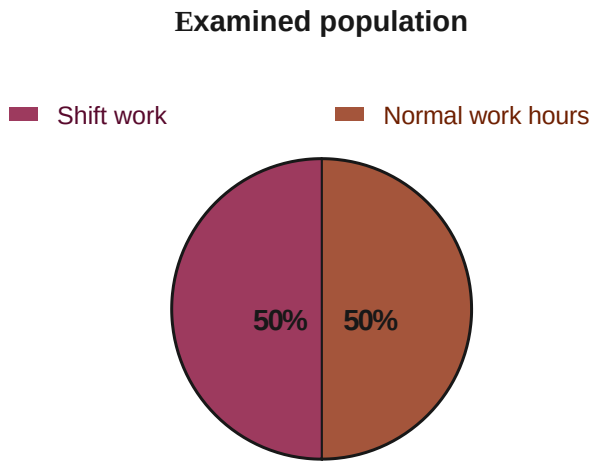


Fig. 1 Distribution of the examined population in groups

5.1.1 Demographic data

The analysis of the demographic data of the participants shows that the examined workers are at a similar mean age-43,10 ±10,41 for shift workers and 45,38± 10,39- for the ones with normal working hours (Table 1).

Work regime	Mean age	Standart division	N
Shift work	43,10	10,41	50
Normal work hours	45,38	10,39	50
All	44,24	10,41	100

Таблица 1: Mean age of the examined workers

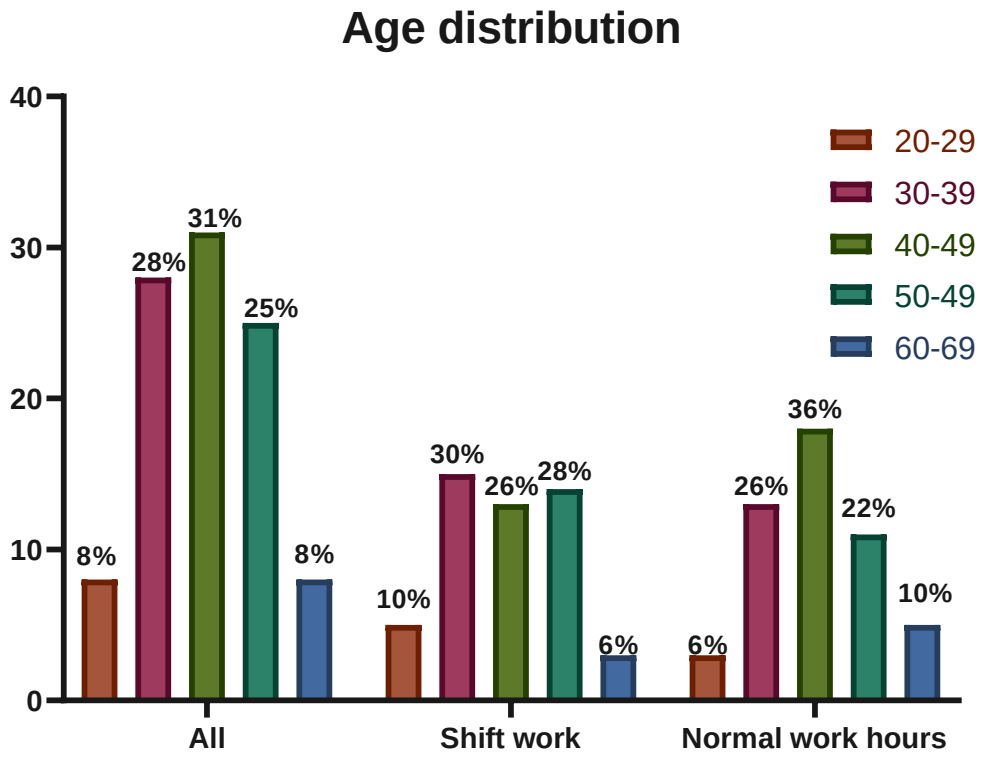


Fig. 2 Age distribution

From all of the examined 29(29%) are women and 71(71%) men. From the shift workers 16 (32%) are women and 34 (68%) are men, while from the ones with normal work hours 13 (26%) are women and 37(74%) are men. There is no significant difference between both of the groups (p=0,288 for the men and p=0,36 for the women). Fig.3.

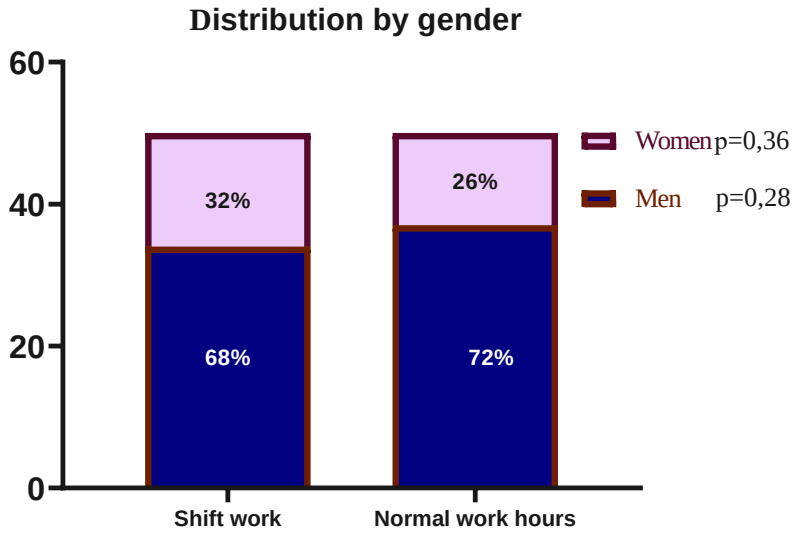


Fig 3: Distribution by gender

5.1.2 **Occupational factors**

Depending on the type of work they do, physical labor is more present in both groups- 26 (52%) in shift workers and 31(62%) in the control group (p=0,22). The number of wokers with mental work is higher in the worker with normal work hours- 24(48%) и 19(38%) for the ones with shift work-p=0,255. Fig 5.

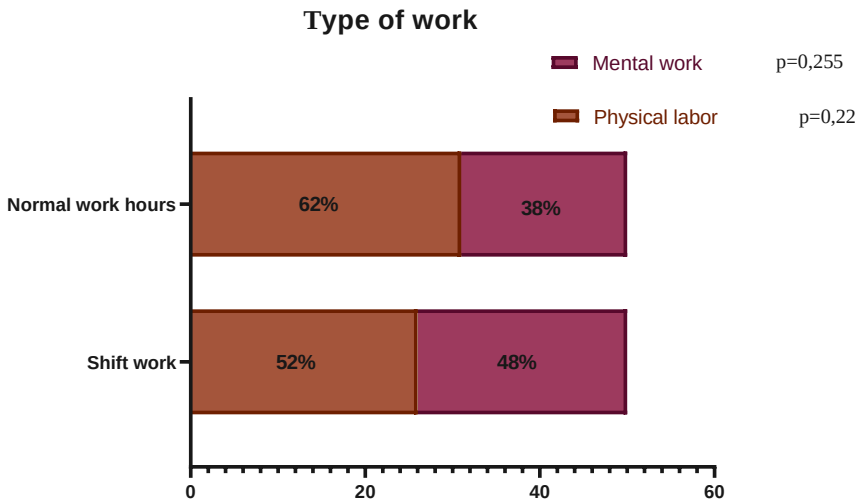


Fig. 5: Distribution depending on the type of work

The examined's years of work experience are 19,86 ±9,98 for all, while for those with a shift mode of work they are 18.34±9.89, and for those with regular working hours - 21.30

±9.92 (p=0.128). The length of work experience of the last practiced profession of the studied from both groups is 14.55 ±7.17 for all, 13.14 ±7.13- for workers with a changed work regime and 15.96 ±7.00 for those with regular working hours (p=0.49). (Fig. 7).

Regime of work	Work experience	Standard division
Shift work	18,34	9,89
Regular hours	21,30	9,92
	Work experience from the last practiced profesion	**Standard division**
Shift work	**13,14**	**7,13**
Regular hours	**15,96**	**7,00**

Таблица 2. General and work experience from the last occupation

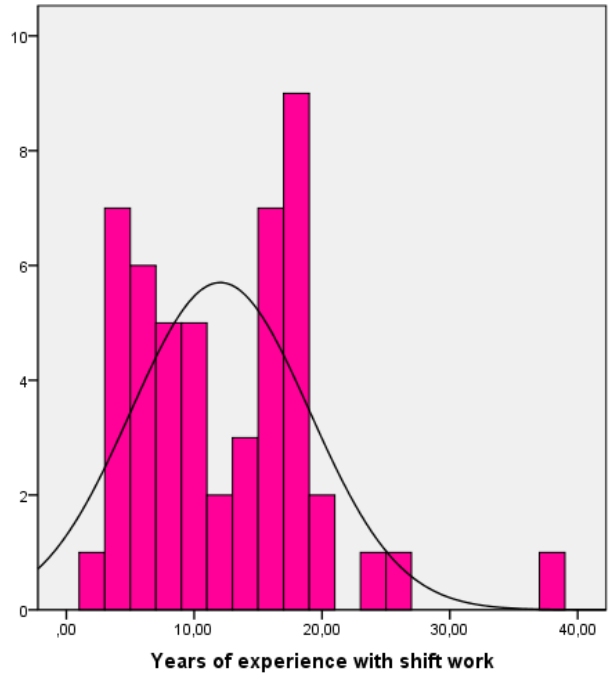


Fig. 7 Distribution according to the years of experience with shift work

According to the posture during work, no significant difference was observed in the two groups, depending on whether it was mainly forced or not. With a mainly forced posture, there were 23 (46%) of the shift workers and 26 (52%) of those with regular working hours-p=0.337. Fig 8.

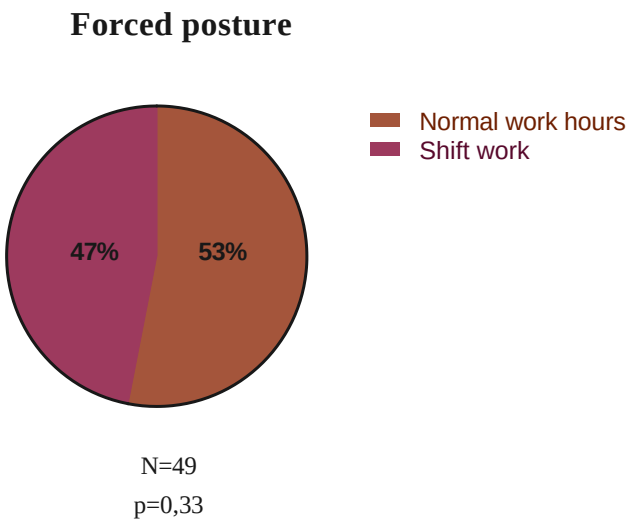


Fig 7: Distribution according to posture during the work process.

According to the workers' personal assessment of the severity of their physical labor at the workplace, they are divided into ones with:

• No physical exertion
• Moderate physical activity
•Heavy physical work

Among the shift workers those with the average physical load prevail - 29 (58%)-(p=0.039), while among those with regular working hours - no physical load - 23 (46%) - p=0.118. Fig 8.

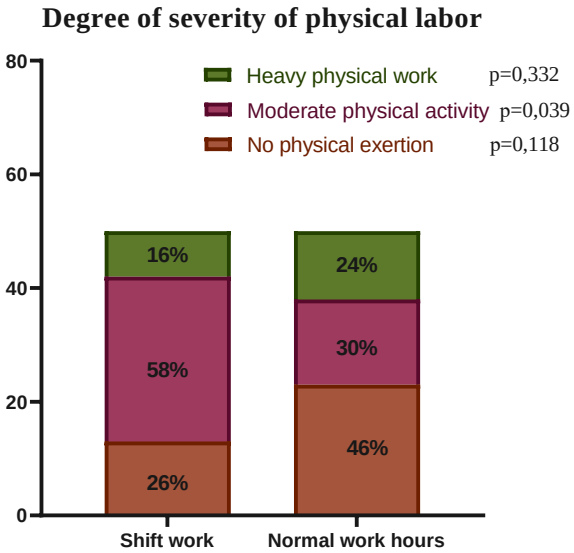


Fig 8: Distribution according to the severity of physical labor

According to the presence of workplace stress, there is a significant difference between the two groups. Out of a total of 76 who answered "yes" to the presence of stress, 45 (90% of their total number) were the shift workers, while 31 (62% of their total number) were those with regular working hours (p= 0.001). Fig.9

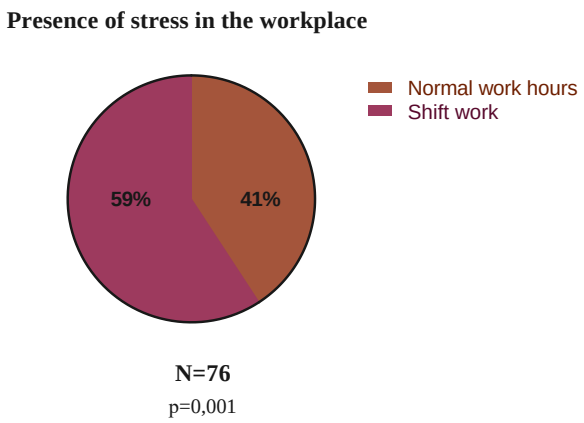


Fig 9: Distribution according to the presence of stress in the workplace

According to the presence of various hazards (chemical, physical and biological) at the workplace, according to the data from the completed survey, no statistically significant differences are observed between the two groups. Table 3.

	Shift work	Normal work hours	P value
Chemical	20(40%)	24(48%)	0,297
Physical	18(36%)	5(10%)	0,131
Biological	17(34%)	12(24%)	0,281

Table 3: Hazards in the workplace

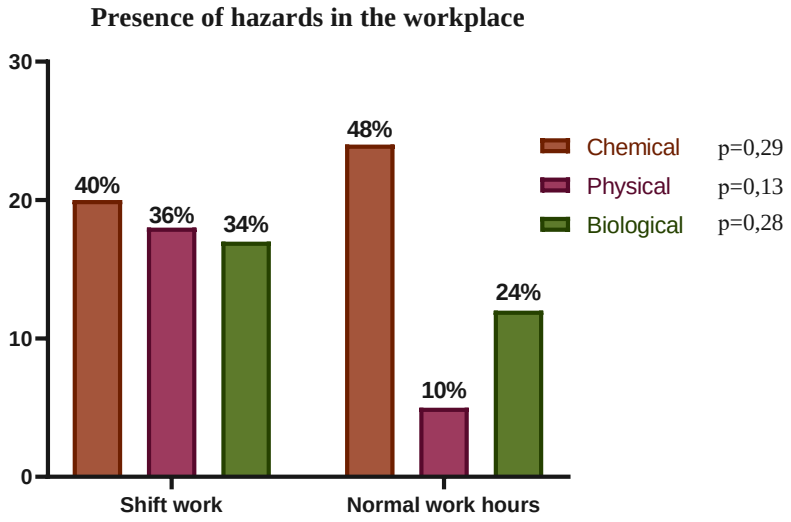


Fig 10: Presence of hazards in the workplace

5.1.3 Health status and harmful habits

5.1.3.1 Health status

The two examined groups depending on their health status, the presence of chronic diseases and their impact on work activity are:

- with no severe chronic diseases
- in a damaged general condition, necessitating absence from work

Shift workers were in significantly more impaired general health than controls and rated their health as requiring frequent absence from work, with 32 (64%) of shift workers assessing their health as "worse ", compared to 19 (36%%) of the controls, the difference being statistically significant (p=0.03). Without accompanying severe chronic diseases - 31 (62%) of the controls compared to 18 (36%) of those with a changed work regime, highlighting the better health status in the controls (p=0.03)-Fig 11.

