

THE EFFECT OF SHIFT WORK ON THE OVERALL HEALTH STATUS OF HOSPITAL-EMPLOYED NURSING STAFF IN BOSNIA AND HERZEGOVINA: A CROSS-SECTIONAL STUDY

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SUMMARY

Background: Nursing is a profession frequently organized around shift work in order to guarantee the continuity of care throughout the 24 hours. However, working in shifts is coupled with the desynchronization of circadian rhythms and may result in adverse effects on nurses' health. Our previous work has demonstrated the presence of increased stress levels, reduced coping abilities and diminished life enjoyment in shift work nurses in comparison to those working only in accordance with the daily schedule. Here we aimed to appraise the effects of shift work on their overall health status.

Subjects and methods: We used a comparative cross-sectional approach on a sample of 157 hospital nursing professionals at the University Clinical Hospital Mostar. Study subjects were divided into two groups: a total of 51% study subjects were included in a specific type of shift work (i.e., 12-hour day shift / 24 hours off / 12-hour night shift / 48 hours off), while the remaining 49% adhered to the conventional 7-hour daily schedule. The instrument used was a Standard Shiftwork Index (SSI), together with a comprehensive appraisal of participants' socio-demographic characteristics. Descriptive and inferential statistical methods were applied, and statistical significance was set at $p \leq 0.05$ (two-sided).

Results: The results have shown that nurses in shift work were significantly more burdened with gastrointestinal disturbances ($p < 0.001$); more specifically, there was a higher frequency of appetite loss ($p = 0.003$), heartburn ($p = 0.03$), nausea ($p < 0.01$) and weight gain ($p = 0.05$) when compared to nursing professionals in the day shift. Conversely, there were no statistically significant differences in cardiovascular health between these two groups. In addition, nurses in shift work more frequently presented with headaches ($p = 0.001$) and varicose veins of lower extremities ($p = 0.037$) in comparison to nurses working only in accordance with the daily schedule.

Conclusions: Shift work can adversely influence psychophysical homeostasis, resulting not only in substandard performance of nursing staff, but also potentially hazardous effects on their overall health status. More specifically, we recognized shift work as a substantial risk factor for gastrointestinal and metabolic disorders in nurses; likewise, the increased prevalence of headaches may consequently have a detrimental effect on social and family relationships. All of this should be tackled in a holistic and organized way, together with any additional psychological/sleep issues.

Key words: shift work - nursing - hospital - health - disease - occupational health

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INTRODUCTION

The term 'shift work' commonly refers to the organization of daily working hours where different individuals (or teams) work in succession in order to cover more than the eight-hour day standard, including the entire 24 hours as an increasingly prevalent social phenomenon (Buja et al. 2013, McDowall et al. 2017). This is especially evident in the nursing profession, where shift work is already recognized as a workplace hazard with a negative impact on patient and provider safety, as well as a salient contributor to adverse consequences in healthcare provision (Caruso et al. 2014, McDowall et al. 2017). Consequently, since workers' health is a construct of a complete psychological, physical and social well-being (Rosa et al. 2019), there is a need to thoroughly address the multifaceted effect of shift work on these components.

Research in healthcare arena shows that shift work (and especially night shifts) can exert a negative influence

on worker's health and wellbeing, since human biology is quite adapted to synchronized light-dark cycle (Reppert & Weaver 2002, Savic et al. 2019). It is known that the nursing profession is already burdened with high levels of stress (Neuberger et al. 2017, 2019). Previously, we have shown an increased stress levels, reduced coping abilities and diminished life enjoyment in shift work nurses in comparison to those working only in accordance with the daily schedule (Ljevak et al. 2020). Likewise, higher levels of anxiety, stress and sleep disturbances were seen in shift work nursing staff, together with negative externalities such as lower social functioning and reduced family/leisure time (Ljevak et al. 2020).

