Original Article

The association of Shift Work and Effort–Reward Imbalance with Gastrointestinal Symptoms among Female Nurses

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Abstract

Background: Shift work impacts workers' health, mainly by disrupting the circadian rhythm, and gastrointestinal (GI) disturbances are among the health effects of shift work. **Objectives:** The objective of this study was to assess the association between shift work, work stress, and GI disturbance among nurses. **Methods:** In July 2018, a cross-sectional study was conducted in Dammam Medical Complex, Saudi Arabia. A total of 250 nurses were selected through convenience sampling from several departments. They completed a validated questionnaire, which included questions about their demographic data, GI symptoms, and effort–reward imbalance (ERI). Work stress was classified into two groups based on the ERI ratio. GI symptoms were categorized into three indices: total, upper, and lower GI. The sampling plan was designed to cover most of the shifts in the included departments throughout nonspecified dates. The daytime nurses' group was selected from the same hospital as a comparison group to the shift workers. Means and standard deviations were calculated for continuous variables and frequencies and percentages were calculated for categorical variables. The associations were assessed using the Chi-squares and analysis of variance. **Results:** Work stress among nurses, as measured by the ERI scale, was strongly associated with both upper and lower GI symptoms, with odds ratios of 5.7 (CI: 3.3–7.9) and 2.2 (CI: 1.8–4.3), respectively. The total GI symptom score of the shift workers was greater than that for the daytime workers, with means of 7.8 ± 6.9 and 5.4 ± 5.1, respectively (P = 0.005). Multivariable regression analysis showed that ERI was associated with both lower and upper GI symptoms after adjusting for shift work and years on the job. **Conclusions:** Shift work was associated with the high prevalence of GI symptoms. Stress (ERI) increased the risk for GI disturbance. Controlling work stress is necessary because it affects nurses' physical and social health, as well as their performances at work and the quality of care they provide.

Keywords: *Gastrointestinal, Nurses, Reward, Shift, Work*

Introduction

Variable work times, such as through shift work, can disturb circadian rhythms and cause difficulties in arranging time to spend with family and friends.[1-3] These disturbances, in turn, may lead to increased stress and other health problems such as gastrointestinal (GI) disturbances.[3]

Stress may affect different physiologic functions of the GI tract, including gastric secretion, gut motility, mucosal permeability and barrier function, visceral sensitivity, and mucosal blood flow.[4-9] Exposure to

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stress, especially chronic stress, is a major risk factor in the pathogenesis of different GI diseases.[10]

Some studies suggested an association between shift work and GI disorders,[11] so that the prevalence of GI disorders is higher in people who work the night shift.[12] However, a number of studies could not confirm such an association[13] or even have reported that shift work is protective against GI disorders.[14]

The relationship between stress and GI disturbances has been assessed by various researchers, using different models/measures of stress, and including workers from different sectors. One of these models is the effort–reward imbalance (ERI) which is used to investigate a stressful psychosocial work environment and to explain its adverse effects on stress-related health risks. All these models have concluded that there is a strong relationship between stress and GI disturbances.[15-18]

In Saudi Arabia, health-care workers, especially nurses, constitute a large percentage of the shift worker population.[19] Although there is a significant body of research on the effect of shift work and work stress, there is insufficient information regarding the combined effect of shift work and work stress on the GI system.

Objectives

This study aimed to determine the association between shift work and stress on GI symptoms among nurses at a Saudi governmental hospital. The authors further intend to formulate recommendations based on the findings of this research.

Methods

Design and participants

A cross-sectional study in June and July 2018 was conducted in Dammam Medical Complex (DMC), Saudi Arabia. A total of 250 nurses were recruited from DMC, a 500-bed governmental public hospital in the Eastern Province of Saudi Arabia. The hospital houses both inpatient and ambulatory facilities.

Being a nurse, working at the aforementioned hospital, and having at least 1 year of work experience were selected as the inclusion criteria. Males were excluded because there were few male nurses at the studied hospital. Before initiating the study, an expected sample size of 250 was calculated using EpiInfo version 7 (CDC, Atlanta, Georgia, USA), with the power and confidence levels being 80% and 95%, respectively.

A convenience sample of nurses was recruited from five departments (emergency room, general surgery, internal medicine, intensive care unit, and outpatient services). Each of these departments was visited on nonspecified dates, at different times of day, to cover all shifts. All nurses on duty at the time of the visits were invited to participate, and there was a response rate of 95%.