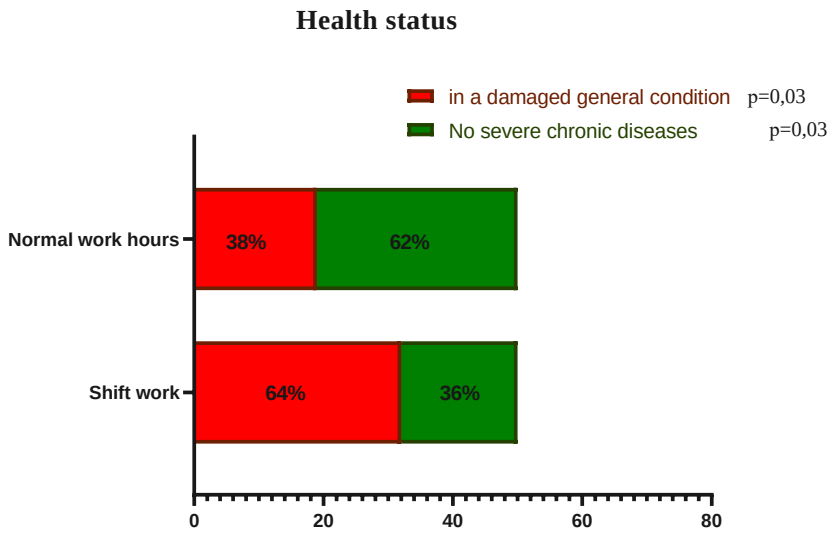


Fig 11: Distribution of the examined according to their state of health

Shift workers are at a "damaged general condition" at a significantly earlier age - 48.46±8.36, than in the ones with regular working hours - 53.67±9.19 (p=0.016), and in both groups the number of those with "impaired general condition" increased with increasing age. Controls to a significantly later age were free of chronic diseases - 41.09±8.69, than in shift workers - 33.55±5.83 (p=0.0002). Fig.12.

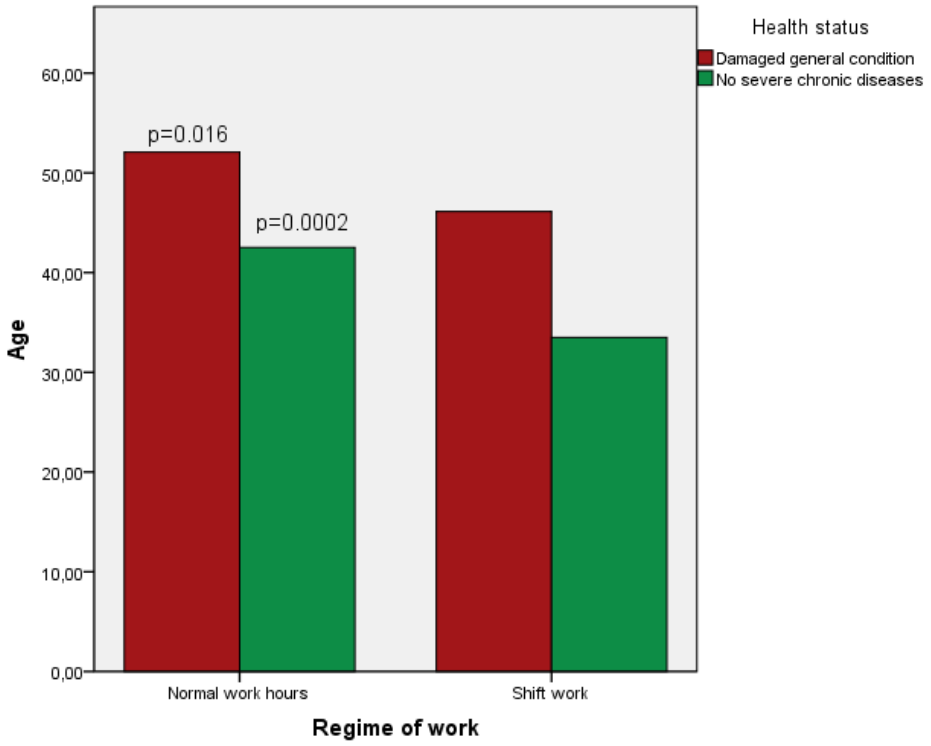


Fig 12: Relationship between health status and increasing age.

No statistically significant differences were observed in the answers about the health status of men and women in the two studied groups. Accordingly, 27 (79.4%) of the men working in shift mode have an "impaired general condition" and 11 (68.8%) of the women (p= 0.24), and in the controls -13 (35.1%)) from men and 2 (15.4%) from women-p=0.28. (Fig 13).

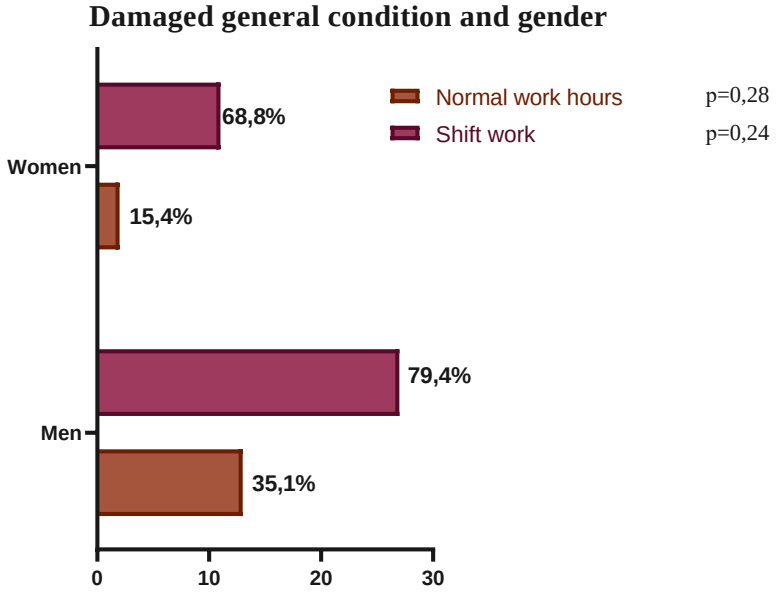


Fig 13: Damaged general condition and sex

The most constant accompanying disease in the studied population is hypertension, observed in 57 (57%) of the cases, respectively in 22 (64.7%) of the workers with a shift work regime and 48 (67.8%) of those with regular working hours.

In second place in terms of frequency is dyslipidemia, observed in 47 (47%) of the cases, respectively 30 (60%) in the workers with a shift work regime and 17 (34%) of the controls, the difference being statistically significant (p=0.043).

In third place are disc herniations in different areas of the spine, observed in 37 (37%) of the cases, respectively 24 (48%) in the workers with a shift work regime and 13 (26%) of the controls (p=0.096).

There were differences in the frequency of ischemic heart disease in men in the two groups - 13 (38.2%) of the shift workers and 5 (13.5%) of those with regular hours of work, and the difference was not statistically significant (p=0.155). According to the presence of an anxiety disorder, there were 12 (75%) women in the group of shift workers, compared to the controls-5(38.5%)-p=0.077. Table 4.

Diseases affecting sleep quality									
	Shift work			Normal work hours			P value		
Gender	Men	Women	All	Men	Women	All	Men	Women	All
Hypertension	22(64,7%)	6(37,5%)	28(56%)	26(70,3%)	3(23,1%)	29(58%)	0,33	0,32	0,43
HF	3(8,8%)	2(12,5%)	5(10%)	0	1(7,7%)	1(2%)	0,37	0,4	0,68
IHD	13(38,2%)	2(12,5%)	15(30%)	5(13,5%)	1(7,7%)	6(12%)	0,15	0,8	0,19
Diabetes	10(29,4%)	2(12,5%)	12(24%)	4(10,8%)	1(7,7%)	5(10%)	0,23	0,43	0,25
Dislipidemia	23(67,6%)	7(43,8%)	30(60%)	15(40,5%)	2(15,4%)	17(34%)	0,04	0,23	0,043
Bronchial asthma	1(2,9%)	2(12,5%)	3(6%)	2(5,4%)	2(15,4%)	4(8%)	0,4	0,4	0,45
COPD	3(8,8%)	1(6,3%)	4(8%)	1(2,7%)	0	1(2%)	0,39	0,4	0,4
Gastritis	1(2,9%)	4(25%)	5(10%)	5(13,5%)	3(23,1%)	8(16%)	0,33	0,4	0,37
GERD	2(5,9%)	2(12,5%)	4(8%)	2(5,4%)	2(15,4%)	4(8%)	0,4	0,4	0,4
Nephrolitiasis	2(5,9%)	1(6,3%)	3(6%)	2(5,4%)	2(15,4%)	4(8%)	0,4	0,39	0,4
Gout	14(41,2%)	1(6,3%)	15(30%)	9(24,3%)	1(7,7%)	10(20%)	0,2	0,4	0,28
Cox- or gonartrosis	3(8,8%)	2(12,5%0	5(10%)	0	2(15,4%)	2(4%)	0,37	0,4	0,39
Disc herniation	16(47,1%)	8(50%)	24(48%)	10(27%)	3(23,1%)	13(26%)	0,15	0,21	0,09

Stroke	3(8,8%)	0	3(6%)	3(8,1%)	1(7,7%)	4(8%)	0,4	0,4	0,39
Anxiety	5(14,7%)	12(75%)	17(34%)	2(5,4%)	5(38,5%)	7(14%)	0,36	0,07	0,16
Depression	7(20,6%)	3(18,8%)	10(20%)	2(5,4%)	4(30,8%)	6(12%)	0,3	0,29	0,34

Table 4: Frequency of comorbidities affecting sleep quality

The mean Body Mass Index (BMI) of the two groups of the studied population was respectively 28.67±6.47 for the shift workers and 28.31±6.22 for the controls (p=0.775). The average BMI for women with shift work was 24.21 ± 5.67, while for those with regular hours of work it was 25.04 ± 8.53 (p=0.757). The average BMI in men with a changed work regime was 30.77±5.78, while in controls it was 29.46±4.82 (p=0.301). Fig 12.

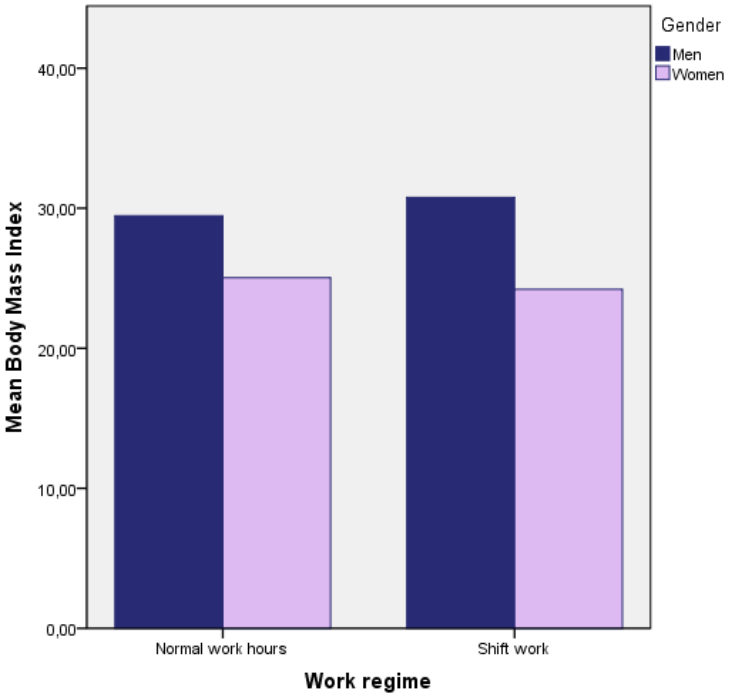


Fig. 14: Mean BMI in both groups by gender

5.1.3.2 **Harmful habits**

64(64%) of the examined were smokers, 35(70%) of the shift workers and 29(58%) of the controls, and no statistically significant difference was observed (p=0.158). The average number of cigarettes smoked per day for shift workers was 13.40±4.48, while for those with regular hours of work it was 11.48±4.57-p=0.097. (Figure 13).

Daily alcohol intake was significantly more frequent among shift workers 40(80%) than among controls-28(56%)- p=0.016.

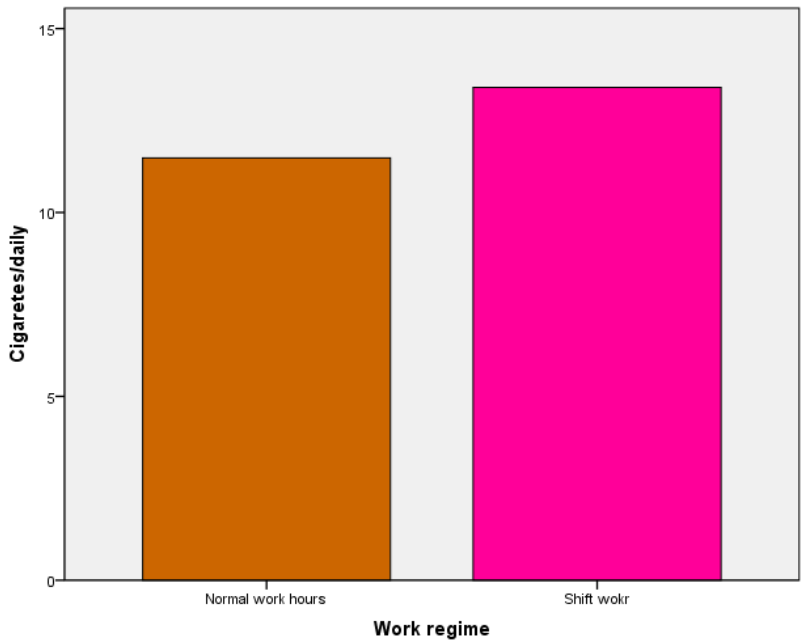


Fig. 15: Average number of cigarettes smoked per day

The average number of caffeinated drinks consumed per day for shift workers was 3.26±1.72, while for those with regular hours it was 2.06±1.15-p=0.298, with a statistically significant difference observed when comparing the men in the two studied groups - respectively 3.65±1.87 for the shift work employees and 2.05±1.12 for the controls - p<0.00001. (Figure 14).