A comprehensive systematic review of shift work and nurses' health has shown that shift work in combination with sleeping disturbances can also be linked to a lower dietary quality score, higher body mass index, decreased physical activity, and a higher prevalence of hypertension (Rosa et al. 2019). More specifically, a

combination of sleeping problems and night shifts increase the risk of developing type 2 diabetes (Tranmer 2013), impaired glucose tolerance and metabolic syndrome (Pietrojusti et al. 2010), with subsequent effects on cardiovascular system as well. Some other researchers have shown a significant impact on the gastrointestinal system (Chang & Peng 2021); however, the exact effects are still not completely clear-cut.

In any case, the adequate response to aforementioned adverse effects of shift work – especially from the psychological vantage point – comes back to resilience. The latter term refers to the ability of bouncing back from a negative experience (i.e., stress and/or adversity) with adaptive and competent functioning (Soutwick et al. 2014). Furthermore, psychological resilience can be related to the sense of self and comprises several pivotal components: self-awareness, self-motivation, self-esteem, self-efficacy, self-affirmation and self-actualization (Jakovljević 2018). Hence, in order to tackle any eventual physical manifestations of work scheduling, mental health and resilience should be addressed as well; nonetheless, we still need steadfast conclusions on the purported link between shift work and organic disease.

In Bosnia and Herzegovina, a specific work arrangement is pervasive in public health care institutions, where all nurses in shift work are required to do eight night shifts per month, which is in contrast to other European countries that strictly regulate both the number and frequency of night shifts. As a result, here we actually had a levelled playing field to evaluate whether the shift work can actually result in an increased symptom and disease burden in hospital nursing personnel in this country. We hypothesized that shift work scheduling that entails night work can have an adverse impact on gastrointestinal, cardiovascular and other body systems in comparison to regular daily (or day) schedule.

SUBJECTS AND METHODS

We conducted a comparative cross-sectional study conducted at the University Clinical Hospital Mostar between February 1st and July 14th, 2019. The study involved a total of 157 hospital nursing professionals: 135 (86%) female and 22 (14%) male employees. The average age of study subjects was 33.3 years (age range: 20–54, SD = 8.033). Respondents were divided into two groups: the first group comprised 80 (51%) study subjects who worked in specific shifts (12-hour day shift / 24 hours off / 12-hour night shift / 48 hours off), while the second group comprised 77 (49%) subjects who worked in accordance with the regular daily (or day) schedule, consisting of seven working hours (i.e., from 7:30 AM to 2:30 PM). This research was approved by the Ethical Committee of the University Clinical Hospital Mostar and it was conducted in line with the

Declaration of Helsinki. All study participants gave their written informed consent after they were informed of the purpose of the study and study aims, as well as complete confidentiality of their personal information.

Study participants in both groups completed a total of six scales from the *Standard Shiftwork Index (SSI)* questionnaire and questions related to general socio-demographic data (Barton et al. 1995). The results of this study follow a scale of *health and wellbeing* which consists of nine items. The questions were primarily based on the symptoms of the most common diseases, respondents' medical history, but also involved two standardized subscales for measuring gastrointestinal and cardiovascular disorders – both with a notable incidence in shiftworkers. More specifically, the latter items were selected from existing health measures and through discussions with specialist of gastroenterology and cardiology. A four-point response option was included, in order to avoid a tendency towards a central answer, with the response options as follows: “almost never”, “quite seldom”, “quite often” and “almost always”. The points were calculated separately for gastrointestinal and cardiovascular subscale, and the higher average result on the scale (and subscales) indicated lower overall health status.

