

## Research Article

# Working Hour and Schedule Characteristics among Nurses: A Retrospective Study

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**\*Corresponding author:** Peršolja M, Vipava Unit of Faculty of Health Sciences, University of Primorska, Slovenia**Received:** September 24, 2022; **Accepted:** November 01, 2022; **Published:** November 08, 2022**Abstract**

**Introduction:** To describe and compare characteristics of working hours and work schedules among nurses in 2019 and 2021. Evidence about the association regarding the relationship between nurses' working hours and schedules with the COVID-19 pandemic is limited.

**Materials and Methods:** The research was conducted at a medical unit of a secondary care regional hospital in Slovenia. Of 71 employees who were eligible, 24 fulfilled the criteria and their data were included in the study.

**Results and Discussion:** There were substantial differences in working hour and schedule characteristics between 2019 and 2021. Compared to 2019, nurses in 2021 worked more hours, more long shifts, had fewer free weekends and education days, and almost double the number of sick days.

**Conclusion:** While the nurse manager managed some of the working hour and schedule characteristics appropriately, additional awareness raising, and implementation of a related computer program, are suggested to optimize and develop work schedules.

**Keywords:** COVID-19; Nursing Service Hospital; Nurse Scheduling; Workload

## Introduction

In 2020 and 2021, medical institutions, especially hospitals, needed to increase their preparedness for patients with COVID-19 who required hospitalization [1]. The pandemic put great psychological pressure on nurses, which increased rates of anxiety, suicide, fear, and depression [2-4], as the qualitative and quantitative changes in their tasks increased the related job demands [5,6]. Moreover, even without a pandemic times the classic schedule (7 am to 3 pm, working only during the week) is an exception among nurses [7]. However, working hours in the EU are governed by the EU's Working Time Directive (European Parliament, 2003) [8].

Shift scheduling in nursing can be described as having cyclic or non-cyclic patterns. In cyclic scheduling fixed patterns of days on and off are established, and staff are rotated continuously through them [9]. In non-cyclic patterns nurses are asked to sign up for those shifts that they wish to work. Each planning period is considered independently, and new schedules are prepared at the beginning of each month [10]. Adjustments and decisions need to be made daily, and there are many changes in shift at short notice [11]. The objective is to find a balance between satisfying individual preferences and minimizing personnel costs [12,13].

Managers should consider many characteristics of schedules, as they can disrupt employees' circadian rhythms with improper scheduling patterns. The literature describes the following schedule characteristics as being important for employees: rapid changes in schedule [14,15], the direction and speed of shift rotation [16,17], shift length (mainly 12-hour shifts) [14,17-21], shift start and finish times [14], short breaks between shifts and quick returns [19,21-24],

work on scheduled days off [25], and a high number of hours per week (over 60 hours) [26]. The key strategy is to make sleep a priority and adopt a slow, forward-shifting rotation pattern, rotate shifts after 2-week periods and allow an average of 2 days off per week [27], regular breaks [16], choice over shift work schedules [14], and use 8-hour shifts when possible [20]. The organization of work in health care settings has been shown to affect the health of employees [28,29], and a strong risk factor for poor health is shift work [29,30].

This study aimed to describe and compare characteristics of working hours and work schedules among hospital nurses in 2019 and 2021. It was assumed that the COVID-19 pandemic in the year 2021 would result in changed working hours and schedules. The specific objective was to answer the following research questions: Are there differences between 2019 and 2021 in the nurses' working hour and work schedule characteristics? How many working hours/days do nurses have per week/month? How many consecutive working days? What is the length of work shifts? Which is the direction of rotating shifts? Do nurses have to quickly return? What is the maximum number of consecutive night shifts they do? How many day/evening/night shifts do they do per year? How many weekends are nurses free per year? Are there any unusual characteristics of nursing schedules not yet described in the literature?

Compiling data about nurses' working conditions is important, but most of the published studies on the working hours and schedules of nurses have been done in high income countries, based on shift scheduling computer programs or self-reported data. This paper can contribute to a better understanding of nurses' working hours and schedules in developing countries, with the aim to intervene to mitigate any possible negative effects. Such knowledge is useful, since

it provides insights into how best to deal with the issues raised with various changes to work schedules.