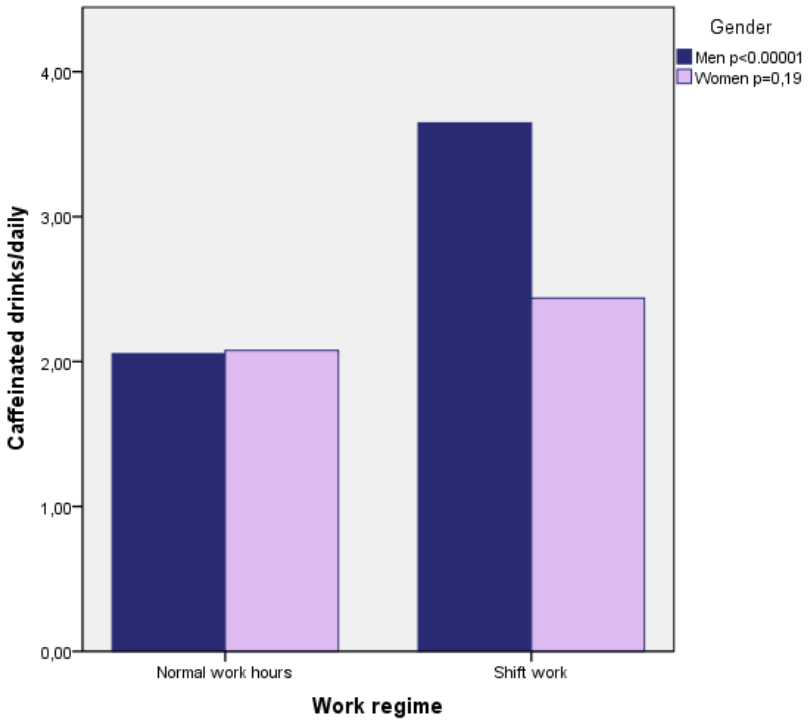


Fig 16: Number of caffeinated drinks consumed per day

5.2 **Sleep quality and its relationship with demographic and occupational factors**

According to the quality of their sleep in the last one month, the studied population was:
• Poor sleep quality
• Good sleep quality
Among shift workers, those who described their sleep as "poor quality" predominated - 32 (64%), in contrast to controls, where 12 (24%) responded in this way, with a statistically significant difference observed (p=0.011). A higher frequency of "good quality" sleep was found in workers with regular hours of work, 38 (76%), respectively, in 18 (36%) of those with shift work (p=0.002).Fig 15.

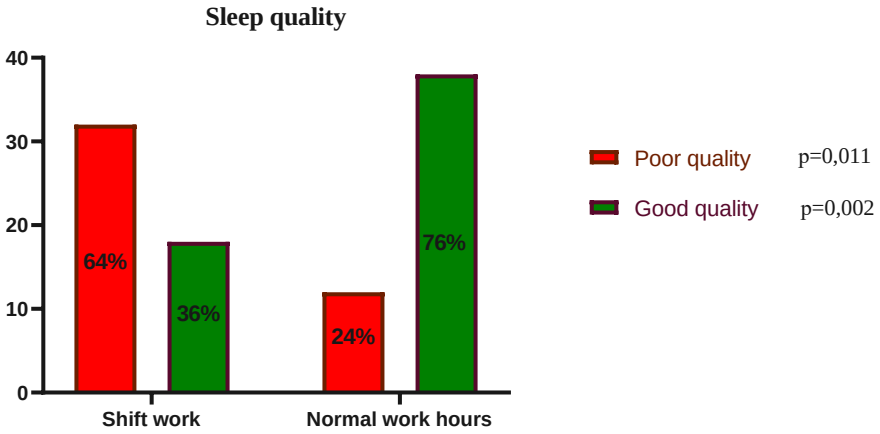


Figure 17: Distribution according to sleep quality for the last one month
Among shift workers, poorsleep quality was observed at a significantly earlier age- 45.12±10.16, compared to those working regular shifts-53±9.39 (p=0.01), as in both groups with increasing age, the number of those with "poor" sleep quality increases. (Figure 18)

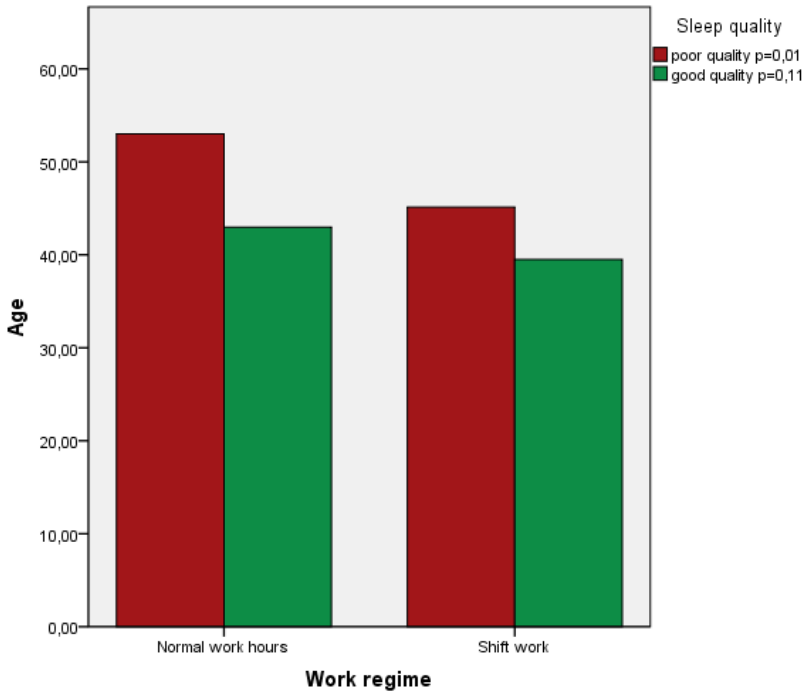


Fig. 18: Distribution by age and sleep quality

There was no significant difference in sleep quality between the sexes in the two groups, with shift workers 22 (64.7%) of men and 10 (62.5%) of women rating their sleep as 'poor' , compared to 10(27%) of males and 2(15.4%) of females in controls. (Figure 19).

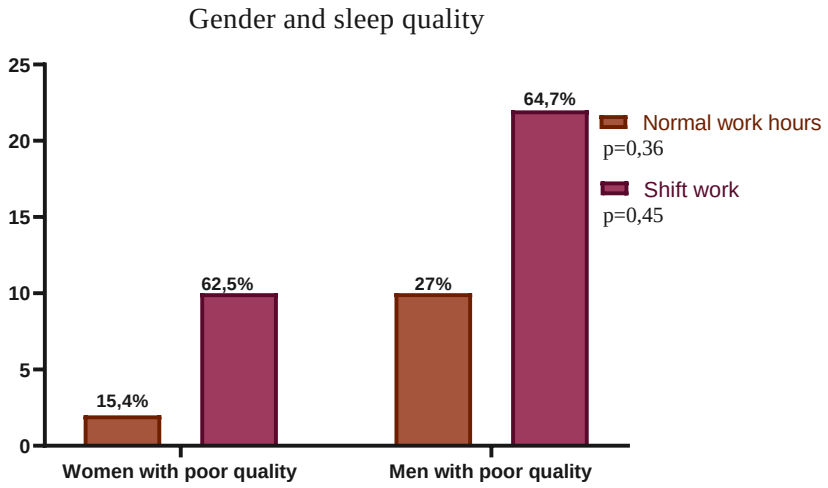


Fig. 19: Distribution by gender and sleep quality

We have compared the two groups according to their self-reported sleep quality and various occupational factors, with a view to assessing the relationship between them.

No significant statistical difference was observed in the average years of work experience on a shift mode between the workers who marked their sleep with "good" or "bad" quality - respectively 10.33±6.32 for the former and 13±7.26 (p= 0.092). The highest number of workers marked their sleep as "poor quality" with ≥10 years of shift work experience - 21 (65.62%) – (p=0.05) - Figure 19.

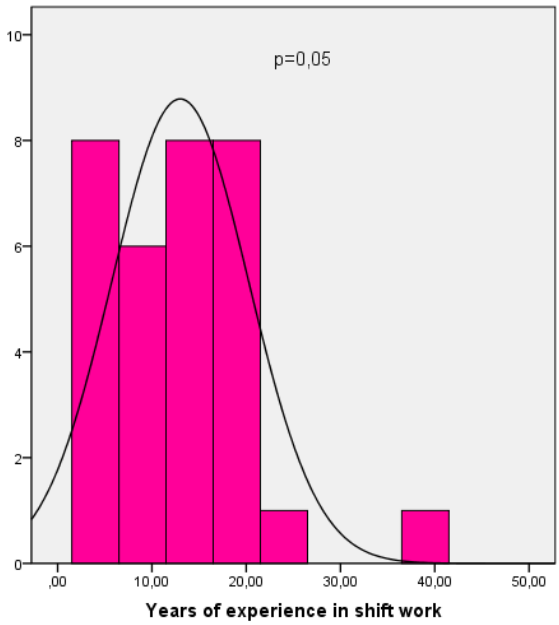


Figure 19: Correlation between years of shift work experience and poor sleep quality

Among the various occupational factors, only shift work showed an increased risk for poor sleep quality. Table 5.

Evaluation of the relative risk of poor sleep quality in relation to different occupational factors					
Occupational factor	Odds-Ratio (OR)		P-Value	Relative Risk (RR)	
	OR	95% CI		RR	95% CI
Shift work	0,178	0,75-0,423	0,028	2,263	1,485-3,448
Physical labor	1,933	0,856-4,364	0,156	1,318	0,941-1,847
Forced pose	1,754	0,79-3,895	0,181	1,326	0,891-1,972
Stress at work place	0,556	0,213-1,452	0,242	1,145	0,923-1,422
Chemical hazards	1,479	0,663-3,297	0,266	0,801	0,505-1,270
Physical hazards	0,410	0,158-1,066	0,087	1,980	0,946-4,143
Biological hazards	0,954	0,400-2,275	0,473	1,034	0,558-1,915

Table 5: Evaluation of the relative risk of poor sleep quality for the different occupational factors

A statistically significant difference was observed in the time of falling sleep on non-working days of the two studied cohorts. In shift workers, 10-11 PM 37 (74%) predominated, compared to controls where most indicated 12 PM or later-39(78%)-p=0.001 (Figure 20).

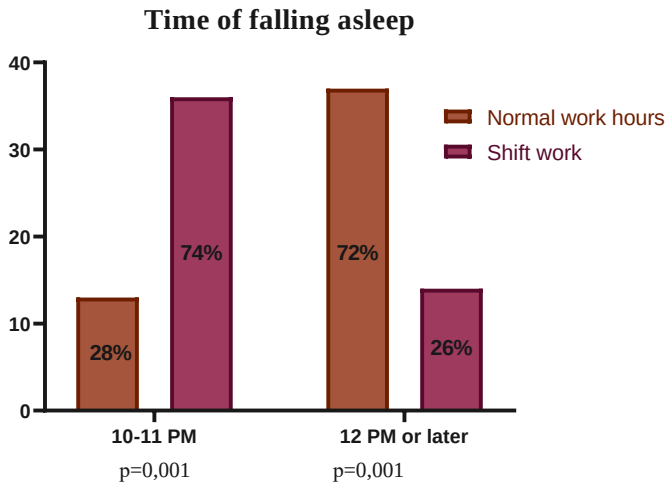


Fig 20: Distribution by time of falling asleep

Regarding the time needed to fall asleep, most of the shift workers - 26 (52%) indicated <5 minutes, compared to 9 (18%) of the controls - p=0.03. Among workers with normal working hours, the answer to the question was predominantly- 10-15 minutes - 19 (38%) compared to 14 (28%) of shift workers - p = 0.27. (Figure 21).

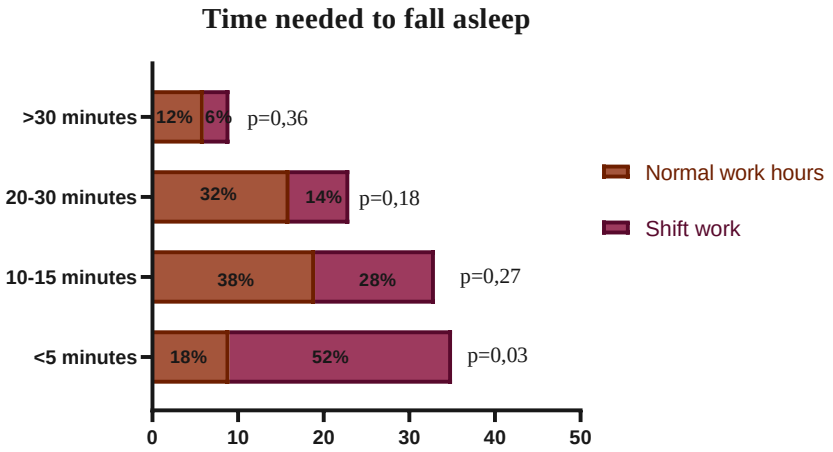


Fig 21: Distribution according to time needed to fall asleep

There was a statistically significant difference in regards to the time of arousal on non-working days, with the majority of shift workers - 45 (88%) - answering that they wake up earlier than 6 am or between 6 and 7 am, compared to 15 (30%) of controls-p<0.0001. The majority of workers with regular working hours - 35 (70%) indicated between 8 and 9 or 10-11 hours, compared to 5 (12%) of shift workers. (Figure 22).

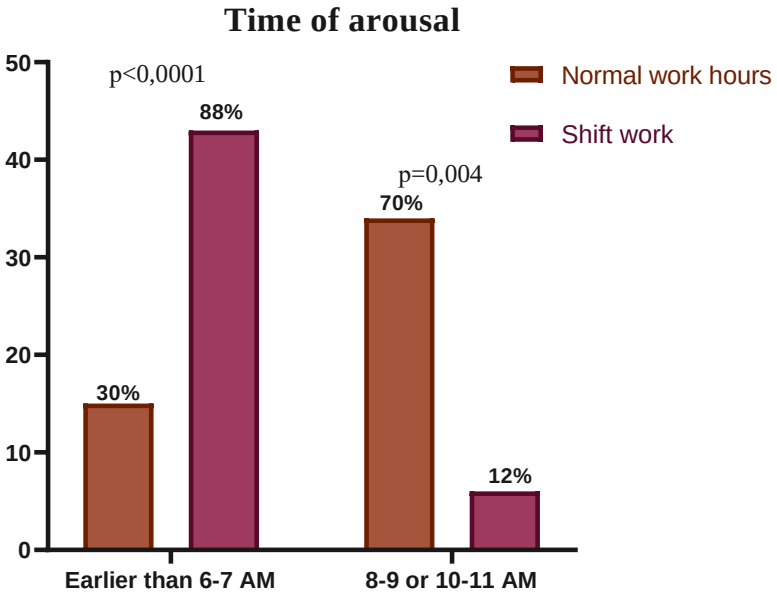


Figure 22: Distribution by time of arousal

The mean number of hours of sleep on non-working days of shift workers is 6.96±1.53, while for the controls it is 8.22±0.84, the difference being statistically significant-p<0.0001 (Figure 23) .

