



Impact of night shift rotations on nursing performance and patient safety: A cross-sectional study

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Abstract

Aim: Hospitals operate on a 24-hr basis, with shiftwork being unavoidable for most nurses. This study aims to explore the impact of night shiftwork rotations on nurses' physiological status, work performance and patient safety concerns among nurses in public hospitals.

Design: A descriptive predictive correlational design using a self-administered questionnaire.

Methods: Electronic and printable survey questionnaires were distributed among nurses working in public hospitals in multiple regions of Saudi Arabia. The study recruited 1,256 nurses from different nationalities, hospital work units and work experience.

Results: A large proportion of nurses on night shiftwork encountered patient safety issues (85.7%) and physiological consequences (93.6%). Counselling sessions and programmes to support at-risk nurses are recommended.

KEYWORDS

night shift, nursing management, patient safety, shiftwork, workforce planning

1 | INTRODUCTION

Shiftwork is a standard method of professional practice and is unavoidable for many nurses (Dall' Ora et al., 2016). This is because hospitals and nursing services run a 24-hr operation. Twelve-hour shift rotations are very common worldwide, but there are growing concerns about its impact on care quality and patient safety (Dall' Ora et al., 2016; Ferri et al., 2016). Studies that investigated the negative impact of night shiftwork have shown that it affects workers' health, mainly causing fatigue, sleepiness, mood changes and weight gain (Books et al., 2020; Ferri et al., 2016; Giorgi et al., 2018; Siqueria et al., 2016). Other studies have reported problems with job performances and psychosocial well-being (Banakhar, 2017; Ferri

et al., 2016). Night shiftwork, which requires nurses to work at night and sleep during the day, also significantly alters the circadian rhythm of affected persons (Kerkhof, 2018). Some studies have shown that night shiftwork is associated with poor performance and adoption of low safety indicators when such shifts are performed within a rotating shift schedule (Han, Trinkoff & Geiger-Brown, 2014; Niu et al., 2013). Burch et al. (2009) showed that fixed night shiftwork could be associated with increased job dissatisfaction. More so, the challenges of shiftwork are associated with intention to leave the profession and thus, turnover of nurses and night work has been found to be a risk factor for future disability retirement (Park et al., 2019; Ropponen et al., 2018). These challenges have led to calls for the introduction of napping during night shifts among nursing staff (Li et al., 2019).

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There are a limited number of studies regarding the impact of night shiftwork on nurses (Dall' Ora et al., 2016; Han, et al., 2017; Niu et al., 2013). A systematic review found that most studies reported on rotational shiftwork and night shifts together because the characteristics of these two shifts are linked to one another and it postulates that the research papers produced so far have not specifically investigated the effects of night shiftwork (Dall' Ora et al., 2016). Nurses involved with night shiftwork have encountered several challenges with their job performance and patient safety. Niu et al. (2013) reported in a randomized study of 62 nurses that the error rate on a standard test for night-shift workers was 44% higher than fixed-day-shift workers. Also, Johnson et al. (2014) found that 56% of 289 nurses involved in night shifts were sleep-deprived and sleep-deprived nurses had a higher mean number of patient care errors than non-sleep-deprived nurses. Beyond sleep deprivation, night shiftwork may also have other physiological effects on nurses. Some studies have reported that adverse effects of night shiftwork on the physiological status of nurses include anxiety, musculoskeletal disorders, stress and development of obesity from poor feeding habit (Banakhar, 2017; Booker et al., 2020; Books et al., 2020; Liu et al., 2018; Thompson et al., 2017). Furthermore, a study reported that 36% of health workers indicated that night work had an impact on their fatigue levels (Smith-Coggins et al., 2014), while another study found that night-shift workers were significantly most likely to report job dissatisfaction and absenteeism (Burch et al., 2009).

In the Middle Eastern literature, little importance has been given to the physiological status, nurses' performance and safety (Dall' Ora et al., 2016). In Palestine, a study found that women involved with night shiftwork experience higher level of job distress than men (Jaradat et al., 2018), while in Iraq, Iran and Turkey, night shiftwork among nurses caused fatigue, family problems and decreased job and life satisfaction (Abdulah et al., 2020; Nasrabadi et al., 2009; Yildirim & Aycan, 2008). Two studies reported that job stress and night shiftwork were negatively correlated with performance and poor feeding habits among nurses in the Kingdom of Saudi Arabia (KSA) (Almajwal, 2016; Al-Makhaita et al., 2014). A recent study in KSA showed that up to 90% of hospital nurses experienced psychosocial impact due to night shiftwork, particularly among nurses who had frequent (>20 weeks) of night shift assignments (Alsharari, 2019). However, none of the previous studies conducted in KSA have specifically investigated the impact of night shift rotations on nursing performance, patients' safety and the nurses' physiological complications and were conducted in a limited context that do not necessarily represent all nurses in the country.

