PUBLIC HEALTH

IMPACT OF NIGHT WORK ON HEALTH AND WORK ABILITY AMONG HEALTHCARE WORKERS

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Abstract

Aim of the study. The study objective was to determine the impact of night work on health and work ability of health workers. Material and methods. This was a cross-sectional study conducted with an anonymous survey questionnaire distributed among 120 health workers employed in PHI CGH „8th September" - Skopje, in the period January-May 2024. The study comprised male and female subjects aged 21 to 62 years, 86.7% of them worked full-time, 60% worked in shifts, 40% worked only in the first shift, while 50% of them also had night shifts. Results. The mean age of examined subjects was 40.9±10.6 years, and the average length of service in the current workplace was 11.8±8.9 years (range 1-42 years). 44.2% of them were active smokers with an average smoking experience of 6.2±9.1 years, while only 2.5% of them drank alcohol daily in an amount greater than one large glass (200 ml) of beer/wine or one small glass (50 ml) of brandy or other strong drink. A significant difference between subjects who worked and those who did not work night shifts was determined for the consumption of alcohol in a larger amount (P=0.030), followed by dissatisfaction with the workplace (P=0.031), as well as in dissatisfaction with life (P=0.042). The majority of subjects believed that psychophysical abilities during and after night work were worse than during day work, 66.6% of them answered that they had difficulties in sleeping after night shifts. The frequency of cardiovascular diseases was significantly higher among subjects who worked night shifts compared to those who did not work (P=0.043), together with the frequency of health conditions that require regular medication at a strictly defined time (P=0.037). The average values of current work ability in subjects who worked night shifts and those who did not work night shifts were similar. Conclusion. The results of the study evidently showed a significant impact of night work on health and well-being as well as on work ability of health workers.

ЈАВНО ЗДРАВЈЕ

ВЛИЈАНИЕ НА НОЌНАТА РАБОТА ВРЗ ЗДРАВЈЕТО И РАБОТНАТА СПОСОБНОСТ КАЈ ЗДРАВСТВЕНИТЕ РАБОТНИЦИ

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Печатарски права: ©2025 Сашо Столески, Ѓулсевер Асани Куки, Драган Мијакоски, Јордан Минов, Весна Велиќ Стефановска. Оваа статија е со отворен пристап дистрибуирана под условите на нелокализирана лиценца, која овозможува неограничена употреба, дистрибуција и репродукција на било кој медиум, доколку се цитираа торигиналниот(ите) автор(и) и изворот.

Конкурентски интереси: Авторот изјавува дека нема конкурентски интереси.

Извадок

Цел на студијата. Целта на студијата беше да се утврди влијанието на ноќната работа врз здравјето и работната способност на здравствените работници. Материјал и методи. Ова беше студија на пресек спроведена со анонимен анкетен прашалник дистрибуиран кај 120 здравствени работници вработени во ЈЗУ ГОБ „8-ми Септември" - Скопје, во периодот јануари-мај 2024 година. Студијата опфати машки и женски испитаници на возраст од 21 до 62 години, 86,7% од нив работеа со полно работно време, 60% работеа во смени, 40% работеа само во прва смена, додека 50% од нив работеа и ноќни смени. Резултати. Просечната возраст на испитаниците беше 40,9 ± 10,6 години, а просечниот стаж на актуелното работно место беше 11,8 ± 8,9 години (опсег 1-42 години). 44,2% од нив беа активни пушачи со просечен пушачки стаж од 6,2 ± 9,1 години, додека само 2,5% од нив консумираа алкохол дневно во количина поголема од една голема чаша (200 мл) пиво/вино или една мала чаша (50 мл) ракија или друг жесток пијалок. Значајна разлика помеѓу испитаниците кои работеа и оние кои не работеа ноќни смени беше утврдена само за консумирање алкохол во поголема количина (P = 0,030), следено со незадоволството од работното место (P = 0,031), како и во незадоволството од животот (P = 0,042). Поголемиот дел од испитаниците сметаа дека психофизичките способности за време и по ноќната работа се полоши отколку за време на дневната работа, а 66,6% од нив одговорија дека имаат тешкотии со спиењето по ноќните смени. Зачестеноста на кардиоваскуларни заболувања беше значително поголема кај испитаниците кои работеле и ноќни смени во споредба со оние кои не работеле (P=0,043), заедно со фреквенцијата на здравствени состојби кои бараат редовна терапија со лекови во строго дефинирано време (P=0,037). Просечните вредности на моменталната работна способност кај испитаниците кои работеле ноќни смени и оние кои не работеле ноќни смени беа слични. Заклучок. Резултатите од студијата евидентно покажаа значително влијание на ноќната работа врз здравјето и благосостојбата, како и врз работната способност на здравствените работници. Здравствените работници треба да бидат свесни за ризиците поврзани со ноќната работа за да преземат мерки за спречување на проблемите со здравјето.

Introduction

According to the International Labour Organization (ILO), shift work is "a method of organising working time in which workers alternate with each other in the workplace so that the undertaking can work longer than the hours of work of individual workers" at different times of the day and night[1].