The data has been collected into the MS Excel database (version 11; Microsoft Corporation, Redmond, WA, USA), while IBM SPSS Statistics for Windows (version 20.0; IBM Corporation, Armonk, NY, USA) was utilized for statistical analysis. A descriptive statistical approach was used for initial data processing; more specifically, categorical variables were expressed as frequencies (N) and percentages (%), while arithmetic means (M) and standard deviations (SD) were used for continuous variables. Differences between categorical variables were tested with chi-square test, while t-test for independent samples has been used to test differences between continuous variables. The normality of the distribution of the examined variables was tested by the Shapiro-Wilk test. The factor structure of individual scales has been verified by factor analysis under the principal components analysis with varimax rotation. The significance of the correlation matrix has been determined by Bartlett test, and the suitability of the correlation matrix for factorization with the Kaiser-Meyer-Olkin of Sampling Adequacy test. Statistical significance was set at $p \leq 0.05$ (two-sided)

RESULTS

This study revealed statistically significant differences between the two subject groups of hospital nursing professional regarding certain aspects of their health status. The results have shown that shift employees are significantly more burdened with digestive/gastrointestinal disturbances; more specifically, there was a higher frequency appetite loss (M=2.51), nausea (M=2.19),

Table 1. A comparison of individual and overall symptom burden pertaining to digestive and cardiovascular health between the two groups of hospital nursing professionals (daily schedule vs. shift work)

Symptom / disturbance	Group	M	SD	t	df	p
Appetite loss	daily schedule	2.04	0.865	-3.020	150	0.003*
	shift work	2.51	1.091			
Nausea	daily schedule	1.70	0.779	-3.748	155	0.000*
	shift work	2.19	0.843			
Heartburn	daily schedule	1.99	0.966	-2.196	155	0.030*
	shift work	2.34	1.030			
Heart palpitations	daily schedule	2.08	0.885	-0.809	155	0.420
	shift work	2.20	0.999			
Vertigo	daily schedule	1.79	0.848	-0.231	155	0.817
	shift work	1.83	0.925			
Hypertension	daily schedule	1.49	0.641	-0.770	155	0.443
	shift work	1.59	0.867			
Weight gain	daily schedule	2.08	1.167	-1.971	155	0.050*
	shift work	2.46	1.272			
Weight loss	daily schedule	1.60	0.862	-1.348	155	0.180
	shift work	1.80	1.011			
Total: digestive	daily schedule	9.40	2.637	-4.283	155	<0.001*
	shift work	11.30	2.901			
Total: cardiovascular	daily schedule	5.36	1.693	-0.824	155	0.411
	shift work	5.61	2.065			

* denotes statistical significance

Table 2. A breakdown of specific symptoms and/or diseases developed before or after placement of nursing personnel in either daily schedule or shift work

Diseases	Daily schedule		Shift work		χ^2	p
	Developed before placement N (%)	Developed after placement N (%)	Developed before placement N (%)	Developed after placement N (%)		
Chronic back pain	8 (10.4)	27 (35.1)	8 (10.0)	31 (38.8)	0.229	0.632
Gastritis	2 (2.6)	16 (20.8)	4 (5.0)	13 (16.3)	0.534	0.465
Stomach ulcer			3 (3.8)	2 (2.5)		
Sinusitis, tonsillitis	6 (7.8)	6 (7.8)	21 (26.3)	8 (10.0)	0.046	0.830
Asthma		3 (3.9)	4 (5.0)	3 (3.8)		
Angina pectoris			5 (6.3)	3 (3.8)		
Heart attack			1 (1.3)	1 (1.3)		
Hypertension		4 (5.2)	1 (1.3)	11 (13.8)	3.323	0.068
Cardiac arrhythmia	1 (1.3)	5 (6.5)	2 (2.5)	10 (12.5)	1.638	0.201
Hypercholesterolemia		5 (6.5)	1 (1.3)	12 (15.0)	2.94	0.086
Diabetes		2 (2.6)	1 (1.3)	3 (3.8)		
Eczema		3 (3.9)	1 (1.3)	6 (7.5)		
Chronic anxiety		7 (9.1)	1 (1.3)	8 (10.0)	0.038	0.845
Depression	1 (1.3)	6 (7.8)	1 (1.3)	5 (6.3)	0.143	0.705
Haemorrhoids	7 (9.1)	5 (6.5)	7 (8.8)	8 (10.0)	0.635	0.426
Varicose veins	2 (2.6)	10 (13.0)	2 (2.5)	21 (26.3)	4.355	0.037*
Anaemia	4 (5.2)	6 (7.8)	11 (13.8)	9 (11.3)	0.543	0.461
Headaches	11 (14.3)	17 (22.1)	9 (11.3)	37 (46.3)	10.16	0.001*

* denotes statistical significance

heartburn (M=2.34) and weight gain (M=2.46) since their involvement in shift work, in comparison to nurses in the daily schedule (i.e., M=2.04 for appetite loss, M=1.70 for nausea, M=1.99 for heartburn and M=2.08 for weight gain) (Table 1). There were no statistically significant differences in other individual symptoms (Table 1).