## Material and Methods

### Study Design

A retrospective observational study was conducted in a Slovenian secondary care regional hospital in 2022. It aimed to observe and describe a situation in two years (2019 and 2021 when the COVID-19 pandemic was active). Data collection was performed by the principal researcher.

### Setting

The researched Slovenian hospital has 26 specialty departments with approximately 300 beds. Approximately 430 nursing care personnel – mostly nursing technicians (NT) (n=280; 65.12%), and a third of them being registered nurses (RN) (n=150; 34.88%) – provide the necessary services. The hospital deals with nearly 20,000 prospective payment system episodes a year, with an annual bed occupancy rate of 62%. This research was done on a medical ward with 109-bed capacity and 6,125 hospitalized patients in 2019, and 6,828 in year 2021. The hospital was anonymized at the request of the management of the institution.

### Participants and Data Sources

The researcher asked the hospital management for permission to do the research and presented the aims and methods of the study. During the related staff meeting, the nursing manager invited all medical ward nurses to collaborate in this study. All nursing staff participated, but many were excluded from the sample because of their specific tasks: the head nurse, the nurse responsible for ordering supplements, nurses who were deployed on COVID-19 units, students, and nurses who resigned during the research period.

There were 45 NT and 28 RN employed on the researched medical ward on 1 January 2019, and 51 NT and 28 RN on 31 December 2021. Of the 71 employees who were eligible, only 24 (33.8%) fulfilled the criteria and all were included in the study (n=12 nurses were moved to different units; n=13 were absent because of maternity or paternity leave; 8 nurses quit their jobs in the hospital, 5 nurses worked short schedules (4 or 6 hours).

There were 10 (41.7%) RNs and 14 (58.3%) NTs in the sample. Five (20.8%) of the nurses were male. The nurses were mostly (n=13, 54.2%) aged 31 to 40 years, 4 (16.7%) were 30 years or younger, 5 (20.8%) were 41 to 50 years old, and 2 (8.3%) were 51 or older. Most of the nurses had two children (n=10, 41.7%). The age of the youngest child varied from 0 to 33 years (Mean = 8.917, SD=10.21). Nurses were employed in nursing from 4 to 33 years (Mean=14.67, SD=9.47).

### Variables

The independent variables were as follows: (a) observation year (2019, 2021); (b) staff demographic data (gender, age, number of children, age of the youngest child, years employed in nursing, shift usually worked); (c) staff education (RN, NT).

The dependent variables were: (a) the characteristics of the schedule (hours of work shift, long weeks (> 40 hours per week), number of consecutive night shifts, number of day shifts per year, number of evening shifts per year, number of night shifts per year,

number of free weekends per year, the direction of rotation shifts); (b) the characteristics of the working hours (weekly working hours, number of working days, number of sick days, number of education days, amount of annual leave, working hours per working day, number of consecutive work days).

Shifts were classified according to time of day: day shift (starts after 06:00, ends before 15:00); evening shift (starts after 14:00, ends before 21:30); night shift (starts after 19:00, ends before 07:30). Shift of more than 9 hours were classified as long shifts. The number of working days is not equal to the number of shifts, as nurses can work one or more shifts on the same day. Net working hours are the hours of employee presence at the work place, gross hours include annual leave, sick and education days. Quick returns are when there is less than 11 rest hours between two shifts.

Direction of rotation means the order of shift change: A forward rotation is in the clockwise direction, from day to evening to night shift. A backward rotation is in the counter-clockwise direction, from day to night to evening shift.

Work patterns consisting of combinations of shifts were characterized as long weeks (> 40 hours per week), continuous work days (maximum number of continuous working days), and free weekends (free on Saturday and Sunday).

Characteristics of shifts and work patterns were summed by individual and then divided into four categories: 0, 1-100, 101-200 and >200 shifts/person/year. Day, evening, night, long weeks were also divided into four categories: 0, 1-12, 13-50, and >50 per person/year.

We also looked at all shifts within the year for each nurse, and classified them as permanent day, morning or evening (no night), rotating or other.