The term night work covers all work performed during a period of not less than seven consecutive hours, including the interval from midnight to 5 a.m., to be determined by the competent authority after consultation with the most representative organisations of employers and workers or by collective agreements. Night worker means an employee whose work requires the performance of a significant number of hours of night work exceeding a certain limit. The limit shall be determined by the competent authority after consultation with the most representative organisations of employers and workers or by collective agreements[2]. According to Article 127 of the Law on Labor Relations (Official Gazette of the R. Macedonia No. 62/05), night work is considered to be work during the night (the period between 10 p.m. and 6 a.m. the following day), and an employer who regularly uses workers for night work is obliged to notify the State Labor Inspectorate[3].

One fifth of the global workforce is engaged in shift work, with 20% of European and American workers engaged in night shifts. Healthcare workers make up the majority of shift workers to enable the provision of 24/7 healthcare services. Shift work in the healthcare system is considered essential and necessary to ensure continuity of care in hospitals and residential facilities. Rotation and scheduling are key features of shift work and healthcare workers are largely bound to schedules that provide 24-hour care and include night shifts in their work arrangements. Night shift work is one of the most common causes of circadian rhythm disruption, causing significant changes in sleep and biological functions, which in turn can affect physical and psychological well-being and can have negative impact on work performance[4,5]. Many health problems can be directly attributed to lack of rest and sleep, such as slower reaction times, impaired learning ability, reduced cognitive ability, mood disturbances, and drowsiness. These symptoms can pose serious threats to healthcare professionals and their ability to perform their tasks accurately and correctly[6]. The challenges of shift work are associated with the intention to leave the profession, and therefore night work has been shown a risk factor for the development of disability and early retirement[7].

A comprehensive systematic review of the literature on shift work has shown that shift work combined with sleep disturbances may also be associated with lower dietary quality scores, higher body mass index, reduced physical activity and a higher prevalence of hypertension. There is an increased risk of developing type 2 diabetes, impaired glucose tolerance, and metabolic syndrome, with subsequent effects on both the cardiovascular and gastrointestinal systems8. It may also exacerbate some existing health conditions such as epilepsy, depression, anxiety, diabetes, or any other ongoing condition

that requires regular medication[9]. The occurrence of chronic adverse effects depends on several factors such as age, duration of exposure, or inappropriate behaviour. This is greatly influenced by worker's specialty, workload and ultimately the need and frequency of being involved in night shifts[10]. Night shift work in the healthcare sector is not only associated with poorer health, but also with increased frequency of absenteeism and lower levels of job satisfaction[11].

Night shift work is associated with an increased risk of heart diseases[12]. Epidemiological studies have clearly documented that cardiovascular events such as myocardial infarction, stroke, and arrhythmias have the highest incidence of morbidity and mortality in the early morning hours, as opposed to occurring at random. The exact mechanisms by which shift work causes cardiovascular diseases are not yet fully understood, but it is thought that the main contributing factors include the disrupted circadian rhythm and confounding factors such as smoking, poor dietary habits, and stressful social situations, which are common among shift workers[13]. Disrupted circadian rhythms lead to hormonal and metabolic changes, resulting in high blood pressure, atherosclerosis, diabetes, and obesity[14,15]. Shift workers have an average of 40% higher risk of ischemic heart disease compared to non-shift workers[5].

Furthermore, the combined effects of overtime and insufficient sleep can critically increase nervous system activity, potentially causing acute myocardial infarction[16].

Gastrointestinal disorders are one of the most common health problems reported in shift workers. A high prevalence of gastrointestinal problems such as gastrointestinal ulcers, gastritis, constipation, and diarrhea, as well as an increased risk of colon cancer, has been observed in shift workers. Helicobacter pylori infection is more prevalent in shift workers than in day shift workers, possibly indicating that shift work interferes with natural gastric defenses[17,18].

As early as 2007, the International Agency for Research on Cancer (IARC) classified shift work as a probable carcinogen, based on sufficient evidence in experimental models and limited evidence in humans. It has been suggested that exposure to artificial light at night and changes in sleep-wake cycles due to night-shift work schedules may be responsible for the increased risk of cancer. Due to the potential antiestrogenic effects of melatonin, it has also been suggested that night-shift workers may be more susceptible to the development of hormone-dependent neoplasms, such as breast, prostate, and endometrial cancers[19].

A higher incidence of altered menstrual cycles, premenstrual syndrome and menstrual pain, endometriosis, infertility, and reduced breastfeeding frequency have been observed in many groups of shift workers, such as medical, aviation, and industrial workers. Some studies have reported a higher incidence of spontaneous abortion and fetal growth retardation, including preterm birth and low birth weight. For these reasons, women are exempted from night work from the beginning of pregnancy, with the option of working day shifts for the first 2–3

years after the birth of the child[18,19].

Night shifts can result in significant stress and sleep disturbances, which affect the overall well-being and quality of life of healthcare workers, and night work impairs the alertness and professional performance of healthcare workers and reduces the quality of care[20,21].

The study objective was to determine the impact of night work on health and work ability of healthcare workers, as well as to prevent harmful effects on health of healthcare workers through a better understanding of the risks of night work, and to provide recommendations and guidelines for educating and advising healthcare personnel on how to deal with the risks of shift work.