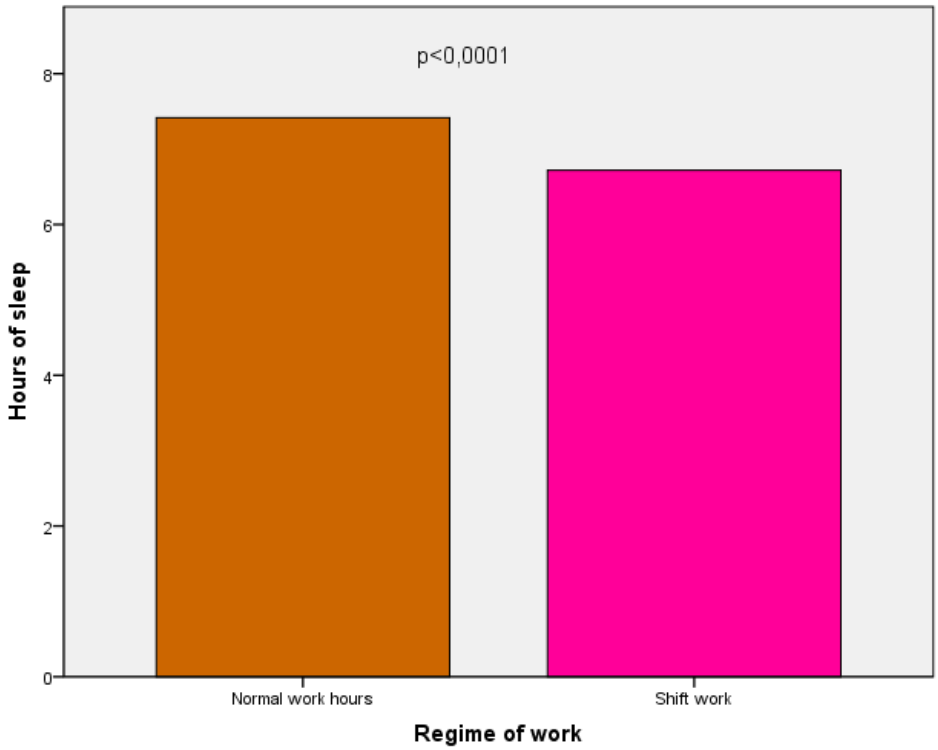


Figure 23: Hours of sleep on non-working days

No statistically significant difference was observed in the time of falling asleep and waking up, the time required to fall asleep and the hours of sleep depending on gender in both groups. Table 6

Time of falling asleep					
Shift work			Normal work hours		
Men	Women	P value	Men	Women	P value
11 PM- 44,1%	10 PM-37,5%	0,31	12 PM-59,5%	12 PM-61,5%	0,45
Time, needed to fall asleep					
Shift work			Normal work hours		
Men	Women	P value	Men	Women	P value
<5min-50%	<5min-56,3%	0,47	20-30 min-35,1%	10-15min-53,8%	0,2

Time of arousal					
Shift work			Normal work hours		
Men	Women	P value	Men	Women	P value
6-7 AM-55,9%	Earlier than 6 AM- 43,8%	0,3	8-9 AM-40,5%	8-9 AM-53,8%	0,26
Hours of sleep					
Shift work			Normal work hours		
Men	Women	P value	Men	Women	P value
7,03±1,6	6,81±1,42	0,31	8,14±0,88	8,46±0,66	0,41

Table 6-Gender and sleep indicators

In relation to the other occupational factors (working posture, type of work, presence of stress and various hazards at the workplace), no relationship was observed with the hour of and time needed to fall asleep, the time of arousal and the hours of sleep.

Subjects from both groups completed the Pittsburgh Sleep Quality Index, Insomnia Severity Index and Epworth Sleepiness Scale.

In shift workers, the mean number from PSQI points was significantly higher than in controls - 12.04±6.36 and 4.54±5.40 respectively ($p<0.0001$), indicating a general reduced quality of sleep in the first group. The number of PSQI points increases with an increase in years of experience in shift work (Pearson correlation= 0.352). Fig 24 and 25.

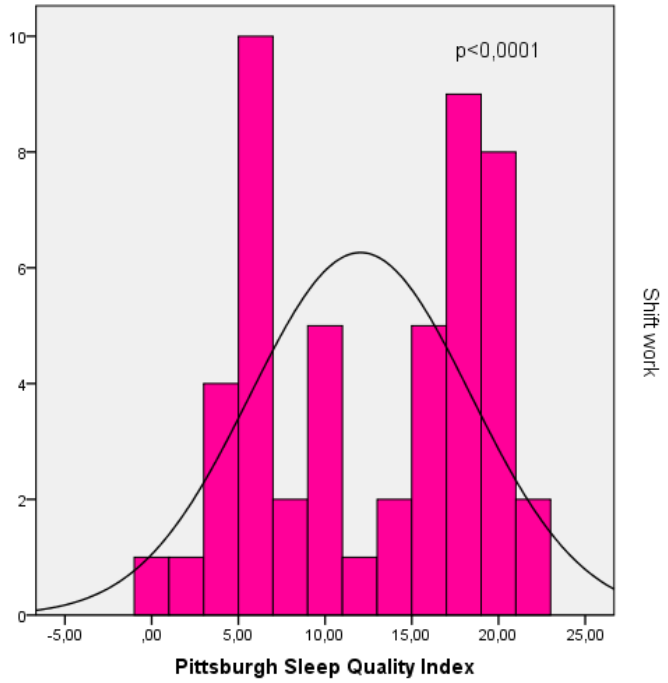


Fig 24: Distribution of the number of PSQI points in shift work

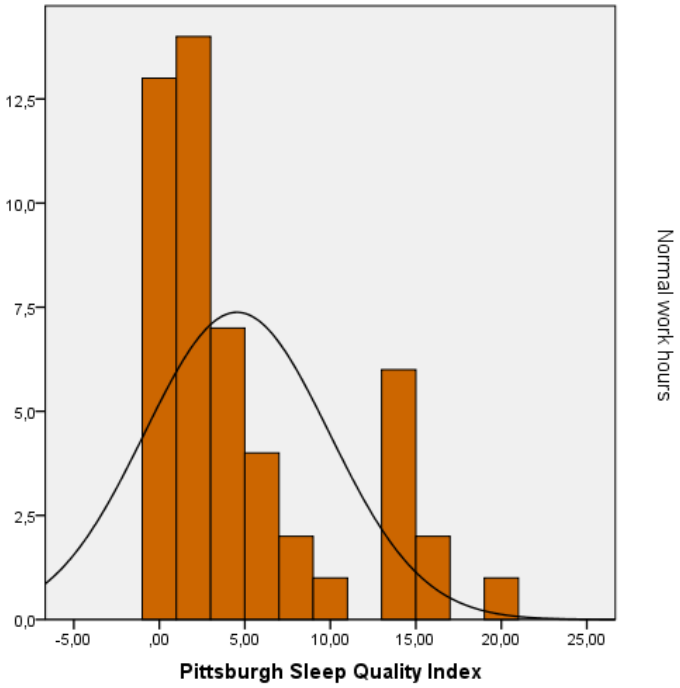


Fig 25: Distribution of PSQI points in workers with normal work hours

The mean number of points from ISI in shift workers are significantly higher than those in employees with regular hours - 13.3±7.50 and 4.32±5.97, respectively ($p<0.0001$) , showing more pronounced symptoms of insomnia in the first group. A positive correlation was observed between the increase in the years of experience in shift work and the number of ISI points (Pearson correlation= 0.367). Fig. 26 and 27.

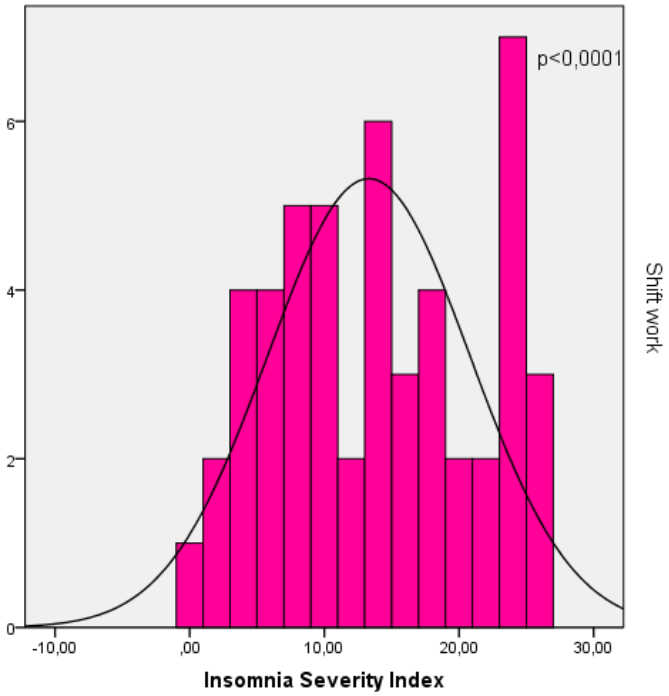


Fig 26: Distribution of the number of ISI points in shift workers

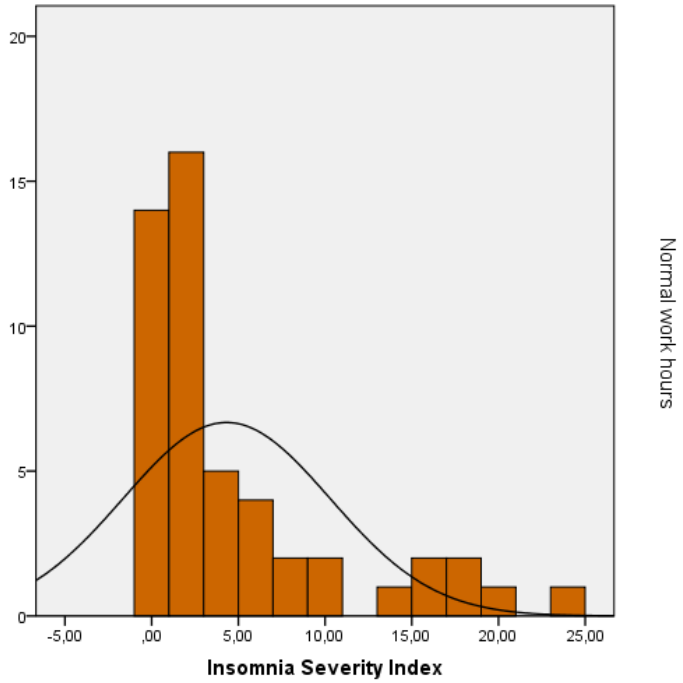


Fig 27: Distribution of the number of ISI points for workers with normalwork hours

The mean number of points from ESS in shift workers were higher than in controls - 8.84±8.25 and 3.94±5.69, respectively, and the difference was statistically significant (p=0.004), indicating higher sleepiness in the first group. A positive correlation was observed between the increase in years of experience in shift work and an increase in the number of ESS points (Pearson correlation=0.385). Fig 28 and 29.

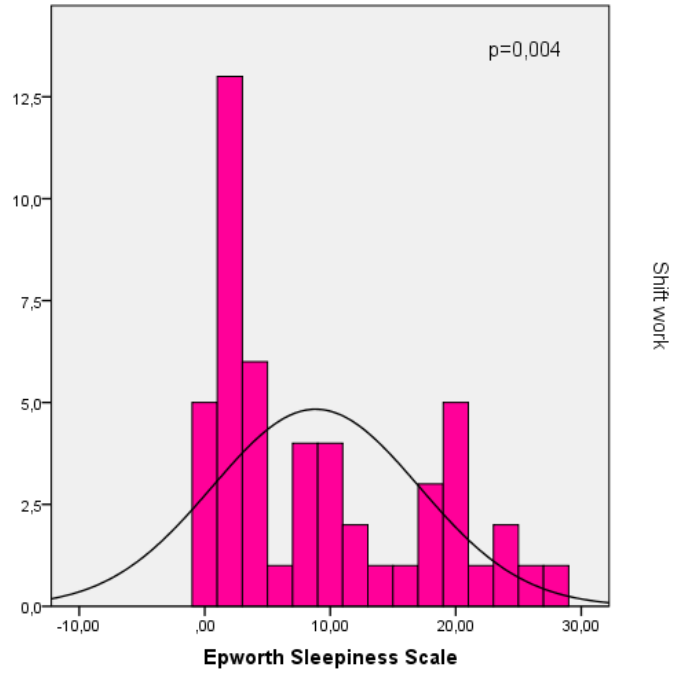


Fig 28: Distribution of ESS points in shift workers

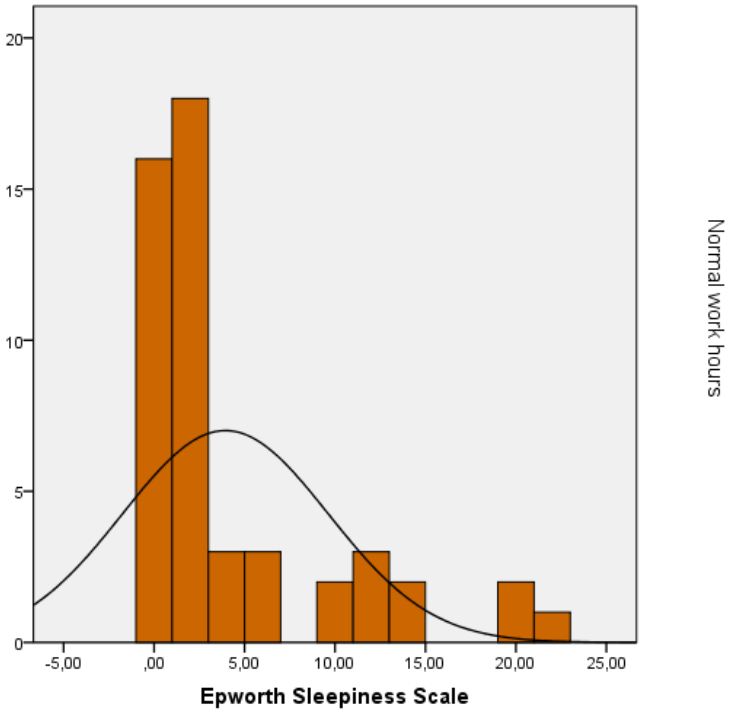


Fig 29: Distribution of ESS points for workers with normal work hours

A significant difference was observed in the number of PSQI and ESS points when comparing both genders in the group with a shift work mode - 13.2±6.28 for men in the PSQI and 9.56±5.99 for women, respectively (p= 0.024) and 10.47±8.65 for men in ESS and

5.37±6.22 for women (p=0.008). In the control group, no significant difference was observed in the number of points from the three assessment scales. Table 6.