Likewise, when summative results were concerned, an overall score was much higher for digestive disturbances, and the statistically significant difference in the symptom burden has been found between these two groups (t= -4.283, p<0.001) – with employees involved in shift work reporting a greater number of symptoms

(M=11.30) in comparison to those in the daily schedule (M=9.40). Conversely, differences in the severity of cardiovascular disorders were not statistically significant between the two groups (p=0.411) (Table 1).

A comparative frequency analysis of specific acute and chronic conditions showed that the increased prevalence of basically all surveyed items was seen after the employees started with either daily schedule or shift work (Table 2). However, once their service was underway in either daily schedule or shift work, there was a significantly higher number of nursing staff experiencing

varicose veins (p=0.037) and headaches (p=0.001) in the shift work group in comparison with those working the daily schedule (Table 2). Table 3 additionally specifies other diseases present in both groups of study subjects.

A significant correlation has been found between the length of employment and the frequency of symptoms/diseases only in employees in the daily schedule; more specifically, subjects with longer work experience presented with larger disease burden (Table 4). Furthermore, there was a significant correlation with overall disease prevalence with the prevalence of digestive and cardiovascular symptoms in both daily schedule and shift work employees (Table 5).

Table 3. Other diseases noted in hospital nursing professionals in daily schedule and shift work

	N	%
Other diseases – Daily schedule		
Vertigo	3	3.9
Uterine surgery	1	1.3
Glandular adenoma	1	1.3
Epilepsy	1	1.3
Immunological problems	1	1.3
Cervical spine surgery	1	1.3
Decreased thyroid function	1	1.3
Other diseases – Shift work		
Allergies	2	2.5
Scoliosis	2	2.5
Shoulder pain	1	1.3
Frequent pneumonias	1	1.3
Epicondylitis	1	1.3
Fibroadenoma, thyroid nodules	1	1.3
Gilbert's syndrome	1	1.3
Sliding hiatal hernia	1	1.3
Abdominal bloating	1	1.3
Insomnia	1	1.3
Psoriasis	1	1.3
Vision impairment	1	1.3

% denotes a percentage in the total symptom/disease burden of study respondents

DISCUSSION

One hallmark of the inpatient care is the 24-hour availability of nursing personnel in health care institutions (most notably hospitals), which means that a significant portion of nurses working the night shift is inevitable (Gershengorn & Garland 2016). By comparing to groups of nurses (i.e., daily schedule vs shift work), this study delivered baseline data and evaluation of the purported link between shift work and negative impact on their overall health status. Our results support some of the previous research endeavours on the topic that relate shift work with an increased risk of adverse events in manifold domains of shiftworkers' health and well-being (Rosa et al. 2019, Zhang et al. 2020, Chang & Peng 2021). As nursing professional may not be aware of this problem, it becomes increasingly important to clarify the exact relationship in order to institute adequate workplace health promotion strategies.