### Data Sources

The data was obtained from 24-month nursing schedules (12 from 2019 and 12 from 2021). The schedules were handwritten on paper, in A3 format, and prepared by the head nurse every month for the next 4 weeks. Before the research, the names of nurses were hidden, and every nurse got an identification number which was the same for the years 2019 and 2021. Only the hospital head nurse had the original schedules with the nurses' names.

### Ethics

Ethical approval was received from the hospital included in this study. The need for consent by participants was deemed unnecessary, as the data were anonymized before starting the analysis. The study was conducted in accordance with the Declaration of Helsinki.

### Statistical Methods

Reliability was reached in the data analysis with the random selection of those nurses who met the criteria described earlier. Exploratory data were performed to inspect the data and identify inconsistencies. IBM SPSS Statistics 26.0 was used for data analysis, at the level of the individual nurse. Quantitative data analysis was performed using descriptive methods: mean (M), Standard Deviation (SD), frequency (n), percentage (%), Pearson's correlation (r). Correlation strengths were valued as follows: 0–0.09 not correlated, 0.1–0.3 weak, 0.31–0.6 medium, and 0.61–1 strong correlation (31).

The repeated measures t-test and independent groups t-test were used to determine whether the difference between means for two sets of scores was the same or different. The significance was set at  $p < 0.05$ . Cronbach's Alpha for the instrument was 0.895 ( $n=419$ ).

## Results and Discussion

The nurses mostly (75%,  $n = 18$ ) worked rotating shifts, but there were 12.5% ( $n=3$ ) who worked day or evening but not night shift, and 12.5% ( $n = 3$ ) with another schedule. In total 24 nurses worked 54,166.26 gross hours in 2019 and 54,707.91 in 2021.

For the rotating schedule it was not possible to define the direction of rotation, as the sequences changed all the time from backward to forward. There were no quick returns in the observed sample.

There was a significant increase in working hours per year in 2021 as compared to 2019 (Table 1). Nurses worked mostly 3 weekends per month with a minimum of 5 (2019, 2021) free weekends per year to a maximum of 44 (2019) and 42 (2021). Nurses had fewer free weekends in 2021. The difference between the annual frequency of sick days is significant, the mean of sick days almost doubled in 2021

**Table 1:** Distribution (%) of working hour characteristics summarized by individuals.

Variables		% (n)	
		2019	2021
Dayshift	0	0 (0)	0 (0)
	1 - 100	37.5 (9)	33.2 (8)
	101 - 200	62.5 (15)	66.7 (18)
	> 200	0 (0)	0 (0)
Evening shift	0	12.5 (3)	16.7 (4)
	1 - 12	25 (6)	25 (6)
	13 - 50	25 (6)	8.3 (2)
	> 50	37.5 (9)	50 (12)
Nightshift	0	12.5 (3)	16.7 (4)
	1 - 12	16.7 (4)	8.3 (2)
	13 - 50	41.7 (10)	45.8 (11)
	> 50	29.2 (7)	29.2 (7)
Long weeks (> 40h / week)	0	0 (0)	0 (0)
	1 - 12	0 (0)	0 (0)
	13 - 50	0 (0)	0 (0)
	> 50	100 (24)	100 (24)
Free weekends	0	0 (0)	0 (0)
	1 - 12	8.3 (2)	25 (6)
	13 - 50	91.7 (22)	75 (18)
	> 50	0 (0)	0 (0)
Long day shift	0	0 (0)	0 (0)
	1 - 12	16.7 (4)	8.3 (2)
	13 - 50	83.3 (20)	83.3 (20)
	> 50	0 (0)	8.3 (2)
Sick days	≤ 10 days	79.2 (19)	62.5 (15)
	> 10 days	20.8 (5)	37.5 (9)

Legend: %: Percent, n: Number.

(2019: min. = 0, max. = 16 days; 2021: min. 0, max. =50 days). A fifth (20.8%,  $n=5$ ) of nurses were on sick leave more than 10 days in 2019, and just over a third (37.5%,  $n=9$ ) in 2021 (Table 2).

The number of consecutive work days ranged from 3.75 (2019) and 3.17 (2021) to 8.08 and 8.83, with a mean of approximately 5 days. The total number of education hours per year decreased significantly in 2021 compared to 2019.