Pittsburg Sleep Quality Index					
Shift work			Normal work hours		
Men	Women	P value	Men	Women	P value
13,2±6,28	9,56±5,99	0,024	4,67±5,27	4,15±5,97	0,39
Insomnia Severity Index					
Shift work			Normal work hours		
Men	Women	P value	Men	Women	P value
13,79±8,04	12,25±6,27	0,23	4,4±5,28	4,07±7,86	0,37
Epworth Sleepiness Scale					
Shift work			Normal work hours		
Men	Women	P value	Men	Women	P value
10,47±8,65	5,37±6,22	0,008	4,13±5,05	3,38±7,47	0,36

Table 7: Gender and results of the evaluation scales in the two studied groups

5.3 **Sleep indicators and their relationship with occupational factors**

Both groups underwent a 10-hour polysomnographic study at hours convenient for the subjects' sleep. The total duration of sleep, the duration of different sleep phases, sleep latency and efficiency, the number of arousals during the recording, the presence of periodic movements of the lower limbs and respiratory disorders were recorded.

5.3.1 **Duration of sleep**

A statistically significant difference in total sleep duration was observed in the two studied groups. The average number of minutes of sleep for shift workers was 336.89±49.63, while for those with regular hours of work it was 459.89±62.82 ($p<0.00001$). A negative relationship is established between the minutes of total sleep and the years of experience on a shift mode (Pearson correlation = -0.3), and accordingly the former decrease with an increase in the latter. Fig 30 and 31.

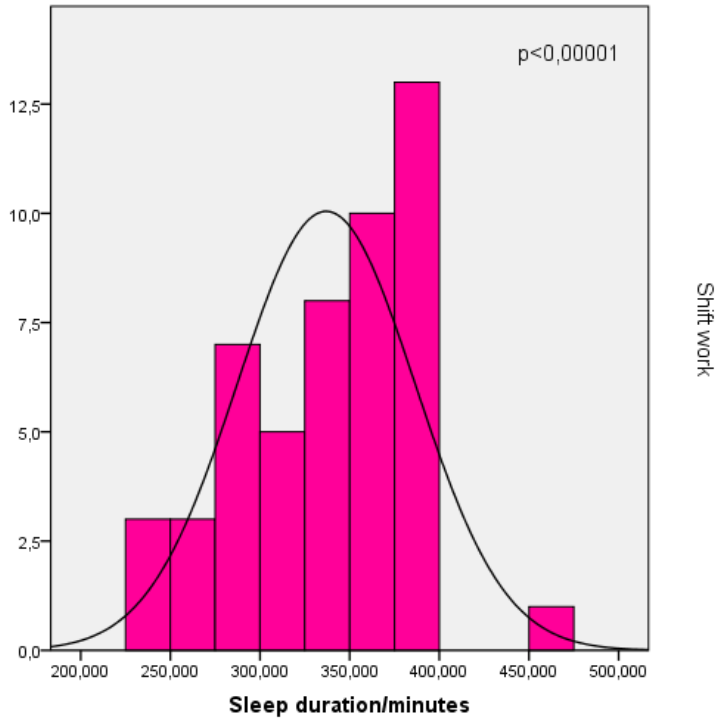


Fig 30: Duration of sleep in shift workers

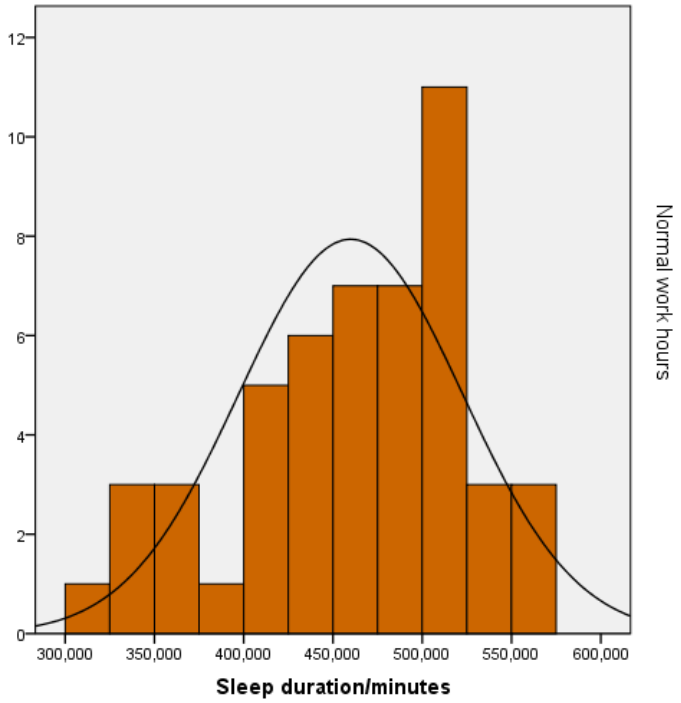


Fig 31: Sleep duration in workers with normal work hours

In both study groups, the durations of N1, N2, N3 and REM stages as percentages of total sleep time were not significantly different, as presented in Figures 32 and 33.

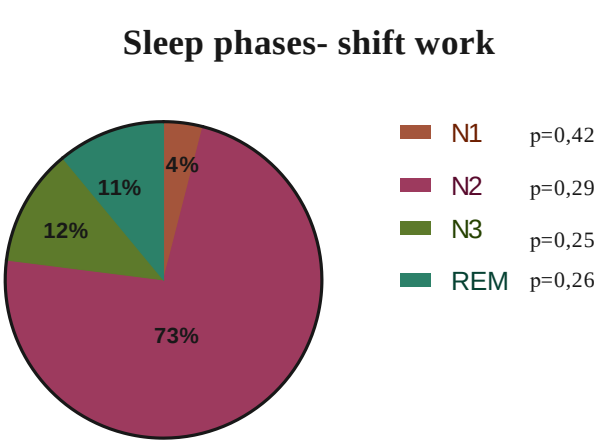


Fig 32: Sleep phases in shift workers

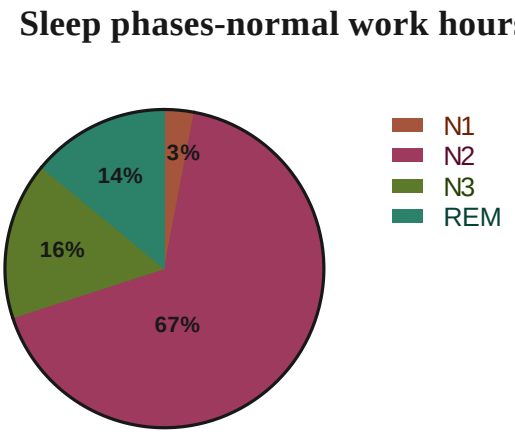


Fig 33: Sleep phases in workers with normal work hours

No significant difference was observed in the total duration of sleep in both groups according to gender, for women it was 400.48±84.71 min., and for men it was 397.54±83.76 min (p=0.46) . A negative correlation was found between increasing age and decreasing sleep duration (Pearson correlation=-0.36). Fig 34.

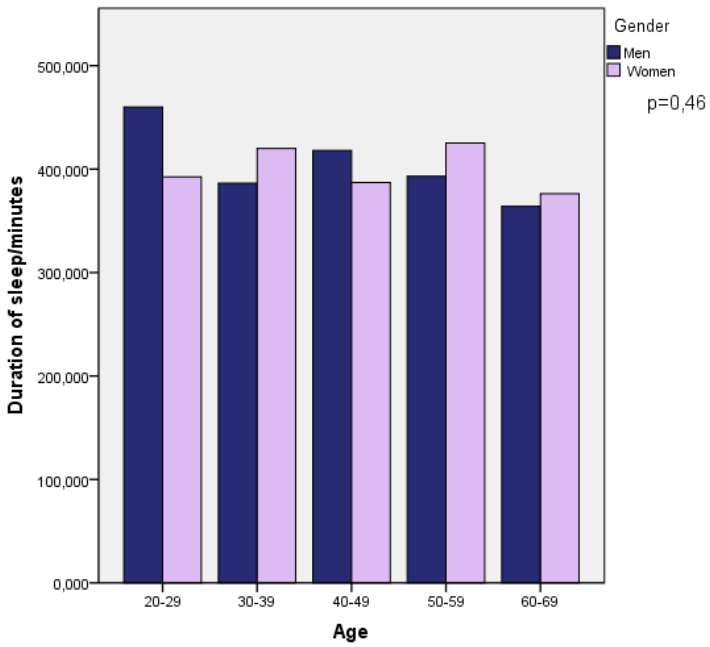


Figure 34: Total sleep duration in both genders

Compared to the rest of the occupational factors (work posture, type of work, presence of stress and various hazards), no statistically significant difference was found in the duration of sleep in shift workers. Table 7.

Work posture		
Forced	P-value	Normal
333,79±40,7min	0,18	339,81±52,24min
Type of labor		
Physical	P-value	Mental
335,63±42,22min	0,24	338,87±57,46min
Stress at the work place		
Presence	P-value	Absence
337,6±40,72min	0,14	336,81±50,92min
Chemical hazards		
Presence	P-value	Absence
339,85±46,91min	0,40	334,91±52,05min
Physical hazards		
Presence	P-value	Absence

334,77± 46,73min	0,25	338,07±51,88min
Biological hazards		
Presence	P-value	Absence
337,67±49,9min	0,24	336,5±50,25min

Table 8: Occupational factors and their influence on total sleep duration/min.

5.3.2 **Sleep latency**

Shift workers had significantly shorter sleep latency (time taken to fall asleep) than controls. In the first group it was 4.99±4.10 min, while in the second group it was 13.11±7.09 min ($p<0.0001$). No correlation was found between the years of experience in shift work and sleep latency (Pearson correlation = -0.1). Fig 35 and 36.

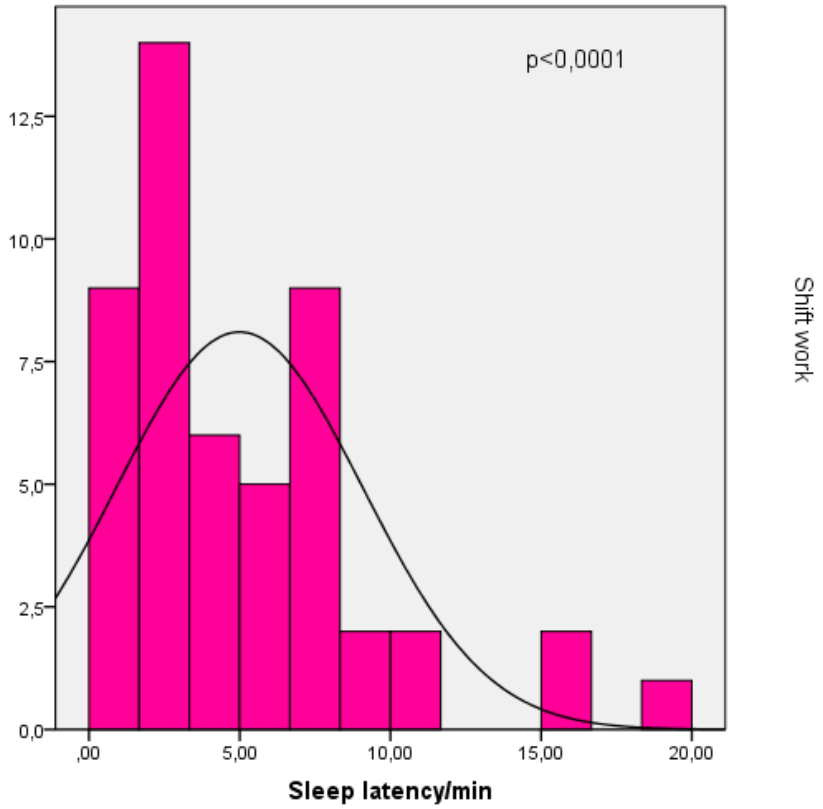


Fig 35: Sleep latency in shift workers

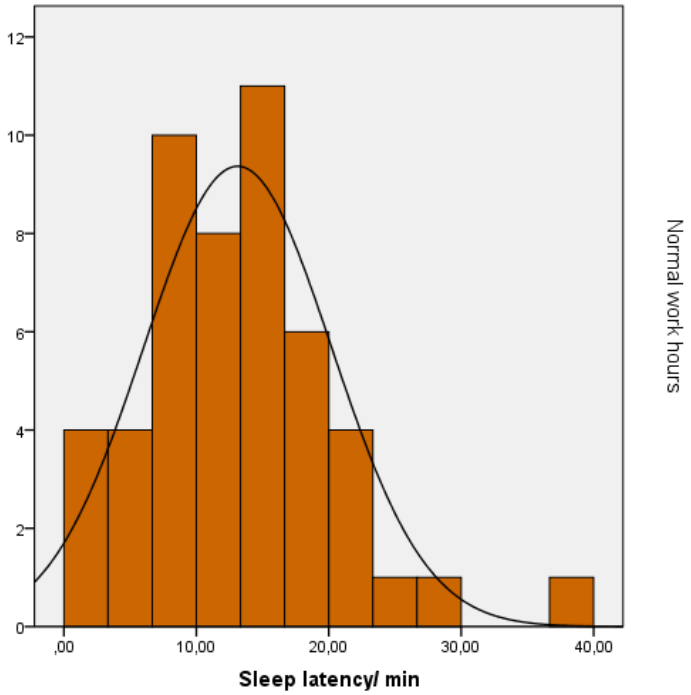


Figure 35: Sleep latency in workers with normal work hours

Gender does not show a statistically significant influence on the duration of sleep latency, in men it is 9.49±7.44 min, and in women - 7.96±6.01 min (p=0.14). A negative correlation was found between increasing age in women and decreasing sleep latency (Pearson correlation= - 0.36). (Figure 37).

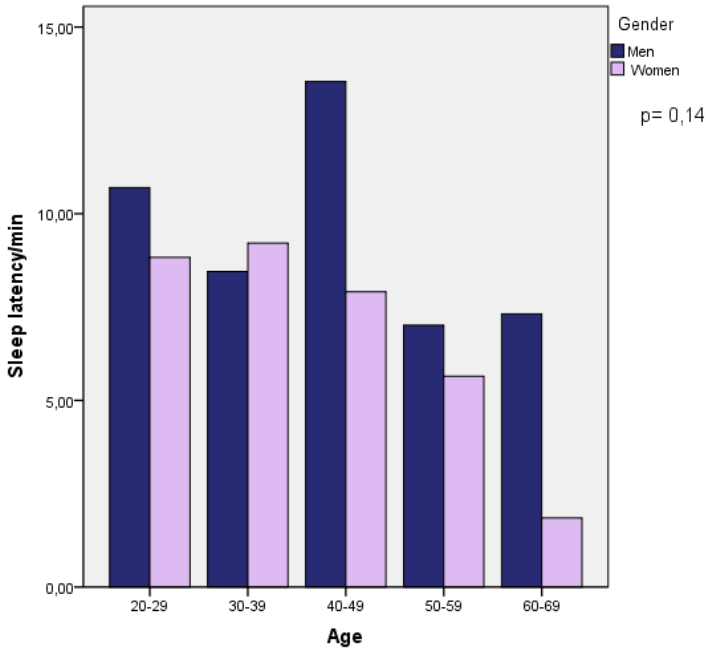


Figure 36: Connection between sex, age and sleep latency

In relation to the other occupational factors, a significant difference in the length of sleep latency was found in the presence of the various occupational hazards. Table 9.