Recently, there has been a growing interest in KSA to promote safer and healthier workplace environments that respond to employees' needs, especially in the healthcare sector. This has been envisioned by the Saudi government as part of Vision 2030 initiatives to introduce multitransformational changes to the healthcare system and to enhance individuals' lifestyles (Alharbi, 2018). As nurses provide most healthcare services and comprise the largest healthcare group in the country, such transformational plans should address all the challenges currently facing nurses and affecting the delivery of nursing services including shiftwork issues. The purpose

of the current study was therefore to investigate the impact of night shiftwork on nursing physiological status, work performance and patient safety concerns among public hospital nursing staff in KSA. It aimed to answer the following research questions: (a) What are the nurses' perceptions of the impact of night shiftwork on nursing physiological status, work performance and patient safety concerns in public hospitals? (b) Are the sociodemographic variables useful in predicting the impact of night shift rotations on nurses' physiological status, work performance and patient safety?

2 | MATERIALS AND METHODS

2.1 | Design and participants

A descriptive predictive correlational design was used to investigate nurses' perceptions of the physiologic, work performance and patient safety issues during night shiftwork and its correlation with nurses' demographic variables. There are nearly 200,000 nurses in the public and private healthcare sector in the country working in primary, secondary and tertiary healthcare facilities, among which almost 60% are expatriate nurses (MOH, 2019). In the public healthcare sector, hospital nurses are required to perform about 40 hr a week to fulfil the job requirements as full-time staff. In public hospitals' departments, head nurses routinely arrange the work schedule for staff nurses in a weekly fashion with five continuous workdays, 8-hr shift each, followed by two consecutive off-days. Nurses on shift rotations are expected to complete night duty rosters that range from 5–10 days per a calendar month and that can vary from one place to another based on units' needs and nurses' preferences. However, there are currently no financial benefits or other forms of compensations for the nurses when doing shiftwork in general or assigned to cover extra night shifts in the public health sector (MOH, 2019).

The current study was carried out from October to December 2019. It was planned that the survey would reach all nurses working in public hospitals in multiple regions of the country; hence, a non-probability convenient sampling method was used to recruit the target nurses. The inclusion criteria were being a registered full-time nurse who performs shiftwork, nurses involved in night shiftwork, ≥1-year work experience in the nursing profession and being employed in the public sector (MOH). The study adheres to the STROBE checklist for reporting cross-sectional studies.

2.2 | Instrument

The data collection instrument was a self-administered questionnaire developed by the first author. The questionnaire was developed after an extensive review of published materials on the topic, taking into account the current study settings' situational variations. Two formats of the questionnaire (electronic and paper-based versions) were produced and distributed among eligible nurses. The questionnaire was divided into three sections: the

sociodemographic profile of the participants with 13 questions; patient safety and nursing performance issues (safety); and the physiological impact of night shift rotations with five items each. The safety scale had questions that dealt with having enough and qualified nurses undertaking night shifts, patients' cooperation and nurses' perception of their safety during the night shift. The physiological impact scale consisted of items related to the nurses' adaptation, healthy lifestyle, rest and alertness during night shifts. The questions were framed as positive statements that nurses responded on a 4-point Likert scale that ranged from strongly agree [1] to strongly disagree [4]. A scoring system was applied: the higher the rating on the scale, the higher the impact of night shift rotations on nursing performance and patients' safety and the nurses' physiological consequences.

The initial questionnaire was reviewed and validated by five experts, including academic, professional nurses and experienced occupational health workers who modified some aspects of the questionnaire. The experts recommended a two-way translation of the survey items from English to Arabic, for more convenience of the Arabic-speaking participants, which was done accordingly. The five experts were also asked to rate the relevancy and clarity of each item, which indicated a range from 0.80–1 and the rate for the overall scale was 0.90, which is >0.80 criterion. The final copies of the questionnaire were considered to have face and content validity by the experts. Subsequently, the questionnaire's copies were pre-tested on 35 Arabic and non-Arabic-speaking nurses working in public hospitals, who met the inclusion criteria but were not included in the current data set, to ensure cultural appropriateness, check language clarity and assess the required time to complete all items of the survey. As a result, minor changes were done, including word choice, font-size adjustment and rephrasing of some items in both languages. Additionally, the reliability coefficient (Cronbach's alpha) of the total scale was 0.84 indicating good level of internal consistency; and for the subscales, it was 0.71 and 0.82 for the safety and the physiological impact subscales, respectively.