The number of night shifts per year rose from an average of 36 in 2019 to 39 in 2021. The number of consecutive night shifts was on average 1.64 in 2019 and 1.28 in 2021, with the difference between the observed years being significant. No nurses worked 4 or more consecutive night shifts in either of the years studied. The number of nurses with more than 50 night shifts per year varied from 0% among RNs to 63.6 % among NTs ( $n=7$ ).

The number of dayshifts per year was significantly lower in 2021, but the frequency of long shifts was significantly higher compared to 2019 (min. 6, max. 45 in 2019; min. 11 and max. 57 in 2021). The frequency of long weeks (>40 hours/week) was similar in both observed years ( $t=-0.661$ ,  $df=19$ , Sig. 0.516).

The correlations show that the nurses did more evening shifts as they got older ( $r=0.473$ ,  $p=0.020$ ). As their youngest child got older, the nurses did more working days per year ( $r=0.466$ ,  $p=0.022$ ). We

**Table 2:** Repeated measures t-test results, considering year.

Variables (df = 23)	Year	Statistics			
		Mean	SD	t	Sig.
Total working hours (neto)	2019	1698	135.92	- 7.38	0.00
	2021	1901	169.72		
No. consecutive night shifts	2019	1.64	0.87	4.12	0.00
	2021	1.281	0.85		
No. free weekends	2019	23.37	11.04	4.27	0.00
	2021	20.29	10.72		
No. education hours	2019	8.33	11.67	3.50	0.00
	2021	1.00	2.70		
No. long shifts	2019	24.29	11.63	- 3.27	0.00
	2021	29.29	13.28		
No. day shifts	2019	113.83	39.84	2.16	0.04
	2021	105.29	43.73		
No. sick hours	2019	46.33	39.33	- 2.12	0.04
	2021	85.33	84.75		
Continuous working days	2019	5.23	0.89	- 1.56	0.13
	2021	5.47	1.25		
No. evening shifts	2019	35.29	30.06	- 1.24	0.23
	2021	38.83	36.06		
No. night shifts	2019	36.83	29.69	- 0.85	0.41
	2021	39.12	32.30		
No. working days	2019	202.79	14.31	- 0.73	0.47
	2021	205.29	20.40		

Legend: No: Number/Frequency, SD: Standard Deviation, t: t-test coefficient, Sig: Statistical significance.

**Table 3:** Mean and independent sample t-test considering nurses' education degree.

Variable (df = 22)		Mean	SD	t	Sig. (2-tailed)
No. evening shifts, 2019	RN	3.30	4.45	- 10.89	0.00
	NT	58.14	15.37		
Max. length of shift in hours, 2021	RN	21.24	3.37	10.35	0.00
	NT	11.78	0.60		
No. evening shifts, 2021	RN	0.80	0.78	- 10.33	0.00
	NT	66.00	19.82		
No. free weekends per year, 2021	RN	31.1	7.14	8.28	0.00
	NT	12.57	3.75		
Max length of shift in hours, 2019	RN	21.14	4.33	8.05	0.00
	NT	11.88	0.34		
No. education hours, 2019	RN	20	9.43	8.01	0.00
	NT	0	0		
No. free weekends per year, 2019	RN	34.2	7.59	7.46	0.00
	NT	15.64	4.60		
Continuous working days, 2021	RN	4.32	0.57	- 6.17	0.00
	NT	6.29	0.88		
No. long day shift, 2021	RN	41.3	9.47	5.86	0.00
	NT	20.71	7.73		
No. day shifts, 2019	RN	147.6	15.68	5.03	0.00
	NT	89.71	33.69		
No. working days per year, 2019	RN	191.5	7.706	- 4.37	0.00
	NT	210.85	12.36		
No. day shifts, 2021	RN	139.7	19.30	4.34	0.00
	NT	80.71	39.54		
Continuous working days, 2019	RN	4.57	0.43	- 3.93	0.00
	NT	5.71	0.84		
No. working days per year, 2021	RN	191.2	15.22	- 3.48	0.00
	NT	215.36	17.73		
No. long day shift, 2019	RN	32.1	11.29	3.34	0.00
	NT	18.71	8.39		
Bruto total hours 2021	RN	2378.3	131.62	2.74	0.01
	NT	2208.9	160.82		
No. consecutive night shifts, 2019	RN	0.79	0.334	- 2.67	0.01
	NT	1.64	0.95		
No. consecutive night shifts, 2021	RN	0.82	0.305	- 2.46	0.02
	NT	1.607	0.966		
Bruto total hours 2019	RN	2324	139.0	2.45	0.02
	NT	2209	91.64		
No. education hours, 2021	RN	2.4	3.86	2.34	0.03
	NT	0	0		