Our study has revealed a significant increase in digestive disturbances in shiftworking nurses (Table 1). A very recent systematic review and meta-analysis by Chang & Peng (2021) provided an in-depth understanding on how

Table 4. The correlation (r) of age and length of work experience with the overall occurrence of the disease and the occurrence of digestive and cardiovascular disorders between the two groups of hospital nursing professionals (daily schedule vs. shift work)

	Daily schedule			Shift work		
	Disease frequency	Digestive disturbance frequency	Cardiovascular disorder frequency	Disease frequency	Digestive disturbance frequency	Cardiovascular disorder frequency
Age	0.212	-0.161	0.118	0.077	-0.218	-0.157
Work experience	0.336**	-0.142	0.199	0.150	-0.149	-0.153

(r) Pearson's correlation coefficient; *p<0.05; **p<0.01

Table 5. The correlation (r) of overall disease frequency with the occurrence of digestive and cardiovascular disorders between the two groups of hospital nursing professionals (daily schedule vs. shift work)

	Daily schedule			Shift work		
	Work experience	Digestive disturbance frequency	Cardiovascular disorder frequency	Work experience	Digestive disturbance frequency	Cardiovascular disorder frequency
Age	0.807**			0.719**		
Disease freq.		0.369**	0.302**		0.297**	0.354**

(r) Pearson's correlation coefficient; *p<0.05; **p<0.01

rotating shifts influence gastrointestinal health of shiftworkers in general. They have defined day shifts as those starting between 7:00 and 9:00 AM, while shifts starting at any other time were considered rotating shifts. The results have shown that rotating shift work can increase the risk of gastrointestinal disturbances, especially peptic ulcers and indigestion (Chang & Peng 2021). Furthermore, a pilot study conducted in Poland on 171 nurses working in night shifts and 70 non-shift nurses has shown that shift work resulted in certain gastrointestinal problems – most notably irregularity in defecation (Bilski 2006). In addition, only 9.9% of nurses consumed a warm meal at night shift, and there was an increased caffeine intake (Bilski 2006). Naturally, a high prevalence of psychosocial stress among nurses can also give rise to functional gastrointestinal disorders (Koh et al. 2014), which was exemplified in a study from Korea where a higher prevalence of irritable bowel syndrome was found among rotating shift workers (Kim et al. 2013).

Shift work seems to be linked to cardiovascular diseases in nurses as well (Brown et al. 2009, Gangwisch et al. 2013, Rosa et al. 2019). Even though underlying pathophysiological mechanisms are thus far elusive, one potential explanation is an observed drop in melatonin synthesis during shift work, since it is known that melatonin lowers blood pressure and reduces blood coagulability (Franzese & Nigri 2007, Rosa et al. 2019). Consequently, cardiovascular risk increases with an exposure to at least six continuous years of shift work (Rosa et al. 2019); furthermore, on a sample of 2500 nurses that were involved in shift work for at least five years, there was a higher risk of arteriosclerosis and myocardial infarction (Koh 2010). A recent study by Ritonja et al. (2019) suggests that night work parameters are linked to substantial cardiometabolic risk, and shift workers with an evening-oriented chronotype may be more prone to the adverse cardiometabolic effects when exposed to night work. Albeit in our study there was no statistically significant difference in cardiovascular symptoms between nurses in the daily schedule and shift work, there was still a slightly higher symptom score in the shift work group (Table 1).

Importantly, shift work was linked with statistically significant weight gain in our study (Table 1). This is in line with the first systematic review and meta-analysis on the topic that was recently published, confirming the substantial role of shift work in the development of obesity among nurses – particularly in Europe, Australia and the United States, and especially for night shift work (Zhang et al. 2020). This phenomenon is frequently linked to sleep disturbances that can decrease glucose tolerance and influence hormonal rhythm (Qiao et al. 2020); likewise, eating habits, irregular meals and food selection might be changed by shift and night working schedules (Horton Dias & Dawson 2020). This

definitely underscores the role of hospital management in improving awareness of the obesity risk among nursing personnel involved in night shift work.

Moreover, it seems that total cortisol production and its pattern are able to mediate the relationship between shift work and total cardiometabolic risk, as demonstrated among female hospital employees in a recent study from Canada (Ritonja et al. 2018). By using a cross-sectional approach, the latter study showed that can have a partial role here, with 17% of the total effect attributed to total cortisol production; conversely, cortisol pattern was not a mediator. However, an overall small mediating effect implies that cortisol production should be viewed as only a partial mediator in the relationship between shift work and cardiometabolic risk, emphasizing multifactorial and complex nature of this pathway (Ritonja et al. 2018). Another study conducted on Japanese nurses found significantly increased cortisol levels in saliva in the early morning during night shifts, emphasizing a phase deviation within the circadian rhythm (Baba et al. 2015).