2.3 | Ethics

An informed consent form was attached to the first page of both the electronic and the printed copies of the questionnaire, which a consenting nurse had to sign before proceeding to complete the survey. The electronic format was designed to inform participants about the purpose and content of the survey so they could make an informed decision to proceed by clicking on the "agree to participate" icon. The current study's ethical approval was obtained from an institutional review board in KSA (approval no. 09/01/41).

2.4 | Data collection

The questionnaire was administered to the nurses via emails and mobile phone text messages after seeking permission from the

nursing administrative offices in KSA's respective regions. The questionnaire was mainly distributed electronically using Qualtrics platform via emails, text messaging and social media apps on mobile devices. Some printed copies were arranged and were available in some selected centres for those nurses who preferred to complete a printed copy of the survey. Informed consent was attached to the printed questionnaire copies so that nurses can sign, respond and then return it with the completed form to the nursing office for collection by a team member of the research. A QR code and a web link were also shared with nurses to participate and invite peers at their convenient time and print and fill the survey if they opt the paper-based method. Qualtrics platform has a check code to prevent multiple entries from the same participant to minimize bias. Nurses completed and returned the survey at a convenient time and no personal identifying data were collected.

2.5 | Data analysis

The SPSS version 24 (Armonk, NY: IBM Corp. USA) was used for data analysis. A summary score for each patient safety and performance effect and physiological effect scales were computed (ranged from 5–20). Higher scores indicated a higher impact of night shift rotations in each case. Nurses with a score of less than 10 were considered to have no issues with patient safety and nursing performance, or physiological consequences as a result of night shift duties in each case, while those with a score of 10 or higher were considered to have patient safety and nursing performance issues, or physiological complications due to night shift rotations.

Quantitative variables were presented as means (\pm standard deviation; *SD*) and median (interquartile range; *IQR*), while qualitative data were presented as proportions. The Shapiro–Wilk's test was used to assess normality of the total of performance and safety or physiological effect scores. Both were found to be non-normally distributed ($p < .001$ for both). Where appropriate, Mann–Whitney and Kruskal–Wallis tests were applied to estimate the differences between median performance and safety or physiological effect scores concerning the demographic characteristics. Besides, multi-variable logistic regression analyses were applied to assess patient safety and performance or physiological factors using the full model fits. Statistical significance was determined by a p -value $< .05$.

3 | RESULTS

3.1 | Sociodemographic characteristics of the participants

Of 1,317 participants who attempted to complete the survey, data from 1,256 (95.4%) nurses with filled questionnaires were analysed. The demographic profiles of the participants are presented in Table 1. Most respondents fall within the 21–30 and 31–40 years' age groups (55.9% or 702/1256 and 38.6% or 498/1256,

TABLE 1 Demographic profile of nurses (N = 1,256)

Variable	Characteristics	Frequency	Percentage
Age group (years)	21–30	702	55.9
	31–40	498	39.6
	>40	56	4.5
Gender	Male	637	50.7
	Female	619	49.3
Nationality	Saudi	1,184	94.3
	Philippines	38	3.0
	India	16	1.3
	Others	18	1.4
	Marital status	Married	814
Marital status	Single	403	32.1
	Divorced	27	2.1
	Separated	12	1.0
	Religion	Muslim	1,213
Religion	Christian	35	2.8
	Others	8	0.6
	Education	Diploma	733
Education	Bachelor's degree	426	33.9
	Postgraduate degree	97	7.7
Work experience (years)	1–3	333	26.5
	4–6	333	26.5
	7–10	311	24.8
	>10	279	22.2
Nursing position	Staff nurse	942	75.0
	In-charge nurse	153	12.2
	Nursing supervisor	161	12.8
	Work department	Emergency	311
Work department	Intensive care unit	129	10.3
	Surgical	114	9.1
	Medical	108	8.6
	Obstetrics and gynaecology	101	8.0
	Paediatrics	68	5.4
	Other	425	33.8
	Region	Makkah	332
Region	Madina	95	7.6
	Riyadh	130	10.4
	Eastern region	140	11.1
	Al-Jouf	73	5.8
	Tabuk	120	9.6
	Asser	261	20.8
	Jazan	105	8.4

(Continues)

TABLE 1 (Continued)