Material and methods

Study design

This cross-sectional study was conducted using an anonymous questionnaire among employees of the PHI City General Hospital "8th September" - Skopje, in the period January-May 2024.

Study sample

The study included workers from the City General Hospital "8th September" in Skopje. Before the start of the survey, permission for the survey was requested and received from the management of the City General Hospital "8th September" – Skopje, while ethical approval was not requested. All subjects were previously informed about the purpose and methodology of the study and they voluntarily agreed to participate. In order to meet the set goals of the study, the study group consisted of 120 healthcare workers: 60 who also worked night shifts (first, second and third shifts), and 60 who worked only day shifts (first and/or second shift). The study included subjects of both genders aged 21 to 62 years.

According to the level of education and the work tasks they performed, they were classified into several groups: nurses/health technicians, laboratory technicians, paramedics and medical doctors and specialists. Healthcare workers from three shifts - first, second and third (night shift) from different departments were included.

Methods

The research methodology included a "Questionnaire on the impact of night work on health and work ability among healthcare workers". The questions were compiled based on the risk factors that occur during night work, lifestyle, health status, life and work satisfaction, and the subjects' perception of their work ability. All subjects who gave verbal consent to participate in the study filled out the sections of the questionnaire related to general information, information on smoking status, alcohol consumption, and information on the work process. The information provided in the questionnaire was treated as confidential and all participants in the study were anonymous.

The questionnaire used as an instrument in the study was specially designed and based on several standardized questionnaires in order to obtain the most accurate information and to ensure psychometric

properties: "Night worker's health questionnaire", "Health and Work Questionnaire", and "Validation of the Work Limitations Questionnaire in Brazilian Army Military Personnel"[22-24]. The questionnaire consists of 52 questions divided into 6 groups such as: demographic data (gender, age, ethnicity, education/qualification), data on work and workplace, data on lifestyle (cigarette smoking, alcohol consumption, physical activity), life and work satisfaction, questions on health of health workers during night work and data on the perception of personal work ability. The information obtained from the questionnaire was used to assess the degree of impact of night work on health and work ability, as well as to compare different shifts and their effect on health of the study subjects.

Statistical analysis

Statistical analysis was performed using the Statistical Package for the Social Sciences (SPSS), version 14.0 for Windows. Continuous variables were expressed as mean values with standard deviation (SD), and the nominal variables as numbers and percentages. Univariate statistical models were used for testing the differences in prevalence and comparison of the means. Chi-square test (or Fisher's exact test where appropriate) was used for testing difference in the prevalence, while comparison of data means was performed by independent-samples T-test. A P-value less than 0.05 was considered as statistically significant.

Results

Demographic data for the study sample is shown in Table 1.

Table 1: Demographic characteristics of study subjects

Variable		Subjects (n=120)
Gender	Males	6 (5%)
	Females	114 (95%)
Male/female ratio		0.05
Age (years)		40.9 ± 10.6
Range (years)		21 - 62
Total work experience (years)		17.1 ± 10.6
Range (years)		1 - 42
Length of service at current job position (years)		11.8 ± 8.9
Range (years)		1 - 42
Place of residence City Village		 110 (91.7%) 10 (8.3%)
Education - Secondary education - Higher education (three-year professional studies) - Higher education		 62 (51.7%) 46 (38.3%) 12 (10%)

Frequencies are presented as the number and percentage of respondents with the corresponding variable. Numeric data are expressed as mean values with standard deviations.

Job and workplace information

Among the total examined group (EG), the majority of subjects (104-86.7%) worked full-time, 8 hours per day and 40 hours per week, 5 days per week, 3 subjects (2.5%) worked 36 hours per week, 3 (2.5%) worked 37.5 hours per week, while 10 subjects (8.3%) worked more than 40 hours per week (up to a maximum of 64 hours a week). The average number of working hours was 40.9±4.2 hours per week (range 36-64 hours).

They worked in multiple job positions - medical doctors and specialists (10%), nurses and medical technicians (78.3%), laboratory technicians (8.3%) and paramedics (3.4%). The majority of subjects, i.e. 72 (60%) worked in shifts, and 48 (40%) worked only in the first shift. Thirty-four (28.3%) subjects worked overtime, and the average number of overtime hours was 3.1±6.8 hours (range 0-36 hours).

Figure 1 shows the percentage of workers in different shifts (first, second and third).