Work posture		
Forced	P-value	Normal
5,83±4,59min	0,28	4,27±3,56 min
Type of labor		
Physical	P-value	Mental
4,54±2,99 min	0,23	5,47±5,05 min
Stress at the work place		
Presence	P-value	Absence
5,08±4,18 min	0,26	4,12±3,52min
Chemical hazards		
Presence	P-value	Absence
3,81±2,66 min	<0,0001	5,77±4,71min
Physical hazards		
Presence	P-value	Absence
4,04±2,07 min	<0,0001	5,52±4,66 min
Биологични вредности		
Presence	P-value	Absence
3,54±2,76 мин	0,006	5,73±4,5 мин

Table 9: Occupational factors and their influence on sleep latency

5.3.3 **Sleep efficiency**

A significantly lower sleep efficiency was found in shift workers compared to controls, with the first group being 87.35±4.61%, and the second - 93.44±4.69% ($p<0$ .0001). There is no significant correlation between years of shift mode experience and sleep efficiency (Pearson correlation= -0.21).

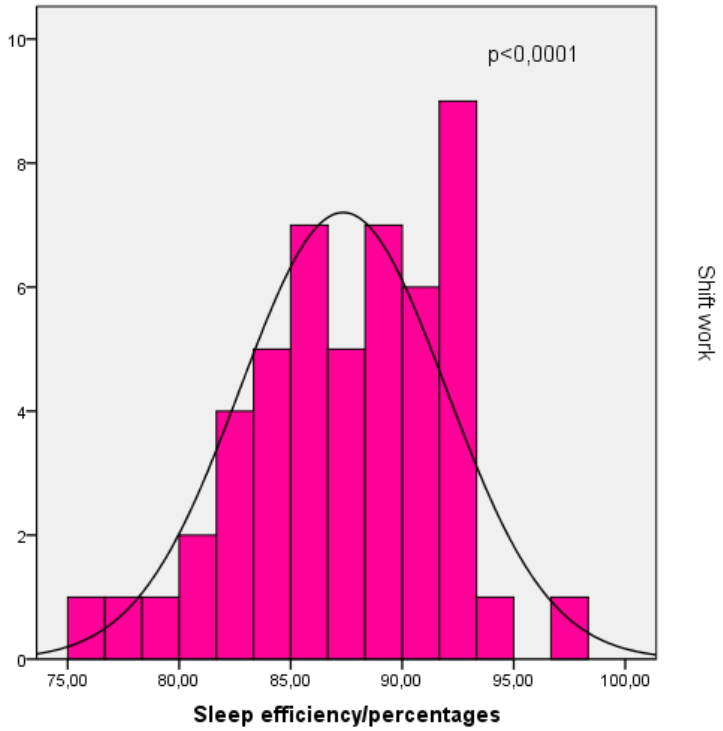


Fig 37: Sleep efficiency in shift workers

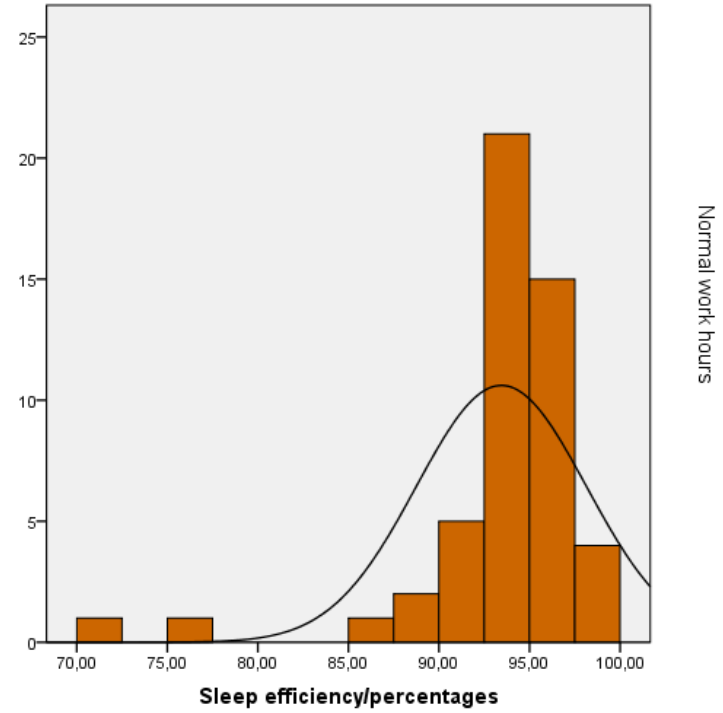


Figure 38: Sleep efficiency workers with normal work hours

No significant influence of gender and age was observed in both groups on sleep efficiency, for men it was 90.35±5.85, and for women - 90.5±4.83 (p=0.44) - Figure 39.

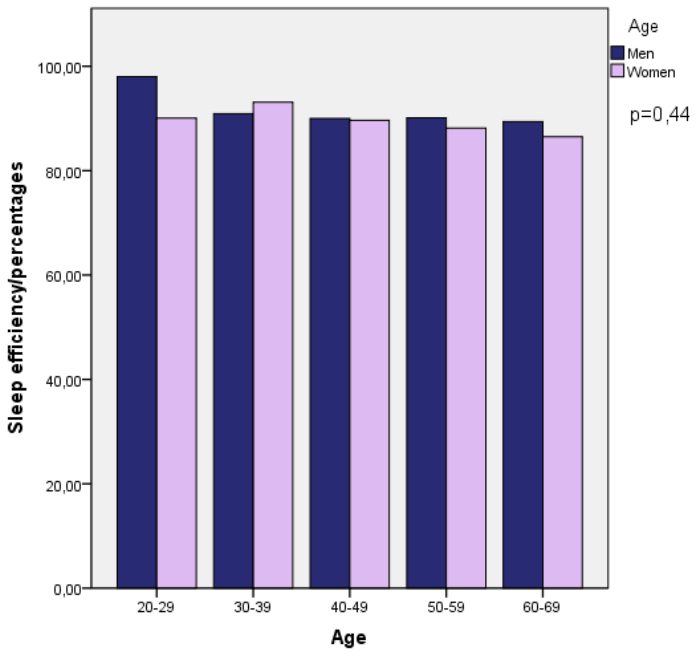


Fig 39: Connection between sex, age and sleep efficiency

Of the other occupational factors, no significant difference in sleep efficiency was found. Table 10.

Work postur		
Forced	P-value	Normal
86,52±5,34%	0,39	88,04±5,64%
Type of labor		
Physical	P-value	Mental
86,83±4,67%	0,41	87,85±4,59%
Stress at the work place		
Presence	P-value	Absence
87,58±4,52%	0,36	85,2±5,4%
Chemical hazards		
Presence	P-value	Absence
87,07±5,01%	0,42	87,76±4,03%
Physical hazards		
Presence	P-value	Absence

87,22±4,96%	0,47	87,52±4,03%
Biological hazards		
Presence	P-value	Absence
87,12±4,79%	0,45	87,78±4,35%

Table 10: Occupational factors and their influence on sleep efficiency

5.3.4 **Number of arousals**

A significantly higher number of awakenings during sleep was found in shift workers compared to those with regular hours of work, with 26.18±26.42 and 11.62±24.33 respectively for the first group and for the second (p=0.002). No correlation was found between the years of experience in shift work and the number of awakenings (Pearson correlation - 0.12). Fig. 39 and 40.

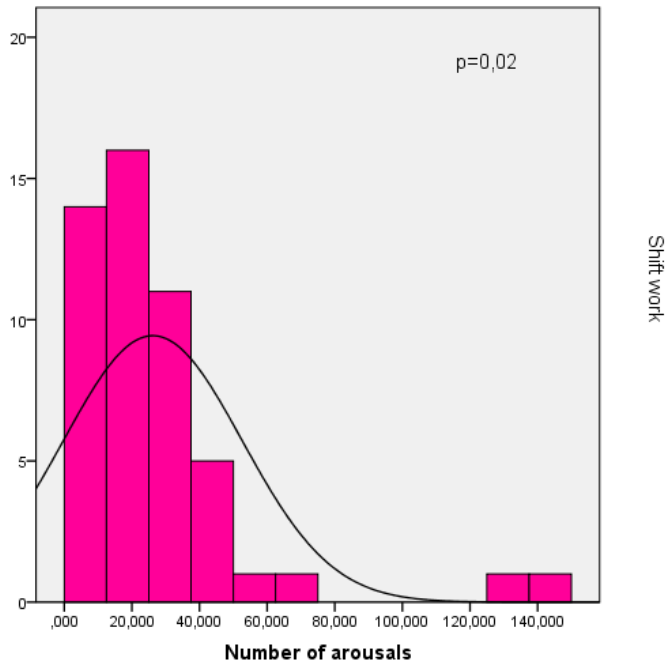


Fig 39: Number of arousals in shift workers

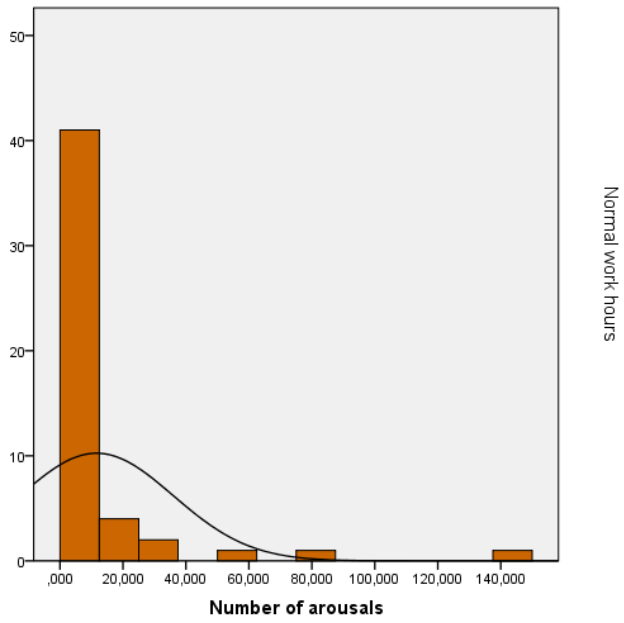


Figure 40: Number of arousals in workers with normal work hours

In relation to gender no significant influence was found on the number of awakenings, with men having 20.78±30.04 and women 14.27±12.65 (p=0.06). With respect to age, in women there is no relationship with the number of awakenings, while in men they increase with age, with the highest number being in the fourth and fifth decade (p=0.004) - Figure 39.

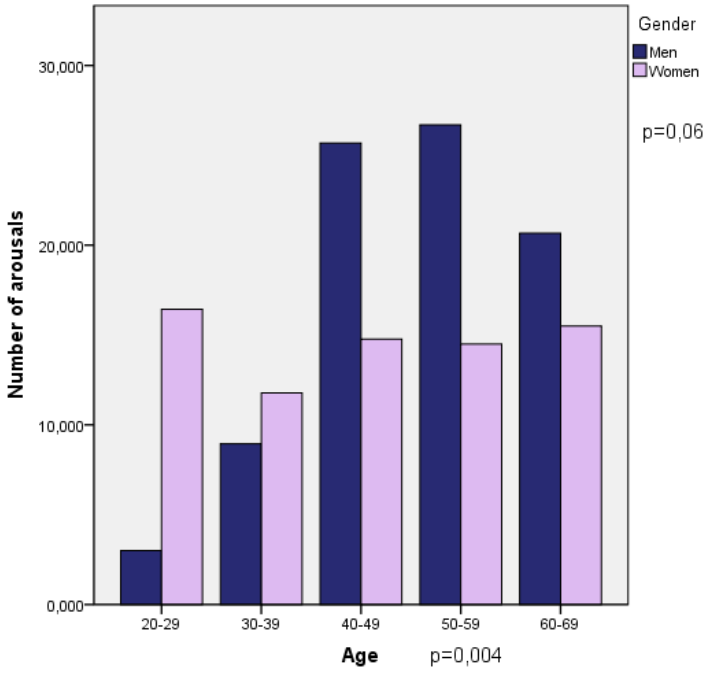


Figure 41: Connection between sex, age and number of arousals

From the other occupation factors, a significant difference in the number of awakenings was found only in workers with stress at their work place - p=0.002. Table 11.

Work posture		
Forced	P-value	Normal
32,08±35,82	0,28	21,14±13,15
Type of labor		
Physical	P-value	Mental
30,8±33,44	0,38	21,16±14,88
Stress at the work place		
Presence	P-value	Absence
27,13±27,57	0,002	17,6±9,55
Chemical hazards		
Presence	P-value	Absence
19,6±11,53	0,35	20,56±22,29
Physical hazards		
Presence	P-value	Absence
20±11.13	0,15	29,65±31,64
Biological hazards		
Presence	P-value	Absence
20,76±11,78	0,17	28,96±31,24

Table 11: Occupational factors and their influence on the number of awakenings during sleep

5.3.5 **Respiratory disorders during sleep**

No statistically significant difference was observed in the apnea-hypopnea index between the two studied groups, with 19.73±27.67 in shift workers and 13.23±19.54 in the controls (p=0.08). No correlation was found between years of experience in shift work and the increase in AHI (Pearson correlation = 0.08). Fig 42 and 43.

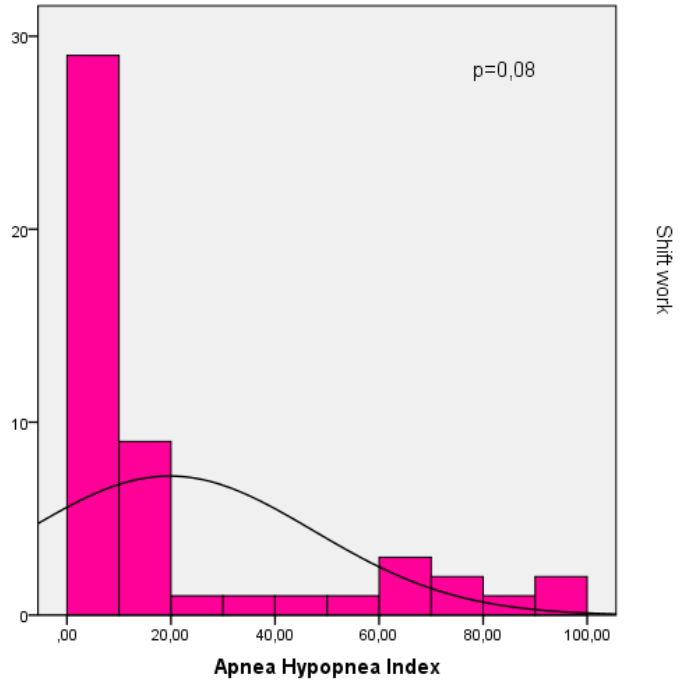


Fig 42: AHI shift workers

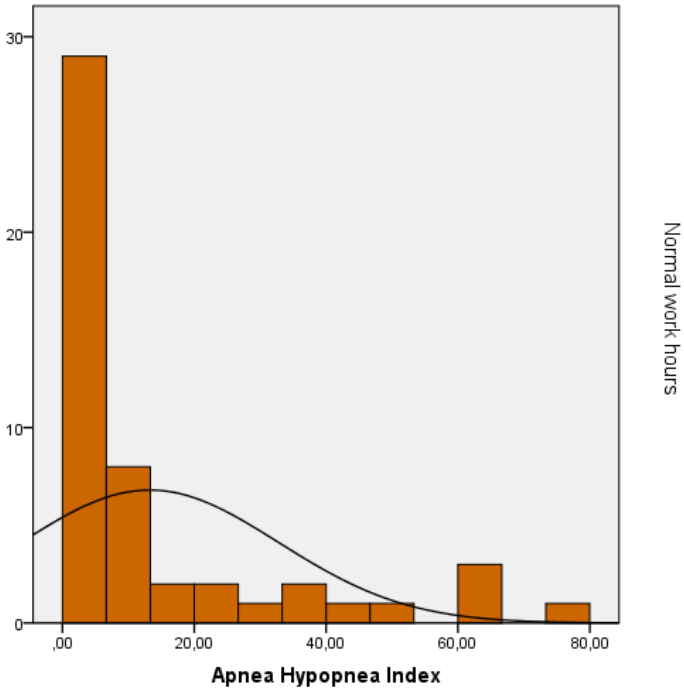


Fig 43: AHI in workers with normal work hours

A significantly higher AHI was found in men in both studied groups compared to women - respectively 19.95±26.06 for the first and 7.99±15.56 for the second (p=0.002). In both sexes, there is a positive correlation between age and AHI (Pearson correlation=0.4), with the highest values in the fifth and sixth decade - Figure 44.