Variable	Characteristics	Frequency	Percentage
Night shift pattern	Rotating	951	75.7
	Fixed	121	9.6
	Floating	184	14.6
Likes night shiftwork	Yes	197	15.7
	No	613	48.8
Night shifts in the past year (weeks)	Sometimes	446	35.5
	1–5	148	11.8
	6–10	140	11.1
	11–20	217	17.3
>20	I cannot remember	311	24.8
		440	35.0

respectively) and about half (50.7% or 637/1256) were male. A total of 94.3% (1184/1256) of the participants were Saudi nationals, 64.8% (814/1256) were married, and 96.6% (1213/1256) were Muslims. Also, most participants had either a diploma (58.4% or 733/1256) or a bachelor's degree (33.9% or 426/1256). Also, 53.0% (666/1256) had between 1–6 years of clinical experience and 75.0% (942/1256) were staff nurses. Almost a quarter (24.8%, 311/1256) of the participants worked in the emergency unit. Makkah region 26.4% (332/1256) had the highest proportion of participants (Table 1). Moreover, 75.7% (951/1256) of the nurses reported that they were involved in shift rotations (9.6%; 121/1256) or floating (14.6%; 184/1256) night shiftwork. Also, only 15.7% (197/1256) of the participants indicated that they preferred night shifts, while others did not prefer it 48.8% (613/1256) or preferred it infrequently 35.5% (446/1256). Some nurses, 24.8% (311/1256), reported having done more than 20 weeks of night shifts in the preceding year.

3.2 | Safety issues and nursing performance

The nurses' responses regarding the impact of night shiftwork on safety and performance issues are shown in Table 2. The nurses' perception of having enough staff at night shift (mean 2.95; SD 0.8) was ranked the highest and their concern of the qualifications of nurses they undertake night shiftwork was ranked the lowest (mean 2.41 = SD 0.75). Table 2 also reports on the physiological effects of night shiftwork on nurses. This showed that their perception that: "I have a healthy lifestyle when working night shift" (mean = 3.39; SD 0.7) ranked highest and concern with being alert ranked lowest, which read thus: "I remain active and alert during night shift" (mean = 2.82; SD 0.84) in their rating of the physiological effect of night shiftwork.

The median scores (ranged from 5–20) of the patient safety and performance and physiological impact of night shift rotations according to the participants' demographic profile are presented in Table 3. The overall median (interquartile range) performance and

TABLE 2 Nurses' level of agreement with performance and safety, and physiological impact of night shifts

Variable	Strongly agree	Agree	Disagree	Strongly disagree	Mean score
	N (%)	N (%)	N (%)	N (%)	±SD
Performance and safety effect					
There are enough nursing staff at night shift	49 (3.9)	323 (25.7)	527 (42.0)	357 (28.4)	2.95 (0.83)
I work with qualified nurses at night shift	85 (6.8)	687 (54.7)	369 (29.4)	115 (9.2)	2.41 (0.75)
Night shiftwork is less likely to be interrupted	90 (7.2)	499 (39.7)	467 (37.2)	200 (15.9)	2.62 (0.84)
Patients cooperate well at night shift	69 (5.5)	489 (38.9)	520 (41.1)	178 (14.2)	2.64 (0.79)
I feel safe working night shift	78 (6.2)	378 (30.1)	454 (36.1)	346 (27.5)	2.85 (0.90)
Physiological effect					
My body's cycle rhythm can adapt to night shift	37 (2.9)	268 (21.3)	470 (37.4)	481 (38.3)	3.11 (0.84)
I get enough time to sleep after my night shift	34 (2.7)	185 (14.7)	455 (36.2)	582 (46.3)	3.26 (0.81)
I have healthy lifestyle when working night shift	13 (1.0)	121 (9.6)	487 (38.8)	635 (50.6)	3.39 (0.70)
There is time for rest during night shiftwork	42 (3.3)	370 (29.5)	416 (33.1)	428 (34.1)	2.98 (0.88)
I remain active and alert during night shift	50 (4.0)	422 (33.6)	484 (38.5)	300 (23.9)	2.82 (0.84)

Note: Scores: [1] strongly agree, [2] agree, [3] disagree, [4] strongly disagree; SD = Standard deviation

safety effect score was 13.0 (12.0, 15.0). The median scores for the performance and safety effect of night shiftwork were higher among female nurses ($p < .001$), higher in Saudis compared with expatriates (median 14.0 vs. 12.0; $p < .001$) and higher among Muslims ($p = .01$). Also, the median scores for the performance and safety effect of night shiftwork were higher among participants with a diploma or a postgraduate diploma ($p < .001$); higher among senior nurses with more work experience ($p < .001$); and were significantly higher in the Eastern borders, Tabuk and Asser compared with other regions where the participants' work ($p < .001$). In addition, the scores for performance and safety effects were higher among participants who did not like night rotations ($p < .001$) and among nurses who had more than 10 weeks of night shifts in the previous year ($p < .001$).