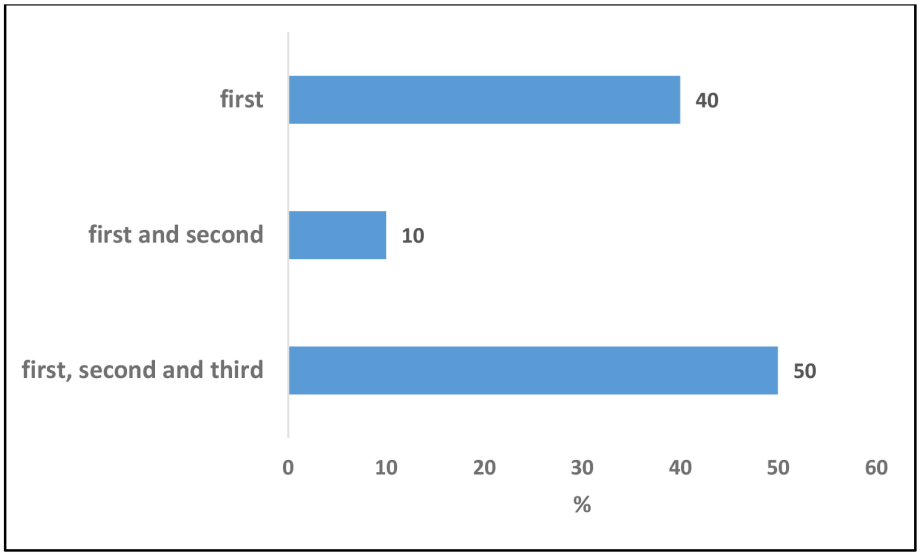


Figure 1: Number of workers in different shifts

Lifestyle of subjects

Table 2 shows the comparison between subjects who worked only the first or first and second shift with those who also worked night shifts (third shift) in terms of smoking status, alcohol consumption, and practicing some form of physical activity.

Table 2: Comparison of smoking status, alcohol consumption and physical activity levels between subjects who worked and those who did not work night shifts

Variables	Subjects with night shifts (N=60) (%)	Subjects without night shifts (N=60) (%)	*P* - value*
Active smokers	28 (46.7%)	25 (41.7%)	*P* = 0.581
Former smokers	17 (28.3%)	13 (21.7%)	*P* = 0.399
Passive smoking	45 (75%)	44 (73.3%)	*P* = 0.835
Moderate alcohol consumption	10 (16.7%)	10 (16.7%)	*P* = 1.000

Heavy alcohol consumption	15 (25%)	6 (10%)	*P* = 0.030*
Physical activity	39 (65%)	42 (70%)	*P* = 0.559
Current diseases	27 (45%)	22 (36.7%)	*P* = 0.353

Frequencies are shown as the number and percentage of subjects with the corresponding variable.

* Tested by χ^2 test or Fisher's exact test.

A significant difference existed between subjects who worked night shifts and those who did not in terms of alcohol consumption in larger quantities, which supports the fact that the night shift represents a significant risk factor for alcohol abuse.

Life and work satisfaction data

Table 3 shows the comparison between subjects who worked only the first or first and second shift with those who also worked night shifts (third shift) in terms of dissatisfaction with their job, life, friends and family, coworkers, and superiors.

Table 3: Comparison of dissatisfaction with workplace, life, friends and family, coworkers, and superiors between subjects who worked and those who did not work night shifts

Variables	Subjects with night shifts (N=60) (%)	Subjects without night shifts (N=60) (%)	*P* - value*
Job dissatisfaction	12 (20%)	4 (6.7%)	*P* = 0.031*
Life dissatisfaction	4 (6.7%)	0	*P* = 0.042*
Friends and family dissatisfaction	0	0	/
Coworkers' dissatisfaction	4 (6.7%)	3 (5%)	*P* = 0.697
Supervisors' dissatisfaction	3 (5%)	3 (5%)	*P* = 1.000

Frequencies are shown as the number and percentage of subjects with the corresponding variable.

* Tested by χ^2 test or Fisher's exact test.

A significant difference was found for job dissatisfaction and life dissatisfaction between subjects who worked and those who did not work night shifts (P=0.031 and P = 0.042, respectively).

Table 4 displays the comparison between subjects who worked only the first or first and second shift with those who also worked night shifts (third shift) in terms of conflicts, restlessness, loss of interest or boredom, difficulty concentrating, success in completing tasks, as well as feelings of exhaustion at work.

Table 4: Comparison of conflict, restlessness, loss of interest or boredom, difficulty concentrating, success in completing tasks, and feelings of exhaustion at work between subjects who worked and those who did not work night shifts

Variables	Subjects with night shifts (N=60) (%)	Subjects without night shifts (N=60) (%)	*P* - value*
Workplace conflicts	37 (61.7%)	42 (70%)	*P* = 0.336
Workplace restlessness	31 (51.7%)	36 (60%)	*P* = 0.358

Loss of interest or boredom at work	44 (73.3%)	39 (65%)	$P = 0.323$
Difficulty concentrating at work	27 (45%)	36 (60%)	$P = 0.099$
Success in completing tasks at work	59 (98.3%)	58 (96.7%)	$P = 0.559$
Feeling exhausted at work	56 (93.3%)	52 (86.7%)	$P = 0.361$

Frequencies are shown as the number and percentage of subjects with the corresponding variable.
* Tested by χ^2 test or Fisher's exact test.

No statistically significant difference was obtained for any of the examined variables between subjects who worked and those who did not work night shifts.

Health status of health care workers during night shift

The following figures provide data on the effects of night work on the work performance and health status of workers who worked at night.

Psychophysical abilities during night work among subjects who worked at night are provided in Figure 2.