Legend: No: Number/frequency, Max: Maximum, RN: Registered Nurse, NT: Nursing Technician, SD: Standard Deviation, t: t-test coefficient, Sig: Statistical significance.

then compared two groups of nurses depending on their level of educational, and the data show that both groups differ significantly

in many aspects of their schedule and working hour characteristics (Table 3).

The main findings of the present study were that there were substantial differences in working hour and schedule characteristics among nursing personnel in 2019 and 2021. Unexpected differences were found with regard to the nurses' schedules and their level of education level, no quick returns, a maximum of 3 consecutive night shifts per month, and relatively few sick days.

The schedule and work hour characteristics for the year 2021, as compared to those for 2019, showed that nurses worked more long shifts in the former. This finding was consistent with Djupedal [32] and Tabrizi et al. [33], who found that approximately 17% of nurses reported experiencing changes in their work schedules due to the COVID-19 pandemic, mostly in an increased number of long workdays. It is known that long work hours increase fatigue, the risk for reduced performance on the job, obesity, injuries, and a wide range of chronic diseases [34-36]. Long shifts are not necessarily associated with health impairments if the total hours worked is not increased [37], but the nurses in the current study worked approximately 200 more hours in 2021 than in 2019. All the sample nurses worked long weeks throughout the periods studied. This is important, as work schedules that include more workdays are said to be a significant predictor of chronic fatigue, increased risk of diabetes, stroke and cardiovascular disease [21,37,38], as well as occupational injuries, such as back, neck, and shoulder musculoskeletal disorders [17]. Our findings show that the observed schedules are rather problematic, as it seems that the nursing manager did not pay enough attention to the shift length. Some authors claim that nurses prefer to work long shifts instead of the usual 8-hour ones [36], others [39] warn that there is the gap between actual working hours and nurses reported preferred working hours. Improving working standards may prevent nurses from working extra hours [40], but a scheduling computer program would increase understanding of the volume of hours worked per year and avoid in this regard [41].

In the pandemic year of 2021 the nurses examine in this study did fewer consecutive night shifts compared to 2019. No nurses worked 4 or more night shifts in a row, in contrast with the shift characteristics reported in some developed countries [42]. As the highest levels of fatigue are reported during night shifts [43], it is recommended [37] that nurse managers plan 3 or fewer consecutive night shifts for those working under them. The nurses in the present study benefited from fewer consecutive night shifts, but this also meant that they had schedules with no strong rhythm and an unpredictable rotation direction. This is important, as rotating shifts are significantly related to acute fatigue [17,44].

The number of free weekends per year during the pandemic year of 2021 fell, and some NTs only had 5 free weekends over the year, but others more than 40. This indicates some inconsistencies and unfair scheduling between nurses, which could lead to conflict and dissatisfaction. Moreover, having less free time to relax may lead to a lower quality of life among nurses [45].

The frequency of sick days rose during the pandemic, in 2021, which is in line with the findings of Rosenström et al. [46], which stated that the strongest predictors of increased sick leave during the pandemic were having a pre-existing illness, exhaustion and fear of



becoming infected. We could not find any significant correlation between demographic and schedule characteristics with regard to the variable “sick days”. This was surprising, as the literature claims that increased age predicts a higher risk of sick leave, and that female staff have a greater likelihood of taking time off for sickness than male staff [47,48]. The low average number of days off due to sickness per year of approximately 6 and 10 in 2019 and 2021, respectively, was also unexpected compared to the 12 days per year reported by Marklund [49].