The overall median (IQR) score of physiological impact was 15.0 (14.0, 18.0). The median scores for the physiological effect of night shiftwork were higher in younger age nurses compared with older counterparts ($p = .002$), higher among female nurses (16.0 vs. 15.0; $p < .001$), higher among Saudis compared with expatriates ($p < .001$) and higher among married participants ($p = .012$). Furthermore, the median scores were higher among Muslim nurses compared with other religions ($p < .001$), participants with a diploma degree

($p = .004$) and those with more work experience ($p = .005$). Also, the median scores were higher among nurses working in surgical, paediatrics and obstetrics and gynaecology units compared with other hospital units ($p < .001$) and higher among participants in the Eastern, Tabuk and Jazan regions compared with other parts of KSA ($p = .001$). Similarly, the median scores of the physiological impact were higher among nurses on rotational shiftwork ($p < .001$), nurses who did not like night rotations ($p < .001$) and among nurses who had more than 10 weeks of night shifts in the previous year ($p < .001$).

Most surveyed nurses (85.7%) reported patient safety and performance issues due to night shift rotations. The overall linear regression of patient safety and performance issues due to night shift rotations included eight sociodemographic variables as predictors, which were statistically significant, $R = 0.406$, $R^2 = 0.165$, adjusted $R^2 = 0.153$, $F(17, 1,238) = 14.35$, $p < .001$. The total safety and performance score was explained by approximately 17% of the variance accounted for by the regression (Table 4). To assess the contributions of individual predictors, the t ratios for the individual regression slopes were performed. Six of the predictors were significantly predictive of the total safety scores; these included gender, $t = 3.24$, $p = .001$; and the dummy-coded predictors for the nursing position (supervisor), $t = 2.37$, $p < .05$; level

TABLE 3 Overall scores of the patient safety, nursing performance and physiological impact of night shift rotations

	Performance and safety effect			Physiologic effect		
	Mean	Median (IQR)	p-value	Mean	Median (IQR)	p-value
Age group (years)			.167			.002
21–30	13.5	13.0 (12.0, 15.0)		15.7	16.0 (14.0, 18.0)	
31–40	13.5	14.0 (12.0, 15.0)		15.6	15.5 (14.0, 18.0)	
41–50	12.8	13.0 (12.0, 14.0)		14.3	14.0 (12.0, 17.0)	
>50	12.0	14.0 (10.0, 14.0)		11.4	11.0 (11.0, 15.0)	
Gender			<.001			<.001
Male	13.2	13.0 (11.0, 15.0)		15.1	15.0 (13.0, 17.0)	
Female	13.8	14.0 (12.0, 16.0)		16.1	16.0 (14.0, 19.0)	
Nationality			.002			<.001
Saudi	13.5	14.0 (12.0, 15.0)		15.7	16.0 (14.0, 18.0)	
Philippines	12.5	12.5 (11.0, 14.0)		13.7	14.0 (12.0, 15.0)	
India	12.0	12.0 (11.0, 13.0)		12.6	13.0 (11.5, 14.0)	
Others	12.5	11.5 (10.0, 15.0)		14.7	14.0 (13.0, 17.0)	
Marital status			.109			.012
Married	13.6	14.0 (12.0, 15.0)		15.8	16.0 (14.0, 18.0)	
Single	13.2	13.0 (11.0, 15.0)		15.2	15.0 (13.0, 18.0)	
Divorced	13.2	13.0 (12.0, 15.0)		15.4	15.0 (13.5, 17.0)	
Separated	14.2	14.0 (12.5, 16.5)		15.1	15.0 (14.0, 17.5)	
Religion			.010			<.001
Muslim	13.5	14.0 (12.0, 15.0)		15.6	16.0 (14.0, 18.0)	
Christian	12.3	13.0 (11.0, 13.5)		13.3	13.0 (12.0, 14.0)	
Others	12.1	12.0 (10.0, 14.0)		13.8	13.5 (12.5, 15.0)	
Education			<.001			.004
Diploma	13.8	14.0 (12.0, 16.0)		15.8	16.0 (14.0, 18.0)	
Bachelor's degree	12.9	13.0 (11.0, 15.0)		15.2	15.0 (13.0, 18.0)	
Postgraduate diploma	13.6	14.0 (11.0, 15.0)		15.8	15.0 (14.0, 19.0)	
Master's degree/PhD	12.5	13.0 (11.0, 14.0)		15.0	15.0 (14.0, 16.5)	
Work experience (years)			<.001			.005
1–3	12.7	13.0 (11.0, 15.0)		15.1	15.0 (13.0, 18.0)	
4–6	13.8	14.0 (12.0, 16.0)		16.0	16.0 (14.0, 19.0)	
7–10	13.8	14.0 (12.0, 15.0)		15.7	16.0 (14.0, 18.0)	
>10	13.7	14.0 (12.0, 15.0)		15.5	15.0 (14.0, 18.0)	
Nursing position			.588			.822
Staff nurse	13.5	13.0 (12.0, 15.0)		15.6	15.0 (13.0, 18.0)	
In-charge nurse	13.4	13.0 (12.0, 15.0)		15.6	15.0 (14.0, 18.0)	
Nursing supervisor	13.6	14.0 (12.0, 15.0)		15.5	16.0 (14.0, 17.0)	
Department			.06			<.001
Emergency	13.3	13.0 (12.0, 15.0)		14.7	15.0 (13.0, 17.0)	
Intensive care unit	13.3	13.0 (11.0, 15.0)		15.5	15.0 (13.0, 18.0)	
Surgical	13.6	13.0 (11.0, 16.0)		16.2	17.0 (15.0, 18.0)	
Medical	13.7	14.0 (12.0, 16.0)		16.0	16.0 (14.0, 19.0)	
Obs. and gynaecology	14.2	14.0 (13.0, 16.0)		16.9	18.0 (15.0, 20.0)	
Paediatrics	13.8	14.0 (12.0, 15.5)		16.7	17.0 (15.0, 19.0)	
Other	13.4	13.0 (12.0, 15.0)		15.4	15.0 (13.0, 18.0)	