In our study, nursing professionals in shift work also reported shoulder pain and epicondylitis. Albeit it is not clear from our survey whether these musculoskeletal symptoms are in direct correlation with working in shifts, a comparative study by D'Agostin and Negro from Italy actually showed that workers in daily schedule (i.e., day workers) have higher prevalence of complaints related to the neck, lower back and upper extremities in comparison to shift workers (D'Agostin & Negro 2014). On the other hand, there was an increased risk of sustaining an occupational musculoskeletal injury in shiftwork nurses on medical and surgical wards (D'Agostin & Negro 2014). Another study on Tunisian nurses from two university hospitals showed that mental and physical loads were more strongly perceived in shift healthcare workers and that the maximum grip force was basically the only physical variable significantly influenced by the rhythm of work (Merchaoui et al. 2017).

Naturally, mental toll of shift work has to be taken into account as well. Although in this research there was no higher burden of chronic anxiety and depression after placement of employees in either daily schedule or shift work (Table 2), our previous study has shown that shift work may indeed exert significant psychological and psychoorganic changes in nursing personnel, with a substantial impact on their family life (Ljevak et al. 2020). Hence, we come back to the question of resilience, which we have to observe as a potpourri of protective elements that mediate the relationship between a stressful event (i.e., shift work in this case) and positive outcomes (Jakovljević 2017). A recent pilot study by Mintz-Binder et al. in four different hospitals in the United States showed that the use of stress-reducing interventions during work can decrease stress in nursing personnel and increase resilience (Mintz-Binder et al. 2021).

We have to acknowledge certain limitations of our study. Even though our sample size can be considered adequate, there was a small number of male nursing professionals; consequently, summative results for all study subjects were presented, while gender differences were not compared. The study is also monocentric in nature, thus there was no comparison with other health care facilities. The cross-sectional design of the current study does not allow a complete appraisal of the casual relationship between the shift work modality and selected variables. More specifically, findings could not be systematically triangulated with the objective data (such as morbidity and absenteeism), which represents an avenue for further study. Finally, there were certain parameters that may have not been taken into consideration in our study; most notably individual inclination regarding the shift work schedule, as well as some specific situational stressors that may have also influenced our findings.

CONCLUSIONS

Shift work has the propensity to adversely influence psychophysical homeostasis, resulting not only in sub-standard performance of nursing staff, but also potentially deleterious effects on their overall health status. In this study we have recognized shift work as an important risk factor for gastrointestinal and metabolic disorders in nurses (the latter primarily in the form of weight gain); likewise, the increased prevalence of headaches may consequently have a detrimental effect on social and family relationships. All of these issues should be tackled in a holistic and organized way, together with any accompanying psychological and/or sleep issues.

Our results definitely contribute to the field of research that is still laden with gaps in understanding the repercussions of shift work on health status of nursing personnel. Going forward, studies tackling this problem will definitely have to be made in a much more standardized fashion, since results stemming from different methodological approaches and research groups can be rather fragmented. Some of the 'critical points' that should be considered in study-to-study comparisons are shift rotation frequency and their length, starting and ending times, number of nights and rest days, as well as the predictability of shift scheduling. This is critical not only to precisely describe the burden of this important public health issue, but also to adequately inform preventative efforts.

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Contribution of individual authors:

Ivona Ljevak, Marijana Neuberg & Tomislav Meštrović outlined the study concept and approach, and participated in paper composition, theoretical explanations, data interpretation and literature appraisal.

Ivan Vasilj was the project coordinator, with significant participation in the study concept and manuscript write-up.

Josipa Tomić contributed to the data interpretation and manuscript write-up.

Tomislav Meštrović & Marijana Neuberg critically drafted and revised the manuscript. All authors provided their approval for the final version of the manuscript.

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