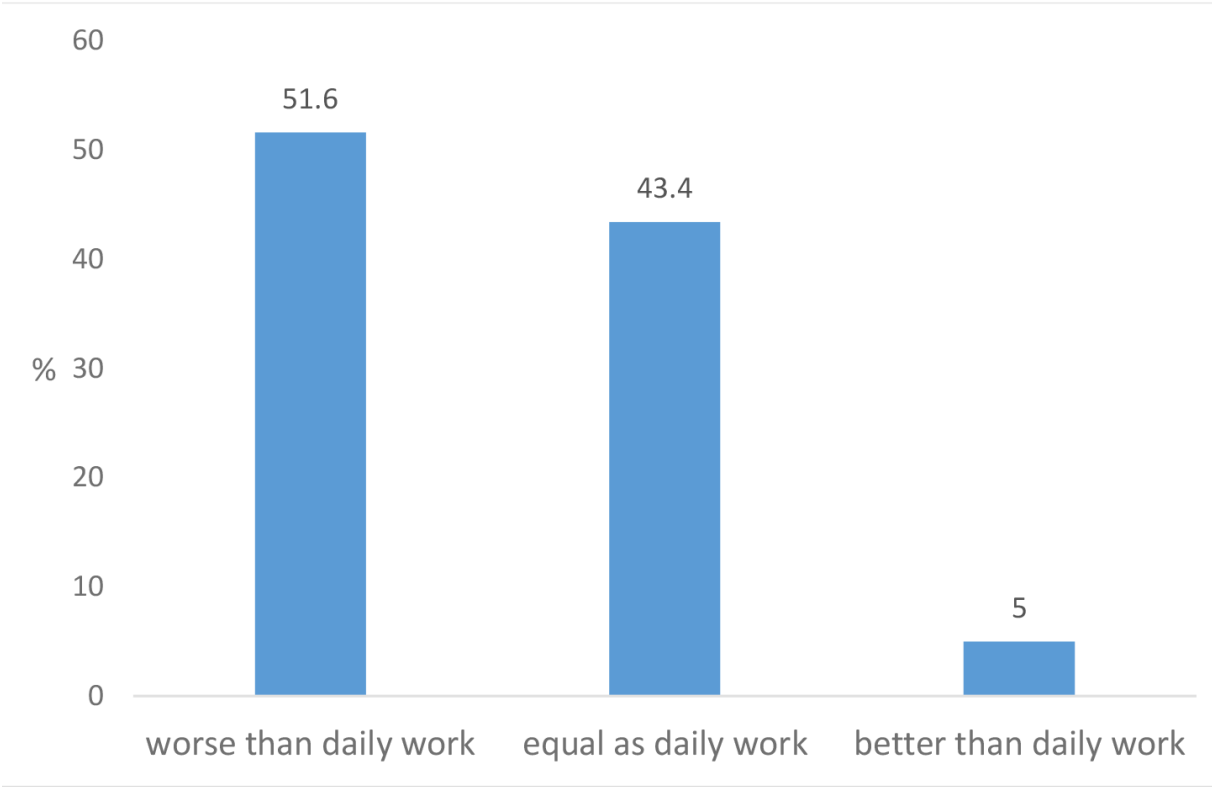


Figure 2: Psychophysical abilities during night work

The majority of subjects believed that psychophysical abilities during night work were worse than those during daily work.

Figure 3 shows the responses of subjects who worked night shifts regarding sleeping problems after working a night shift.

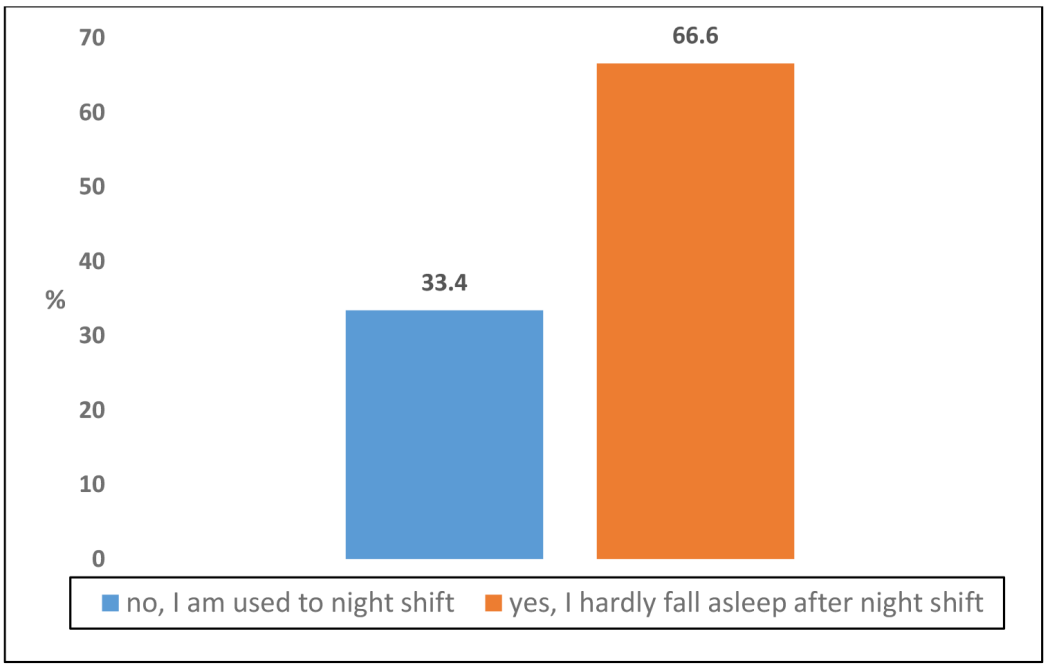


Figure 3: Sleeping problems after night shifts

The majority of subjects (66.6%) responded that they had difficulty sleeping after working a night shift.