(Continues)

TABLE 3 (Continued)

	Performance and safety effect			Physiologic effect		
	Mean	Median (IQR)	<i>p</i> -value	Mean	Median (IQR)	<i>p</i> -value
Region			<.001			.025
Makkah	13.0	13.0 (11.0, 15.0)		15.4	15.0 (13.0, 18.0)	
Madina	13.2	13.0 (12.0, 15.0)		15.4	15.0 (14.0, 18.0)	
Riyadh	13.1	13.0 (12.0, 15.0)		15.1	15.0 (13.0, 17.0)	
Eastern borders	13.7	14.0 (12.0, 16.0)		16.2	16.0 (15.0, 19.0)	
Al-Jouf	12.9	13.0 (11.0, 15.0)		15.4	15.0 (14.0, 18.0)	
Tabuk	14.0	14.0 (12.0, 16.0)		16.1	16.0 (14.5, 19.0)	
Asser	14.2	14.0 (13.0, 16.0)		15.6	15.0 (13.0, 18.0)	
Jazan	13.2	13.0 (11.0, 15.0)		15.4	16.0 (13.0, 18.0)	
Night shift pattern			.053			<.001
Rotating	13.6	14.0 (12.0, 15.0)		15.8	16.0 (14.0, 18.0)	
Fixed	13.3	13.0 (11.0, 15.0)		14.7	14.0 (13.0, 17.0)	
Floating	13.1	13.0 (11.0, 15.0)		15.1	15.0 (13.0, 17.0)	
Likes night shiftwork			<.001			<.001
Yes	11.7	12.0 (10.0, 14.0)		12.4	12.0 (10.0, 14.0)	
No	14.2	14.0 (12.0, 16.0)		17.1	18.0 (15.0, 19.0)	
Sometimes	13.2	13.0 (11.0, 15.0)		14.8	15.0 (13.0, 16.0)	
Night shifts in the past year (weeks)			<.001			<.001
1-5	12.3	12.0 (11.0, 14.0)		14.5	15.0 (13.0, 17.0)	
6-10	12.7	13.0 (11.0, 14.0)		14.8	15.0 (13.0, 17.0)	
11-20	13.8	14.0 (12.0, 15.0)		16.0	16.0 (14.0, 19.0)	
>20	13.7	14.0 (12.0, 16.0)		15.9	16.0 (14.0, 19.0)	
I cannot remember	13.8	14.0 (12.0, 16.0)		15.7	16.0 (14.0, 18.0)	

of education (bachelor degree), $t = -4.70$, $p < .001$; level of education (postgraduate), $t = -2.21$, $p < .05$; age (41-50 years), $t = -2.36$, $p < .05$; night shift preference (I like night shift), $t = -10.94$, $p < .001$; night shift preference (sometimes likes), $t = -5.93$, $p < .001$; and the number of night shifts in the last year, $t = -4.21$, $p < .001$ (Table 4).

Most respondents (93.6%) reported physiological effects due to night shift rotations. The overall linear regression of physiological impact of night shift rotations included eight sociodemographic variables as predictors, which were statistically significant, $R = 0.607$, $R^2 = 0.368$, adjusted $R^2 = 0.359$, $F(17, 1,238) = 42.39$, $p < .001$. The total physiological impact of night shift rotation was explained by approximately 37% of the variance accounted for by the regression (Table 5). To assess the contributions of individual predictors, the t ratios for the individual regression slopes were performed. Eight of the predictors were significantly predictive of the total physiological impact scores; these included gender, $t = 4.27$, $p < .001$; marital status, $t = -2.69$, $p < .05$; and the dummy-coded predictors for the nursing position (in-charge nurse), $t = 2.28$, $p < .05$; level of education (bachelor degree), $t = -2.59$, $p < .05$; age (41-50 years), $t = -3.58$, $p < .001$; age (above 50 years), $t = -3.49$, $p < .001$; night shift pattern (floating), $t = -3.55$, $p < .001$; night shift preference (I like night shift), $t = -21.42$, $p < .001$; night shift preference (sometimes likes),

$t = -14.66$, $p < .001$; and number of night shifts in the last year, $t = -2.62$, $p < .05$ (Table 5).