The major strength of the present study was the use of objective data, allowing us to investigate working hour and shift characteristics related to each individual nurse. There are some limitations, however, as follows: (1) small sample; (2) difficult to read the data on the paper schedules; (3) the literature usually examines RNs and not NT or other profiles of nurses; (4) the lack of clear data on RNs shifts, who sometimes worked 2 or 3 shifts together.

Further studies are needed to investigate the characteristics of nursing schedules in developing countries, especially where nurse managers still use paper shift scheduling, and the schedule characteristics are difficult to follow. These findings highlight some of the increased work demands placed on nurses during the COVID-19 pandemic, which need to be monitored and tracked over time.

## Conclusion

While nurse manager examined in this study managed some of the schedule and working hour characteristics appropriately, additional and continuous awareness raising is required to optimize and develop schedule management competency. The present research could provide nurse managers and administrators with baseline information in the scheduling field, and encourage them to use a scheduling computer program to avoid errors and improve working standards.

## References

- Zhang X, Huang D, Guan P. Nursing Scheduling Mode and Experience from the Medical Teams in Aiding Hubei Province During the COVID-19 Outbreak: A Systematic Scoping Review of 17 Studies. *Risk Management and Healthcare Policy*. 2021; 14: 1805-1813.
- Guixia L, Hui Z. A Study on Burnout of Nurses in the Period of COVID-19. *Psychology and Behavioral Sciences*. 2020; 9: 31-36.
- Hu D, Kong Y, Li W, Han Q, Zhang X, Zhu LX, et al. Frontline nurses' burnout, anxiety, depression, and fear statuses and their associated factors during the COVID-19 outbreak in Wuhan, China: A large-scale cross-sectional study. *E Clinical Medicine*. 2020; 24: 100424.
- Llop-Gironés A, Santillan-Garcia A, Cash-Gibson L, Benach J, Zabalegui A. COVID-19 and the global need for knowledge on nurses' health. *International Nursing Review*. 2022; 69: 196-200.
- Franklin P, Gkiouleka A. A Scoping Review of Psychosocial Risks to Health Workers during the Covid-19 Pandemic. *International Journal of Environmental Research and Public Health*. 2021; 18: 2453.
- Martínez MM, Fernández-Cano MI, Feijoo-Cid M, Serrano CL, Navarro A. Health outcomes and psychosocial risk exposures among healthcare workers during the first wave of the COVID-19 outbreak. *Safety Science*. 2021; 145: 105499.
- Bae S, Fabry D. Assessing the relationships between nurse work hours/overtime and nurse and patient outcomes: systematic literature review. *Nursing outlook*. 2014; 62: 138-156.
- European Parliament CotEU. Directive 2003/88/EC of the European Parliament and of the Council of 4 November 2003 concerning certain aspects of the organisation of working time. *Official Journal of the European Union*. 2003; 299: 9-19.
- Bard JF, Purnomo HW. Short-Term Nurse Scheduling in Response to Daily Fluctuations in Supply and Demand. *Health Care Management Science*. 2005; 8: 315-324.
- Purnomo HW, Bard JF. Cyclic preference scheduling for nurses using branch and price. *Naval Research Logistics (NRL)*. 2007; 54: 200-220.