Table 5 shows data on the occurrence of certain diseases, health disorders, and other conditions among workers who worked night shifts, as well as a comparison of the frequency of these conditions among workers who did not work night shifts.

Table 5: Frequency of certain diseases and conditions among workers who worked and those who did not work night shifts

Variables	Subjects with night shifts (N=60) (%)	Subjects without night shifts (N=60) (%)	*P* - value*
Frequency of diabetes	3 (5%)	2 (3.3%)	*P* = 0.648
Frequency of cardiovascular diseases	17 (28.3%)	8 (13.3%)	*P* = 0.043*
Frequency of gastrointestinal diseases	5 (8.3%)	3 (5%)	*P* = 0.464
Frequency of health conditions where meal timing is particularly important	8 (13.3%)	5 (8.3%)	*P* = 0.557
Frequency of conditions that affect sleep	9 (15%)	2 (3.3%)	*P* = 0.027*
Frequency of chronic diseases where symptoms are more pronounced at night	6 (10%)	2 (3.3%)	*P* = 0.272
Frequency of health conditions that require regular medication at strictly defined times	16 (26.7%)	7 (11.7%)	*P* = 0.037*

Frequencies are shown as the number and percentage of subjects with the corresponding variable.

* Tested by χ^2 test or Fisher's exact test.

The incidence of diabetes was higher among subjects who worked night shifts (5%) compared to those who did not work night shifts (3.3%), but the difference was not significant (P=0.648). The incidence of cardiovascular diseases was significantly higher among subjects who also worked night shifts (28.3%) compared to those who did not work (13.3%) (P=0.043). The frequency of gastrointestinal diseases was also higher among subjects who worked night shifts (8.3%) compared to those who did not work night shifts (5%), but the difference was not significant (P=0.464). The prevalence of health conditions where meal timing is particularly important was higher among night shift workers (13.3%) compared to non-night shift workers (8.3%), but the difference was not significant (P=0.557). The prevalence of sleep-related conditions was significantly higher among night shift workers (15%) compared to non-night shift workers (3.3%) (P=0.027). The prevalence of chronic diseases where symptoms are more pronounced at night was higher among night-shift workers (10%) compared to non-night shift workers (3.3%), but the difference was not statistically significant (P=0.272). The frequency of health conditions that require regular medication at strictly defined times was significantly higher among subjects who also worked night shifts (26.7%) than among those who did not (11.7%) (P=0.037).

According to questionnaire data, the most common symptoms that appeared during night work were stress, anxiety, flushing, weakness, insomnia, dizziness, fatigue, and irritability.

Perception of personal work ability

The comparison of the average values of current *versus* best work ability between subjects who worked night shifts compared to those who did not is shown in Table 6.

Table 6: Comparison of the average values of current *versus* best work ability between subjects who work night shifts and those who do not work night shifts

Variable	Subjects with night shifts (N=60) (%)	Subjects without night shifts (N=60) (%)	*P - value**
Current in terms of best working ability	8±1.63	7.9±1.57	*P* = 0.733

Numerical data are expressed as mean values with standard deviations.
* Tested by t-test for independent samples.

There was no significant difference in the average values of current versus best work ability between subjects who worked night shifts and those who did not work night shifts (P = 0.733).

Table 7: Comparison of the ability to perform usual daily activities over the last 3 months between night shifts workers and non-night shift workers

Variable	Subjects with night shifts (N=60) (%)	Subjects without night shifts (N=60) (%)	*P - value**
Always	32 (53.3%)	30 (50%)	*P* = 0.715
Most often	19 (31.7%)	24 (40%)	*P* = 0.080
Sometimes	8 (13.3%)	5 (8.3%)	*P* = 0.378
Rarely	1 (1.7%)	1 (1.7%)	*P* = 0.100
Never	0 (0%)	0 (0%)	/

Frequencies are shown as the number and percentage of subjects with the corresponding variable.

* Tested by χ^2test or Fisher's exact test.

No significant difference was found in the categories of ability to perform usual daily activities over the last 3 months between subjects who worked night shifts and those who did not work night shifts.

Table 8 presents the comparison of the perception of work ability among subjects who worked night shifts and those who did not work night shifts.

Table 8: Comparison of the perception of work ability among subjects who worked night shifts and those who did not work night shifts

Variable	Subjects with night shifts (N=60) (%)	Subjects without night shifts (N=60) (%)	*P - value**
Quite good	47 (78.3%)	48 (80%)	P = 0.822
Moderate	13 (21.7%)	10 (16.7%)	P = 0.487
Quite poor	0 (0%)	2 (3.3%)	P = 0.154
Very poor	0 (0%)	0 (0%)	/

Frequencies are shown as the number and percentage of subjects with the corresponding variable.

* Tested by χ^2test or Fisher's exact test.

No significant difference was found in the categories of perceived work ability between night-shift subjects and non-night shift subjects.