4 | DISCUSSION

This study found that night shiftwork affects nurses' performance and the safety of patients and nurses in KSA. The participants' responses indicate that they were highly concerned with the inadequacy of nursing staff involved with night shiftwork. This is not surprising since almost half of the participants did not like doing night shifts. The study also found that the nurses' qualifications involved with night shiftwork were the least of their concerns.

The current study's findings are consistent with other studies conducted elsewhere that nurses on night shift rotations face substantial stress, which might affect their performance (Al-Makhaita et al., 2014; Banakhar, 2017; Ferri et al., 2016). Additionally, the study found that the performance and safety effect score varied according to gender, nationality, religion, education, work experience, region and participants' preference and experiences with night shift; this suggests that these differences need to be taken into account while scheduling shifts among the staff. Overall, more

TABLE 4 Results of standard multiple linear regression to predict safety and performance issues from the demographic characteristics and working conditions

Predictor variable	<i>b</i>	β	<i>t</i>	Sr^2_{unique}
Gender	0.53	0.10	3.24***	0.007
Marital status	0.27	0.05	1.53	0.002
Nursing position				
D1 (in-charge nurse)	0.15	0.02	0.63	<0.001
D2 (nursing supervisor)	0.58	0.07	2.4*	0.004
Reference group (staff nurse)				
Age				
D1 (20–30 years)	0.94	0.17	2.40*	0.004
D2 (31–40 years)	0.81	0.14	2.08*	0.003
D3 (> 50 years)	-0.57	-0.01	-0.47	<0.001
Reference group (41–50 years)				
Level of education				
D1 (bachelor)	-0.77	-0.13	-4.67***	0.015
D2 (Postgraduate)	-0.62	-0.06	-2.21*	0.003
Reference group (diploma)				
Night shift pattern				
D1 (fixed)	0.14	0.02	0.56	<0.001
D2 (floating)	-0.41	-0.05	-1.81	0.002
Reference group (rotating)				
Likes night shiftwork				
D1 (yes)	-2.39	-0.31	-10.94***	0.08
D2 (sometimes)	-0.97	-0.17	-5.93***	0.02
Reference group (no)				
Night shifts in the past year (weeks)				
D1 (1–5 weeks)				
D2 (5–10 weeks)	-1.22	-0.14	-4.52***	0.01
D3 (10–20 weeks)	-0.96	-0.11	-3.63***	0.008
D4 (I can't remember)	-0.17	-0.02	-0.72	<0.001
Reference group (> 20 weeks)	-0.17	-0.03	-0.84	<0.001

Overall model ($R = 0.406$, $R^2 = 0.165$, $\text{adj } R^2 = 0.153$, $F = 14.35$, $p < .001$)

Note: *b*, unadjusted regression slope coefficient; β , adjusted regression slope coefficient; Sr^2 , squared semipartial correlation; and D, dummy variable.

* $p < .05$

** $p < .01$,

*** $p < .001$.

than four-fifths of the nurses in the current study had performance and safety issues. This alarms that night shiftwork substantially affects nursing performance and, subsequently, patients' safety in

TABLE 5 Results of standard multiple linear regression to predict physiological effects from the demographic characteristics and working conditions

Predictor variable	<i>b</i>	β	<i>t</i>	Sr^2_{unique}
Gender	0.68	0.11	4.27***	0.009
Marital status	0.45	0.07	2.69**	0.004
Nursing position				
D1 (in-charge nurse)	0.51	0.05	2.28*	0.003
D2 (nursing supervisor)	0.46	0.05	1.96	0.002
Reference group (staff nurse)				
Age				
D1 (20–30 years)	1.37	0.22	3.58***	0.007
D2 (31–40 years)	1.12	0.18	2.97**	0.004
D3 (> 50 years)	-2.57	-0.05	-2.19*	0.002
Reference group (41–50 years)				
Level of education				
D1 (bachelor)	-0.41	-0.62	-2.59*	0.003
D2 (postgraduate)	-0.19	-0.02	-0.71	<0.001
Reference group (diploma)				
Night shift pattern				
D1 (fixed)	-0.38	-0.04	-1.56	0.001
D2 (floating)	-0.78	-0.09	-3.55***	0.006
Reference group (rotating)				
Likes night shiftwork				
D1 (yes)	-4.52	-0.53	-21.42***	0.23
D2 (sometimes)	-2.31	-0.36	-5.93***	0.11
Reference group (no)				
Night shifts in the past year (weeks)				
D1 (1–5 weeks)	-1.24	-0.13	-4.75***	0.01
D2 (5–10 weeks)	-1.18	-0.12	-4.59***	0.01
D3 (10–20 weeks)	-0.39	-0.05	-1.73	0.001
D4 (I can't remember)	-0.53	-0.08	-2.76	0.004
Reference group (>20 weeks)				