- Kullberg A, Bergenmar M, Sharp L. Changed nursing scheduling for improved safety culture and working conditions - patients' and nurses' perspectives. *Journal of nursing management*. 2016; 24: 524-532.
- Galatsch M, Li J, Derycke H, Müller BH, Hasselhorn HM. Effects of requested, forced and denied shift schedule change on work ability and health of nurses in Europe -Results from the European NEXT-Study. *BMC Public Health*. 2013; 13: 1137-1137.
- Lin RC, Sir MY, Sisikoglu E, Pasupathy KS, Steege LM. Optimal nurse scheduling based on quantitative models of work-related fatigue. *IIE Transactions on Healthcare Systems Engineering*. 2013; 3: 23-38.
- Gander P, O'Keeffe K, Santos-Fernandez E, Huntington A, Walker L, Willis J. Fatigue and nurses' work patterns: An online questionnaire survey. *International journal of nursing studies*. 2019; 98: 67-74.
- Juniartha IGN, Sardjono TW, Ningsih DK. A comparison of work-related fatigue and stress among emergency department nurses working in 7-7-10 and 12-12 shifts at the hospitals in Badung and Denpasar. *Enfermeria clinica*. 2020; 30: 74-77.
- Gifkins J, Johnston A, Loudoun R, Troth A. Fatigue and recovery in shift working nurses: A scoping literature review. *International journal of nursing studies*. 2020; 112: 103710.
- Han K, Trinkoff AM, Geiger-Brown J. Factors Associated with Work-Related Fatigue and Recovery in Hospital Nurses Working 12-Hour Shifts. *Workplace Health & Safety*. 2014; 62: 409-414.
- Driscoll TR, Grunstein RR, Rogers NL. A systematic review of the neurobehavioural and physiological effects of shiftwork systems. *Sleep medicine reviews*. 2007; 11: 179-194.
- Garrubba M, Joseph C. The impact of fatigue in the healthcare setting. Melbourne, Australia: Centre for Clinical Effectiveness, Monash Health; 2019.
- Jones G, Hocine M, Salomon J, Dab W, Temime L. Demographic and occupational predictors of stress and fatigue in French intensive-care registered nurses and nurses' aides: a cross-sectional study. *International journal of nursing studies*. 2015; 52: 250-259.
- Sagherian K, Clinton ME, Huijter HA, Geiger-Brown J. Fatigue, Work Schedules, and Perceived Performance in Bedside Care Nurses. *Workplace Health & Safety*. 2017; 65: 304-312.
- Ferri P, Guadi M, Marcheselli L, Balduzzi S, Magnani D, Lorenzo RD. The impact of shift work on the psychological and physical health of nurses in a general hospital: a comparison between rotating night shifts and day shifts. *Risk Management and Healthcare Policy*. 2016; 9: 203-211.
- Flo E, Pallesen S, Moen BE, Waage S, Bjorvatn B. Short rest periods between work shifts predict sleep and health problems in nurses at 1-year follow-up. *Occupational and Environmental Medicine*. 2014; 71: 555-561.
- Geiger-Brown J, Rogers VE, Trinkoff AM, Kane RL, Bausell RB, Scharf SM. Sleep, Sleepiness, Fatigue, and Performance of 12-Hour-Shift Nurses. *Chronobiology International*. 2012; 29: 211-219.
- Min A, Kim YM, Yoon YS, Hong HC, Kang M, Scott LD. Effects of Work Environments and Occupational Fatigue on Care Left Undone in Rotating Shift Nurses. *Journal of nursing scholarship: an official publication of Sigma Theta Tau International Honor Society of Nursing*. 2020; 53: 126-136.
- Barker LM, Nussbaum MA. Fatigue, performance and the work environment: a survey of registered nurses. *Journal of advanced nursing*. 2011; 67: 1370-1382.
- Kostreva M, McNelis E, Clemens E. Using a circadian rhythms model to