The comparison of the feeling of fulfillment and hope for the future among subjects who worked night shifts and those who did not work night shifts is illustrated in Table 9.

Table 8: Comparison of the perception of work ability among subjects who worked night hifts and those who did not work night shifts

Variable	Subjects with night shifts (N=60) (%)	Subjects without night shifts (N=60) (%)	*P - value**
continuously	7 (11.7%)	13 (21.7%)	*P* = 0.142
often	31 (51.6%)	30 (50%)	*P* = 0.855
sometimes	16 (26.7%)	15 (25%)	*P* = 0.835
rarely	6 (10%)	2 (3.3%)	*P* = 0.143
never	0 (0%)	0 (0%)	/

Frequencies are shown as the number and percentage of subjects with the corresponding variable.

* Tested by χ^2test or Fisher's exact test.

No significant difference was found in the categories of feeling fulfilled with hope for the future between subjects who worked night shifts and those who did not work night shifts.

Discussion

Night work has become a significant health concern in recent years and is a very serious public health problem for all workers from various sectors, including healthcare workers. The current study aimed to determine the impact of night shift work on health and work capacity among healthcare workers through analysis of personal medical history on the presence of certain diseases, conditions, symptoms and signs, lifestyle data, demographic data, data on work and workplace, length of service, life and work satisfaction, perception of personal work capacity. It also aimed to raise awareness among night shift workers about possible side effects, as well as to propose appropriate measures and recommendations for protection against the impact of negative effects of night shift work.

Shift work can also have negative health effects through its potential impact on behavior, such as poorer quality of diet or increased smoking or alcohol consumption. Bøggild and Knutsson in 1999 reported that shift workers compared to regular workers were more likely to be smokers[25]. Our results indicate that healthcare workers on night shifts had a higher rate of active smoking compared to non-night shift workers. Also, a large proportion of subjects (84.2%) were passively exposed to tobacco smoke, for less than 4 hours (44.9%) and for more than 4 hours (55.1%). The comparison between subjects who worked night shifts and subjects who did not work night shifts is as follows: active smokers (46.7% *vs.* 41.7%) (P=0.581), former smokers (28.3% *vs.* 21.7%) (P=0.399), and passive smokers (75% *vs.* 73.3%) (P=0.835).

According to the results obtained for alcohol consumption, 20 subjects (16.7%) reported occasional or daily intake of one large glass (200 ml) of beer/wine or one small glass (50 ml) of brandy or other strong drink. Comparison of subjects who worked night shifts and those who did not showed that consumption of alcohol in moderate amounts was the same in both groups - 10 (16.7%) *vs.*10 (16.7%). However, alcohol consumption in larger amounts was statistically significantly higher in night shift workers - 15 (25%) *vs.* 6 (10%) (P=0.030). The results showed that a significant difference existed between subjects who worked and those who did not work night shifts in terms of alcohol consumption in larger amounts, which supports the fact that the night shift is a significant risk factor for alcohol abuse. The comparison of physical activity between subjects who worked and those who did not work night shifts (65% *versus* 70%) showed that night workers were less physically active than those who worked day shifts, which supports the fact that the night shift is a risk factor.

Yang *et al.* investigated the association between shift work and the incidence of cardiometabolic multimorbidity (CMM) in patients with hypertension in a prospective, population-based cohort study of 36,939 participants in the United Kingdom. They used competing risk models

to examine the association between shift work and the risk of CMM, which was defined as the coexistence of hypertension and diabetes, coronary heart disease, or stroke in the study. They also investigated the association between the frequency and duration of shift work and the risks of CMM. In addition, they conducted a cross-classification analysis combining the frequency and duration of shift work, chronotype, and sleep duration as exposure metrics. During a mean follow-up of 11.6 years, a total of 5,935 participants developed CMM. They found that usually/always working night shifts was associated with a 16% higher risk of CMM compared to day workers (OR=1.16 [95% CI, RR=1.02-1.31]). They also found that a higher frequency of night shifts (>10/month) was associated with an increased risk of CMM (OR=1.19 [95% CI, RR=1.06-1.34]), which was more pronounced for >10/month in combination with a morning chronotype or <7 hours or >8 hours of sleep duration (OR=1.26 [95% CI, RR=1.02-1.56]; OR=1.43 [95% CI, RR=1.19-1.72]. They also found that night shift work was associated with a higher risk of CMM in patients with hypertension[26].

Wong *et al.* investigated the relationship between shift work and cardiovascular diseases (CVD) to identify potential gaps in the current knowledge and highlight areas for future research. Hypertension, diabetes, and a sedentary lifestyle are known risks for CVD, and the results of this study suggest that shift work should be added to that list. Elevated inflammatory markers and DNA damage in shift workers may be related to their increased progression of atherosclerosis and the positive association of shift work with coronary artery disease. There are few studies on mitigating approaches for CVD associated with shift work, such as dietary modification or exercise, highlighting the need for further focused research in this area[27].

In our study, according to the anamnestic data, cardiovascular diseases and hypertension (18.3%), musculoskeletal (6.7%) and endocrine and metabolic diseases (8.3%) predominated among the subjects, while other diseases occurred less frequently. The frequency of cardiovascular diseases in subjects who worked night shifts compared to those who did not work night shifts was significantly higher.