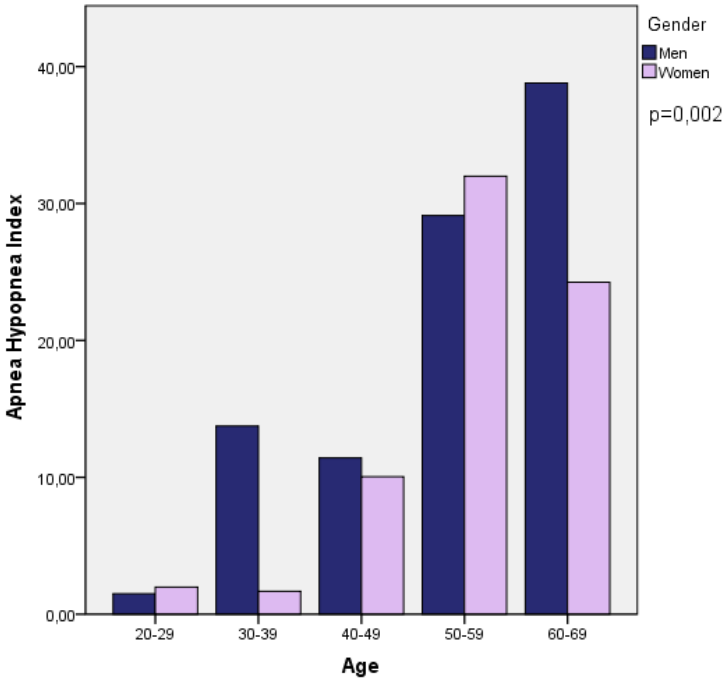


Fig 44: Connection between sex, age and AHI

There is a significant difference in AHI for workers with predominantly forced posture during work and predominantly mental work - p=0.001 and 0.0001, respectively.Table 12.

Work posture		
Forced	P-value	Normal
35,71±33,04	0,001	6,12±10,03
Type of labor		
Physical	P-value	Mental
7,64±14,82	0,0001	23,15±27,43
Stress at the work place		
Presence	P-value	Absence
20,2±28,58	0,34	16,26±19,45
Chemical hazards		
Presence	P-value	Absence
15,5±17,8	0,41	14,78±17,24
Physical hazards		
Presence	P-value	Absence

16,56±17,89	0,37	18,12±25,48
Biological hazards		
Presence	P-value	Absence
17,63±16,35	0,35	19,28±26,15

Table 12: Occupational factors and their influence on AHI

5.3.6 **Periodic limb movements**

In shift workers more frequent periodic limb movements (PLM) were observed during the polysomnographic recording compared to the controls - respectively 433.26±395.69 for the first group and 267.06±413.25 for the second (p=0.02). No significant correlation was observed between the years experience in shift work and the number of PLMs (Pearson correlation=0.26). Fig 45 and 46.

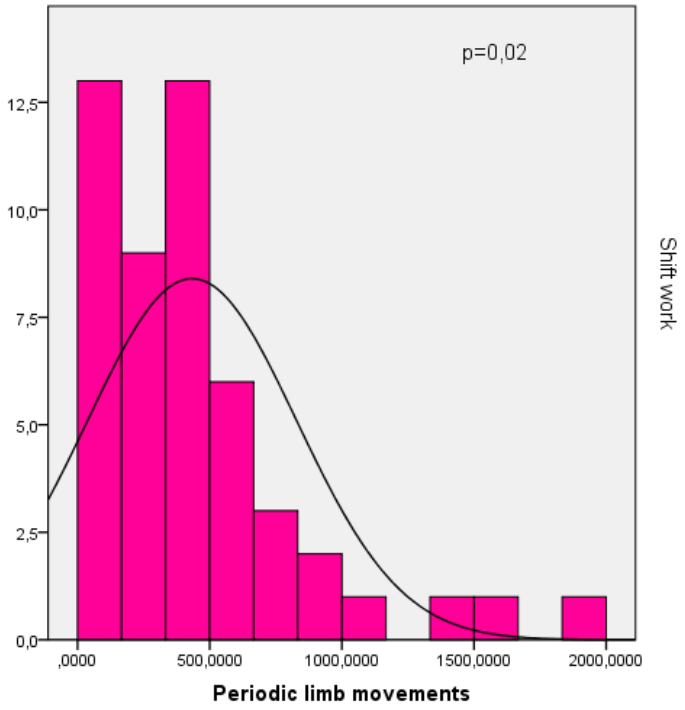
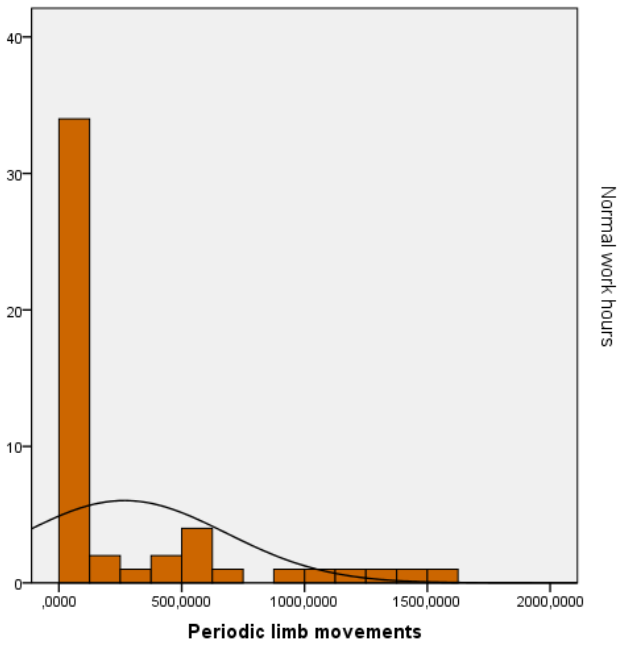


Fig 45: Number of PLM in shift workers



Фигура 45: Number of PLM in workers with normal work hours

No significant difference was found in the number of PLM in both genders, in men they were 369.66±393.59, and in women - 302.41±454.87 (p=0.24). A moderate positive correlation was found between the age of the subjects and the number of PLM in the recording (Pearson correlation=0.4) - Fig 46.

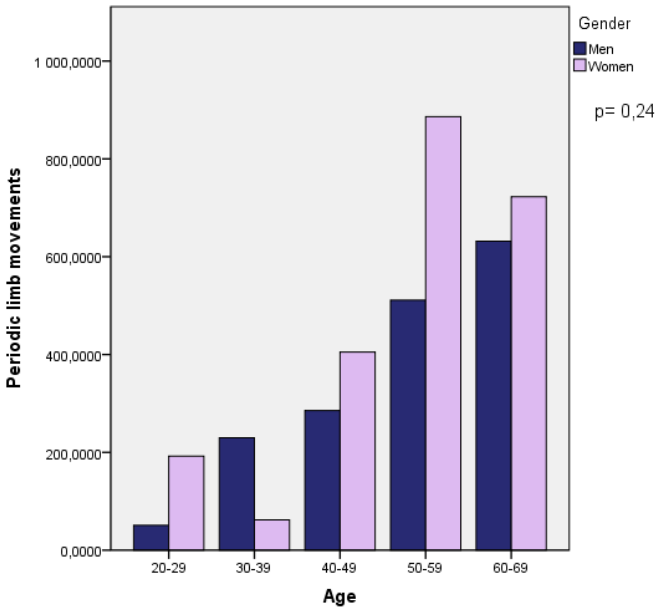


Figure 46: Connection between sex, age and PLM

A significant difference in the number of PLMs was found only in workers with mainly mental work-p=0.002. Table 13.

Work posture		
Forced	P-value	Normal
601,26±377,58	0,075	290,14±358,05
Type of labor		
Physical	P-value	Mental
222,97±280,22	0,002	446,1±466,99
Stress at the work place		
Presence	P-value	Absence
355,6±384,03	0,41	332,91±496,08
Chemical hazards		
Presence	P-value	Absence
387,25±414,6	0,44	399,58±405,16
Physical hazards		
Presence	P-value	Absence
417,95±509,75	0,22	329,9±378,3
Biological hazards		
Presence	P-value	Absence
357,17±476,77	0,46	347,29±384,78

Table 13: Occupational factors and their influence on the number of PLM

6. Discussion

6.1 Health status of shift workers

The general health status of shift workers was assessed in the current study, and the data were compared with those of employees with normal working hours.

We found that the subjective health status of the former was significantly worse compared to the control group. Our results regarding poor health status in shift workers are consistent with previous studies (Lim et al.), which found that 30 to 50% of shift workers described their health status as poor.

In shift workers dyslipidemia was found more often than in those with normal working hours - 60% for the former and 34% for the latter respectively, but no significant differences were observed in the presence of other socially significant and debilitating diseases in both studied groups. This data partially confirms a study by Adovich and co-authors, who described an increased risk of ischemic heart disease, ischemic stroke, dyslipidemia in shift workers.

In both groups, health status worsened with the increase of age, but subjects from the shift worker group described their health status as worse at a significantly younger age (48.46±8.36) than the controls (53.67±9.19). Costa and co-authors comment on the more frequent subjective worsening of health at an earlier and working age in employees with a shift work regime as a result of their reduced abilities to adjust in society and an unrealistic self-assessment of their accompanying illnesses. These problems are probably the result of disturbed sleep, the increased stress of performing highly responsible duties in conditions of sleep deprivation, disturbed social life often in combination with social isolation, as well as the often accompanying mental illnesses.

Regarding gender, in our study no difference was found in the subjective health status of the examined workers in the two groups. A previous study (Azad et al.) found that women in developing countries are at greater risk of poor health and the development of various socially significant diseases due to the lower level of education and health culture compared to men, while in in developed countries, representatives of the female sex seek medical help more often and earlier, which is often the reason for their better health.

6.2 Sleep quality in shift workers

Of the surveyed workers with a shift work schedule, a significantly higher percentage of them (64%) describe their sleep with a poor quality. These results were based on subjective assessment of their sleep quality, but were confirmed by the Pittsburg Sleep Quality Index, Insomnia Severity Index, and Epworth Sleepiness Scale, where shift workers scored significantly higher than the controls.

Our results are consistent with previous studies. Elhami and co-authors studied 30 shift workers and 30 regular workers, and all had their sleep assessed using the PSQI, ISI, and ESS. The authors define these scales as the most suitable for an easy and accurate assessment of sleep, as they cover its main characteristics. In the corresponding study, shift workers had significantly reduced sleep quality and symptoms of insomnia and excessive sleepiness.

Among the shift workers we studied, we found a worsening in sleep quality with the increase of years of experience in shift work, with the highest number of those to report their sleep to be with a “poor” quality were with ≥10 years of experience. Research on the effect of duration of experience in shift work on sleep quality is scarce. A study conducted on healthcare workers in Greece (Nena et al.) found that with every 5 years of shift work experience, the risk of sleep quality deterioration increases.

In our study, we found a correlation between the years of shift work experience and the number of points from PSQI, ISI and ESS, and the relationship is positive - accordingly, with an increase in one, the others also increase. These data confirm a previous study (Park et al.) in which 12,056 shift workers in an electronics factory were examined whose severity of insomnia and excessive sleepiness were assessed by the ISI and ESS. The result of the evaluation scales were 11.88 ± 4.42 from the Insomnia Severity Index and 13.76 ± 3.46 from the Epworth

Sleepiness Scale, and with an increase in shift work experience by 5 years, the number of points increased by 2 to 5.

In both studied groups, sleep quality worsens with the increase of age. In the group of shift workers, this happens at a significantly earlier age. Our results are consistent with those of Karhula and co-authors, who conducted a study of 7,330 employees with shift work and 6,802 with normal hours. The study lasted 5 years (from 2007 to 2012), and the sleep quality of the two groups was examined in the first and fifth year. Most of the shift workers had worse sleep quality over the years than the controls. The probable reason is the reduced abilities of circadian rhythm adaptation with the increase of age.

In our study, no significant difference was found in the subjective quality of sleep depending on gender, but when comparing the results of the PSQI and ESS evaluation scales, the number of points in the studied men of the group with a shift work were significantly higher than those of the women. This data contradicts previous research (Mallampalli et al.), (Shaiib et al.), which showed that subjective sleep quality was worse in women compared to men. The authors of the study assume that the reason is a complex of several factors present in the female sex - hormonal changes associated with the menstrual cycle, menopause, pregnancy and lactation, the more frequent presence of depression and anxiety, headaches, cramps and others. Alshahrani and co-authors conducted a study of 351 shift workers and 159 workers with normal work hours who were assessed with the PSQI and ESS, finding no difference in sleep quality between the two sexes.

In our study, shift workers reported a significantly earlier bedtime on their non-working days compared to controls, as well as a significantly shorter time to sleep, confirming the presence of excessive sleepiness even on days off. Our results are consistent with studies by Thach et al.

Shift workers were found to wake up significantly earlier than desired on days off compared to controls, confirming the presence of insomnia with difficulty maintaining sleep. We also find significantly reduced hours of sleep during shift work, with these employees having a sleep deprivation of 1 to 3 hours. These data are consistent with a study by Kaushiik and co-authors who found that shift workers were sleep deprived from 1 to 4 hours per day. In a study conducted by Vanttola and co-authors, they examined 2,900 medical workers with a shift work schedule, finding that excessive sleepiness persisted on non-working days without symptoms of insomnia.