- evaluate shift schedules. *Ergonomics*. 2002; 45: 739-763.
28. Baydoun M, Dumit N, Daouk-Öyry L. What do nurse managers say about nurses' sickness absenteeism? A new perspective. *Journal of nursing management*. 2016; 24: 97-104.
  29. Trybou J, Germonpre S, Janssens H, Casini A, Braeckman L, Bacquer DD, et al. Job-related stress and sickness absence among belgian nurses: a prospective study. *Journal of nursing scholarship: an official publication of Sigma Theta Tau International Honor Society of Nursing*. 2014; 46: 292-301.
  30. Stevens RG, Hansen J, Costa G, Haus E, Kauppinen T, Aronson KJ, et al. Considerations of circadian impact for defining 'shift work' in cancer studies: IARC Working Group Report. *Occupational and Environmental Medicine*. 2010; 68: 154-162.
  31. Seeram E. An Overview of Correlational Research. *Radiologic Technology*. 2019; 91: 176-9.
  32. Djupedal I, Pallesen S, Harris A, Waage S, Bjorvatn B, Vedaa Ø. Changes in the Work Schedule of Nurses Related to the COVID-19 Pandemic and Its Relationship with Sleep and Turnover Intention. *International Journal of Environmental Research and Public Health*. 2022; 19: 8682.
  33. Tabrizi ZM, Mohammadzadeh F, Quchan ADM, Bahri N. COVID-19 anxiety and quality of life among Iranian nurses. *BMC Nursing*. 2022; 21: 27.
  34. Banakhar M. The impact of 12-hour shifts on nurses' health, wellbeing, and job satisfaction: A systematic review. *Journal of Nursing Education and Practice*. 2017; 7: 69.
  35. Caruso CC. Negative Impacts of Shiftwork and Long Work Hours. *Rehabilitation Nursing Journal*. 2014; 39: 16-25.
  36. Stimpfel AW, Sloane DM, Aiken LH. The longer the shifts for hospital nurses, the higher the levels of burnout and patient dissatisfaction. *Health affairs*. 2012; 31: 2501-2509.
  37. Garde AH, Harris A, Vedaa, Bjorvatn B, Hansen J, Hansen M, et al. Working hour characteristics and schedules among nurses in three Nordic countries – a comparative study using payroll data. *BMC Nursing*. 2019; 18: 12.
  38. McElroy SF, Olney A, Hunt C, Glennon C. Shift work and hospital employees: A descriptive multi-site study. *International journal of nursing studies*. 2020; 112: 103746.
  39. Zhang X, Jiang Z, Yuan X, Wang Y, Huang D, Hu R, et al. Nurses reports of actual work hours and preferred work hours per shift among frontline nurses during coronavirus disease 2019 (COVID-19) epidemic: A cross-sectional survey. *International Journal of Nursing Studies Advances*. 2021; 3: 100026.
  40. Kheiri M, Gholizadeh L, Taghdisi MH, Asghari E, Musavi M, Mahdavi N, et al. Factors affecting the quality of work-life of nurses: a correlational study. *Journal of Research in Nursing*. 2021; 26: 618-629.
  41. Zhao SH, Akkadechanunt T, Xue XL. Quality nursing care as perceived by nurses and patients in a Chinese hospital. *Journal of clinical nursing*. 2009; 18: 1722-1728.
  42. Torquati L, Mielke GI, Brown WJ, Kolbe-Alexander T. Shift work and the risk of cardiovascular disease. A systematic review and meta-analysis including dose-response relationship. *Scandinavian journal of work, environment & health*. 2018; 44: 229-238.
  43. Åhsberg E, Kecklund G, Åkerstedt T, Gamberale F. Shiftwork and different dimensions of fatigue. *International Journal of Industrial Ergonomics*. 2000; 26: 457-465.
  44. Dehring T, Treuer KV, Redley B. The impact of shift work and organisational climate on nurse health: a cross-sectional study. *BMC Health Services Research*. 2018; 18: 586.
  45. Prameswari A, Ayudia L, Sya'diyah H, Iskandarsyah A. Hospital Shift Hours and Its Effect on Quality of Life among Nurses: A Comparative Study. 2021; 4: 92.
  46. Rosenström T, Härmä M, Kivimäki M, Ervasti J, Virtanen M, Hakola T, et al. Patterns of working hour characteristics and risk of sickness absence among shift-working hospital employees: a data-mining cohort study. *Scandinavian Journal of Work, Environment & Health*. 2021; 47: 395-403.
  47. Gohar B, Larivière M, Lightfoot N, Larivière C, Wenghofer E, Nowrouzian B. Demographic, Lifestyle, and Physical Health Predictors of Sickness Absenteeism in Nursing: A Meta-Analysis. *Safety and Health at Work*. 2021; 12: 536-543.
  48. Larsen AD, Ropponen A, Hansen J, Hansen M, Kolstad HA, Koskinen A, et al. Working time characteristics and long-term sickness absence among Danish and Finnish nurses: A register-based study. *International journal of nursing studies*. 2020; 112: 103639.
  49. Marklund S, Gustafsson K, Aronsson G, Leineweber C, Helgesson M. Working conditions and compensated sickness absence among nurses and care assistants in Sweden during two decades: a cross-sectional biennial survey study. *BMJ Open*. 2019; 9: e030096.