The study by Gao *et al.* evaluated the association between shift work and the risk of type 2 diabetes. The results of the meta-analysis showed that shift work was associated with an increased risk of type 2 diabetes (OR=1.10, 95% CI, RR=1.05-1.14). Subgroup analyses showed that shift workers had an increased risk of type 2 diabetes, while healthcare workers had the highest risk compared to clerical and manual workers, and night shift and rotating shift work were associated with an increased risk of type 2 diabetes. A dose-response meta-analysis based on three groups among female workers showed that there may be a positive association between the duration of shift work and the risk of type 2 diabetes. The authors concluded that shift work was associated with an increased risk of type 2 diabetes. Among female workers, the prolongation of years of exposure to shift work appeared to increase the risk of type 2 diabetes (P=0.043)[28].

The frequency of diabetes in our study was higher among subjects who worked night shifts (5%) compared to those who did not work night shifts (3.3%), but the difference was not significant (P=0.648).

Shift work can lead to adverse health effects, including gastrointestinal disorders. A study by Somayeh Rahimi-Moghadam *et al.* aimed to compare the prevalence of gastrointestinal disorders among day nurses, shift nurses, and office workers at the University of Medical Sciences in Kerman, Iran. This cross-sectional study was conducted in 2011, with the participation of 159 hospital nurses and 167 office workers at the same university. The results showed that anorexia (P=0.0001), dyspepsia (P=0.002), nausea (P=0.001), and hiccups (P=0.003) were more prevalent among shift workers. The results also showed that the prevalence of anorexia (P=0.02), gastric ulcer (P=0.04) and dyspepsia (P=0.02) was higher in nurses with irregular shift work than in those with regular shift work. Among demographic characteristics, gender was associated with nausea (P=0.004), and nausea was more prevalent in women (OR=4.3, 95% CI: RR=1.7-6.3). Also, older age was associated with dyspepsia (P=0.02). Gastrointestinal disorders were more common in shift workers. It was recommended that more capable and qualified nurses should be selected for shift work to cope with these adverse effects of shift work29.

Pietroiusti *et al.* investigated whether shift work was associated with an increased rate of peptic ulcer in *H. pylori*-infected workers. A total of 247 day workers and 101 night shift workers were included. The prevalence of duodenal ulcer was significantly higher in night shift workers than in day shift workers (OR = 3.92, 95% CI RR = 2.13 to 7.21). The authors concluded that shift work increased the ulcerogenic potential of *H. pylori* infection and should be considered a risk factor for duodenal ulcer in infected shift workers. Treatment of the infection in this high-risk group may improve workers' health and may reduce the economic impact of peptic ulcer[30].

In the current study, according to the anamnestic data on the presence of certain diseases and conditions in examined subjects, the frequency of digestive system diseases was 3 (%). The frequency of gastrointestinal tract diseases was higher in subjects who also worked night shifts (8.3%) compared to those who did not (5%), but the difference was not statistically significant (P=0.464).

It is clear that the acute and chronic effects of shift work can have a direct impact on health and well-being of the worker, as well as an indirect effect by the inability to work with poor health. In terms of workplace safety policy, the burden that night and shift work impose on organizations creates a need to establish a policy for the proper organization and management of shift work and especially night work. Policies and programs for the adequate scheduling and engagement of workers who work night shifts should promote the prevention, reduction and management of problems associated with night work. Health professionals should try to understand the employer's policy on the organization of work and shifts, as well as the sup-

port available to employees, in the interest of preserving and promoting health and safety at work.

The current study has some limitations. First of all, the study included a relatively small number of subjects and their distribution in individual job positions was not even, which may have affected the obtained results. Furthermore, the total sample was obtained from one hospital, which may lead to self-reporting bias and data generalizability. Also, data on the impact of night work on health and work ability among examined subjects were based mainly on the questionnaire without qualitative and quantitative assessment. Finally, the cross-sectional design of the study may be addressed as a limitation.

Conclusion

The results obtained in this study have clearly shown that night work has negative effects on health and working capacity of healthcare workers; indirectly reduces work efficiency, which, in turn, has repercussions on patients' health. In order to reduce the risks that arise during night work on health and to reduce the work capacity of healthcare workers, on one hand, and to preserve and improve the health status and working capacity, on the other hand, a cooperation between workers, employers and the union is recommended. It is also necessary to increase the motivation and engagement of workers in preserving and improving their health, as well as promoting the culture on prevention of harmful effects of night work. Continuous monitoring of health status and working ability of employees is required through timely implementation of periodic preventive health examinations, while the work process should be organized in such a way as to avoid, as far as possible, overtime work by night workers before or after the daily work period that includes night work. Full cooperation among workers, employers and trade unions is needed to improve safety, health and well-being at work, together with stronger cooperation and exchange of experiences with state institutions in planning and promoting efforts to improve health and safety of workers through dialogue with employers. Regular exercise, avoidance of unhealthy foods, smoking, and a good night's sleep in a quiet and dark room after night work are recommended. The specific restrictions for night workers should be duly taken into account by health authorities, other institutions and employers within the framework of measures to encourage training and qualification, as well as cultural, sport and recreational activities for night workers.

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