In the groups studied by us, in relation to both sexes, no difference was found in the time of falling asleep and waking up on non-working days, the time falling asleep and the total number of hours of sleep.

6.3 Occupational factors and sleep indicators in polysomnograpy

From the polysomnographic records of the shift work employees we studied, a significantly reduced sleep duration was found compared to the controls, and it was 2 hours shorter in the former. Akerstedt and co-authors found that when performing EEG monitoring of shift workers, their sleep was 1-4 hours shorter. They comment that with a shift work regime, awakening occurs after 4-6 hours of sleep, after which the subjects cannot fall asleep again, due to a mismatch between the circadian signals of wakefulness and the physiological need for

sleep. According to their data, sleep loss occurred mainly in N2 (the longest phase) and REM sleep, with the other phases not significantly altered. No other studies were found on the duration of sleep stages. Our results show no difference in the percentage duration of the different stages of sleep when comparing the two studied groups.

Our findings of shorter total sleep duration in the shift workers we studied contradict the study by Chang et al. In their study, they examined shift workers and workers with normal work hours over 2 days using an actigraph, finding no difference in the length of total sleep time between the two groups. Since the actigraph does not give as accurate information as the polysomnograph, there may be a greater risk of error in the results.

The analysis of our data revealed a decrease in sleep efficiency (ratio of total sleep time to time spent in bed trying to fall asleep). Our results are consistent with a study by Lim et al., in which they examined 177 shift workers and 317 regular workers. The quality of life and sleep of the subjects were evaluated by SF-12 (self-assessment scale of quality of life) and PSQI, respectively, and a polysomnographic study was performed. The rating scales showed significantly reduced quality of life and sleep in shift workers, and the polysomnographic analysis showed significantly reduced sleep efficiency. Vanttola and co-authors also found a decrease in efficiency with 5 to 10% in shift workers in their study.

Data on decreased total sleep time, sleep efficiency, and increased number of awakenings confirm the presence of insomnia in shift workers, with difficulty in continuity and fragmentation of sleep and difficulty falling asleep after awakening. These data are consistent with our results from our Insomnia Severity Index assessment.

Analysis of the data from the workers we studied revealed a significantly reduced sleep latency (~5 minutes) in those with a shift work schedule compared to controls (~13 minutes). These results confirm the presence of excessive sleepiness in shift workers. Akerstedt and co-authors conducted a study of shift workers and ones with normal working hours on a non-working day by testing them with the Multiple Sleep Latency Test. The study consists of multiple opportunities to fall asleep during two-hour periods, and when EEG indicators of the presence of a sleep state appear, the worker is woken up. Shift workers had a sleep latency of 5 to 10 minutes, indicative of a moderate degree of sleepiness. The study by Vanttola et al contradicts our results. In the employees studied by them with a shift work regime, significantly increased subjective and objective sleep latencies (~30 min) were found, regardless of the day of the study (non-working, before day and night or after night shift).

In our study, no significant difference was found in the Apnea-Hypopnea Index (AHI) from the polysomnographic recordings in the two studied groups. These data are inconsistent with the study by Cheng-Cheng et al., where it was suspected that obstructive sleep apnea may be more common in shift workers. The supposed reason for this phenomenon is that employees with a shift work schedule have an increased risk of developing obesity, hypertensive disease and diabetes mellitus - risk factors for the development of obstructive sleep apnea. In our study, no significant difference was observed in the frequency of the listed diseases in the two studied groups, which is the likely reason for the non-significant difference in the indicator.

The shift workers we studied showed a significantly increased number of periodic lower limb movements (PLM) during sleep compared to controls. Not enough studies are available on the relationship between shift work and PLM. Joseph and co-authors indicated shift work as one of the risk factors for the development of the syndrome of periodic limb movements, but

did not indicate the mechanism of development of the disease in these cases. Sharifian and co-authors studied 1,700 shift workers, of whom 12.8% had restless legs syndrome. Of those with Restless Leg Syndrome (RLS), 70.4% had periodic limb movement syndrome. Sharifian and co-authors hypothesized that RLS and PLM occur more frequently in shift workers because of a disrupted circadian rhythm of dopamine, which peaks around 10 a.m. when these workers sleep.

Among the studied shift work workers, other occupational factors do not affect the duration and efficiency of sleep. Various occupational hazards have a significant impact on sleep latency, the presence of stress at the workplace - on the number of awakenings, mainly mental labor - on the number of periodic movements of the lower limbs, and the Apnea Hypopnea Index is significantly higher in employees with mostly forced work posture and mental labor.

Studies on the influence of different occupational factors on different sleep indicators are scarce. Fietze and co-authors actigraphed workers from 97 German companies in various industries. In their study, it was found that those employees with a high level of stress in the work environment were at an increased risk of having insomnia, mainly having difficulty falling asleep and maintaining sleep, as well as reduced sleep duration and efficiency. Those with predominantly mental work had an increased Apnea Hypopnea Index and the number of Periodic Limb Movements, which has been suggested to be due to the reduced physical activity of these workers, leading to obesity and, respectively, hypertension, hypercholesterolemia and diabetes mellitus - risk factors for the development of sleep apnea and periodic limb movemen syndrome.

Choi and co-authors studied 50,205 South Korean workers by assessing their sleep quality via a survey. Of the employees surveyed, those with a predominantly forced work posture reported difficulty falling asleep and repeated awakenings from sleep, the likely cause being the chronic pain associated with the respective occupations. The questionnaire survey found that workers with mostly physical labor fall asleep more easily and have subjectively better quality sleep than those with mostly mental labor.

Contrary to these data, Dubinina and co-authors found that workers who have mainly physical labor have difficulty falling asleep and maintaining sleep, and these manifestations are most severely expressed in those employees with a 6-day work week and those with heavy physical work. The assumed mechanism is related to hyperexcitability - the main factor in the pathophysiology of insomnia, during heavy physical work.

Okamoto-Mizuno and co-authors investigated the influence of microclimate in the work environment on sleep stages and sleepiness of workers. They found that exposure to higher than 29 °C resulted in higher waking state activity and shorter slow-wave and REM sleep. They found no effect of lower temperatures on sleep stages.

Nari and co-authors studied 30,827 workers from South Korea who had exposure to vibration and industrial noise. Of these, 61.7% reported one or more symptoms of insomnia. According to the authors, the likely cause is the disturbed balance between sympathetic and parasympathetic nervous system activity accompanying prolonged exposure to vibration.

With the increase of age in the workers we studied, there was a significant decrease in sleep duration in both sexes, sleep latency in women, an increase in the number of awakenings in

men, an increase in AHI and the number of PLM in both sexes. Miner and co-authors attribute the decline in sleep performance with increasing age to a combination of physiological and pathological mechanisms. Gradually, in the older population, there is a loss of neurons in the various centers that control sleep. Accordingly, with increasing age, various socially significant diseases that affect the quality of sleep become more frequent.

7. Conclusions

7.1 Employees with a shift work regime have a subjectively worse state of health compared to the controls, and in the population studied by us, no increase in the frequency of socially significant diseases was found in the first group compared to the second.

7.2 The assessment scales conducted (PSQI, ISI and ESS) show a significantly reduced quality of sleep in employees with a shift work schedule compared to those with normal working hours, with the former having evidence of severe insomnia and excessive sleepiness.

7.3 In both groups, with the increase of age, all sleep indicators worsen, and in shift workers this occurs at a significantly earlier age, with the exception of sleep efficiency. In the studied workers, subjective sleep quality was not significantly affected by gender, but higher scores on the PSQI and ESS test rating scales and a higher Apnea-Hypopnea Index (AHI) were found in men.

7.4 Shift-work workers had statistically significantly reduced duration, efficiency, latency, and increased awakenings and periodic movements of the lower limbs during sleep compared to those with regular work hours recorded by polysomnography. Apnea-Hypopnea Index-a is not affected by shift work.

7.5 Of the occupational factors studied, the shift work statistically significantly affects the studied indicators of sleep. The presence of stress at work affects the number of awakenings from sleep. The presence of a forced work posture and mental work statistically significantly affect the Apnea-Hypopnea Index, and mental work also affects the number of periodic movements of the lower limbs during sleep. Heavy physical work does not affect sleep indicators.

8. Contributions

8.1 Contributions of original character

8.1.1 For the first time in Bulgaria, the quality of sleep and the presence of sleep disorders in workers with a shift work were studied

8.1.2 For the first time in Bulgaria, the influence of the shift work regime on the health status of workers and accompanying diseases has been studied

8.1.3 For the first time in Bulgaria, the influence of occupational factors shift work on the quality of sleep has been studied.

8.2 Contributions of a confirmatory nature

8.2.1 The reduced quality of sleep among shift workers is confirmed

8.2.2 It is confirmed that with the increase of age there is an increase in sleep disorders in shift workers.

8.2.3 The deteriorated state of health of shift workers is confirmed.

9. Publications and scientific events related to the dissertation work

Publications:

1. **Yankova A**. Georgiev K. Dimitrova D . Dimitrova-Kirilova V Nestorova. A patient with insomnia due to restless leg and periodic limb movement syndrome after stroke - a clinical case ELECTRON J GEN MED, 01 Mar 2023, Volume 20, Issue 2
2. **Aleksandra Yankova**, Dimitrinka Dimitrova, Vladina Dimitrova-Kirilova, Veselinka Nestorova Sleep disorders and comorbidities in shift work-overview Varna Medical Forum , 11, 2022, vol 2
3. **Aleksandra Yankova**, Dimitrinka Dimitrova, Vladina Dimitrova-Kirilova, Veselinka Nestorova Sleep disorders in shift work Journal of the Union of Scientists - Varna. Medicine and Ecology Series. 2‘2022; 27:21-26

10. Applications

Name:_____ Date: _____

Pittsburgh Sleep Quality Index (PSQI)

Instructions: The following questions relate to your usual sleep habits during the past month only. Your answers should indicate the most accurate reply for the majority of days and nights in the past month. Please answer all questions.

1. During the past month, what time have you usually gone to bed at night? _____

2. During the past month, how long (in minutes) has it usually taken you to fall asleep each night? _____

3. During the past month, what time have you usually gotten up in the morning? _____ 4. During the past month, how many hours of actual sleep did you get at night? (This may be different than the number of hours you spent in bed.) _____

5.During the past month how often have you had trouble sleeping because you…….	Not during the past month	Less than once a week	Once or twice a week	Three or more times a week
a. Cannot get to sleep within 30 minutes				
b. Wake up in the middle of the night or early morning				
c. Have to get up to use the bathroom				
d. Cannot breathe comfortably				
e. Cough or snore loudly				
f. Feel too cold				
g. Feel too hot				
h. Have bad dreams				
i. Have pain				

j. Other reason(s), please describe:				
6. During the past month, how often have you taken medicine to help you sleep (prescribed or “over the counter”)?				
7. During the past month, how often have you had trouble staying awake while driving, eating meals, or engaging in social activity?				
	No problem at all	Only a very slight problem	Somewhat of a problem	A very big problem
8. During the past month, how much of a problem has it been for you to keep up enough enthusiasm to get things done?				
	Very good	Fairly good	Fairly bad	Very bad
9. During the past month, how would you rate your sleep quality overall?				
10. Do you have a bed partner or room mate?				
	No bed partner or roommate	Partner/roommate in other room	Partner in same room but not same bed	Partner in same bed
If you have a room mate or bed partner, ask him/her how often in the past month you have had:				
a. Loud snoring				

b. Long pauses between breaths while asleep				
c. Legs twitching or jerking while you sleep				
d. Episodes of disorientation or confusion during sleep				
e. Other restlessness while you sleep, please describe:				

Application 1: Pittsburgh Sleep Quality Index

Insomnia Severity Index

The Insomnia Severity Index has seven questions. The seven answers are added up to get a total score. When you have your total score, look at the 'Guidelines for Scoring/Interpretation' below to see where your sleep difficulty fits.

For each question, please CIRCLE the number that best describes your answer. Please rate the CURRENT (i.e. LAST 2 WEEKS) SEVERITY of your insomnia problem(s).

Insomnia Problem	None	Mild	Moderate	Severe	Very Severe
1. Difficulty falling asleep	0	1	2	3	4
2. Difficulty staying asleep	0	1	2	3	4
3. Problems waking up too early	0	1	2	3	4

1. How SATISFIED/DISSATISFIED are you with your CURRENT sleep pattern?

Very Satisfied	Satisfied	Moderately Satisfied	Dissatisfied	Very Dissatisfied
0	1	2	3	4

2. How NOTICEABLE to others do you think your sleep problem is in terms of impairing the quality of your life?

Not at all Noticeable	A Little	Somewhat	Much	Very Much Noticeable
0	1	2	3	4

3. How WORRIED/DISTRESSED are you about your current sleep problem?

Not at all Worried	A Little	Somewhat	Much	Very Much Worried
0	1	2	3	4

4. To what extent do you consider your sleep problem to INTERFERE with your daily functioning (e.g. daytime fatigue, mood, ability to function at work/daily chores, concentration, memory, mood, etc.) CURRENTLY?

Not at all Interfering	A Little	Somewhat	Much	Very Much Interfering
0	1	2	3	4

Guidelines for Scoring/Interpretation:

Add the scores for all seven items (questions 1 + 2 + 3 + 4 + 5 +6 + 7) = _____ your total score

Total score categories:

0–7 = No clinically significant insomnia

8–14 = Subthreshold insomnia

15–21 = Clinical insomnia (moderate severity)

22–28 = Clinical insomnia (severe)

Application 2: Insomnia Severity Index

The Epworth Sleepiness Scale

The Epworth Sleepiness Scale is widely used in the field of sleep medicine as a subjective measure of a patient's sleepiness. The test is a list of eight situations in which you rate your tendency to become sleepy on a scale of 0, no chance of dozing, to 3, high chance of dozing. When you finish the test, add up the values of your responses. Your total score is based on a scale of 0 to 24. The scale estimates whether you are experiencing excessive sleepiness that possibly requires medical attention.

How Sleepy Are You?

How likely are you to doze off or fall asleep in the following situations? You should rate your chances of dozing off, not just feeling tired. Even if you have not done some of these things recently try to determine how they would have affected you. For each situation, decide whether or not you would have: ·

No chance of dozing =0 ·

Slight chance of dozing =1 ·

Moderate chance of dozing =2 ·

High chance of dozing =3

Write down the number corresponding to your choice in the right hand column. Total your score below.

Situation	Chance of Dozing
Sitting and reading	
Watching TV	
Sitting inactive in a public place (e.g., a theater or a meeting)	
As a passenger in a car for an hour without a break	
Lying down to rest in the afternoon when circumstances permit	
Sitting and talking to someone	
Sitting quietly after a lunch without alcohol	

In a car, while stopped for a few minutes in traffic	

Analyze Your Score Interpretation:

0-7:It is unlikely that you are abnormally sleepy.

8-9:You have an average amount of daytime sleepiness.

10-15:You may be excessively sleepy depending on the situation. You may want to consider seeking medical attention.

16-24:You are excessively sleepy and should consider seeking medical attention.

Application 3: Epworth Sleepiness Scale