Overall Model ($R = 0.607$, $R^2 = 0.368$, $\text{adj } R^2 = 0.359$, $F = 42.39$, $p < .001$)

Note: *b*, unadjusted regression slope coefficient; β , adjusted regression slope coefficient; Sr^2 , squared semipartial correlation; and D, dummy variable.

* $p < .05$.

** $p < .01$.

*** $p < .001$.

the KSA. As noted in other countries (Johnson et al., 2014; Niu et al., 2013), night shift rotations may be partly responsible for nurses' errors in hospitals.

Furthermore, the study found that nurses belonging to the younger age group, long years of work experience and being involved in fixed or rotating shiftwork were risk factors for experiencing performance and safety issues. In standard linear multiple regression analysis, several sociodemographic variables were significantly correlated and predictive of nurses' safety and performance issues, which include age, gender, nursing position, educational level, night shift preference and the frequency of night shift assignments. Similar observations have been reported by others (Abdulah et al., 2020; Giorgi et al., 2018; Han, Trinkoff & Geiger-Brown, 2016). Likewise, sociodemographic variables such as gender, marital status, nursing position, age, education level, night shift pattern, night shift preference and the frequency of night shift assignments were significantly correlated and predictive of the total physiological effect score. This is consistent with other studies that found significant negative correlation between night shift characteristics and the physiological status of nurses (Banakhar, 2017; Books et al., 2020; Liu et al., 2018). Consequently, these factors need to be carefully thought of when preparing and planning duty schedules for nurses. Strategies to ameliorate these adverse effects on safety and nursing performance require further investigation.

Moreover, the surveyed nurses' responses indicate that they were highly concerned about their health while involved with night shiftwork and found that remaining active and alert was the least concern of the nurses. The findings of this study are consistent with other studies that nurses involved with night shiftwork face adverse effects like poor sleep, musculoskeletal disorders, stress, poor feeding and other systemic effects (Haile et al., 2019; Liu et al., 2018; Siqueria et al., 2016; Thompson et al., 2017). Overall, more than 93.6% of the participants reportedly experienced the physiological impact of night shiftwork. This indicates that night shiftwork substantially affects most nurses in KSA and, as noted elsewhere (Abdulah et al., 2020; Giorgi et al., 2018; Johnson et al., 2014), maybe partly responsible for fatigue and burnout encountered among nurses in the setting. Nurses at-risk need to attend counselling sessions on how to reduce the impact they experience due to night shiftwork because this high physiological impact may contribute to their intention to leave the nursing profession (Booker et al., 2020; Lo et al., 2018). Moreover, the perceptions of such at-risk participants warrant further investigation.

The present study has some strengths and limitations worth mentioning. The study was conducted across multiple regions of KSA and managed to recruit a large representative sample of nurses in the country. Secondly, the study's questionnaire was simple and convenient for nurses to complete and return in different formats. Thirdly, the study attempts to research an area that has been poorly investigated in KSA. However, the following are the limitations of the study. First, the distribution of public hospitals in KSA regions may not be the same; this may have contributed to the regional differences in the number of participants who completed the survey. Secondly, the nurses were not randomly selected, and self-selection bias is a limitation when advertising for participants. It is possible that nurses who did not encounter

issues with night shiftwork were less drawn to undertake the survey. Thirdly, the study identified mostly challenges with the practice among the participants without necessarily seeking possible methods to address them. A qualitative investigation might have generated additional sociocultural themes on patient safety and performance and the physiological impact of night shiftwork validated the quantitative findings and suggested ways to overcome these challenges.

5 | CONCLUSION

A high proportion of nurses in KSA encounter adverse patient safety, performance and physiological impact due to night shiftwork. This warrants further studies to evaluate the contextual issues which might be impacting the effective delivery of health services by nurses involved in night shiftwork. Also, there is a need to develop a counselling programme for at-risk nurses and opportunities to support nurses who are regularly engaged in night shiftwork.

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CONFLICT OF INTEREST

The authors affirm that they have no conflict of interests.

DATA AVAILABILITY STATEMENT

The data that support the findings of this study are available from the corresponding author upon reasonable request.

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SUPPORTING INFORMATION

Additional supporting information may be found online in the Supporting Information section.

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