Data collection instruments

Data were collected using a validated self-administered questionnaire. Items on the questionnaire asked about personal and demographic characteristics (e.g., age, marital status, and smoking status), work characteristics (e.g., department and years of experience), GI symptoms, and medication use, and ERI questionnaire was used to measure of workplace stress. Other questions concerned whether the nurse was a daytime worker or shift worker. Nurses who worked between 6:00 a.m. and 7:00 p.m. over the last year were considered daytime workers. The shift work nurses worked rotating shifts, in which each nurse worked during the morning (7:00 a.m.–3:00 p.m.) for 1 month, during the evening (3:00 p.m.–11:00 p.m.) for the next month, and during the night (11:00 p.m.–7:00 a.m.) the following month.

GI symptoms were measured using a valid questionnaire covering a range of 32 GI symptoms over the previous 4-week period.[20] Standardized Cronbach's alpha for this questionnaire was reported 0.795 and its concurrent validity was equal to 0.8.[21] The severity scale for each of the symptoms ranged from none to unbearable (1 = none, 2 = mild, 3 = moderate, 4 = quite a lot, 5 = severe, 6 = very severe, and 7 = unbearable). This scale was condensed to three levels (1 = none, 2 = mild–moderate, and 3 = quite a lot, severe, very severe, or unbearable) in the analysis to simplify the process. Three summary indices for GI symptoms were produced: total GI, upper GI, and lower GI. These were calculated by adding one point for each relevant symptom for the upper or lower GI areas. The total GI index was the sum of the upper and lower indices. This included 21 upper and 11 lower individual items.

The short version of ERI questionnaire was used in this study,[22] which includes three scales: effort, reward, and commitment. However, for the purpose of this study, only the first two scales (effort and reward) were used. This was done, primarily, to have fewer items so that the participants could fill out the form easily in a short time, but, most importantly, it was done so that the researchers could calculate the ERI ratio, which determines stress status without needing the commitment scale. Each scale has certain items to be answered. The ERI model assumes that work stress results from high effort and low reward. Furthermore, the present research on work stress employed the ERI model and evaluated its effect on GI symptoms, taking into consideration the impact of shift work. Internal consistency of ERI scales was high

across employment groups: effort 0.78-0.76 and reward 0.81-0.77.[23] The administered questionnaire contained three items to measure the effort component and seven items to measure the reward component. For each of these items, the scores ranged from 1 to 4 (1 = strongly disagree, 2 = disagree, 3 = agree, and 4 = strongly agree). From these scores, the ERI ratio was calculated as ERI ratio = k E/R, where k is a correction factor to account for the unequal number of the effort and reward items, E is the sum of the effort item scores, and R is the sum of the reward item scores. Based on the ERI ratio, nurses were classified as having work stress if their ERI ratios were >1 and as not having work stress if their ERI ratios were ≤1.

Ethical considerations

The study protocol was approved by the DMC Research Ethics Committee (RAC# 027 dated February 07, 2018), and verbal consent was obtained from each participant. All personal data were kept confidential and used only for the purposes of the study. Data confidentiality was maintained during this study. The participation in this study was voluntary. All procedures involving human participants were conducted in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki Declaration and its later amendments or comparable ethical standards.

Data analysis

Means and standard deviations were calculated for continuous variables and frequencies, and percentages were calculated for categorical variables. The Shapiro–Wilk test was used to assess the normality of the data. The associations were assessed using Chi-squares and analysis of variance. Simple linear regression was also used to estimate the unadjusted association between work stress (ERI ratio) and shift work. Then, certain variables entered into the multiple linear regression to determine the association between work stress (ERI ratio) and shift work adjusted for age, number of years of experience, marital status, and smoking status. All analyses were performed using SPSS version 22 (SPSS Inc., Chicago, IL, USA). $P < 0.05$ was considered as statistically significant.

Results

A total of 250 nurses participated in the study, including both shift work nurses and fixed daytime nurses. All participants were females. None of the participants had data missing.

Personal characteristics by the department indicated that nurses working in the outpatient department tended to be younger (median with interquartile range [IQR]: 28 [26–31 years]) compared to all other nurses (shift and day workers) in other departments (median with IQR: 32 [29–37]). Furthermore, nurses working in the outpatient department were less experienced than nurses working in other departments (median with IQR: 5 [3–7] and 10 [7–14], respectively).

Overall, 69% of the nurses were married, and only 4% were current smokers. Twenty percent of the sampled nurses used nonsteroidal anti-inflammatory drugs (NSAIDs), whereas 15% of them had used antacids in the last 6 months.

There were significant differences between the personal and workplace characteristics of the shift work and daytime nurses [Table 1]. The shift workers were younger, with a mean age of 28, less than the daytime workers, with a mean age of 32. Daytime workers had more experience, with 10.7 years on average, than the shift workers, with 5 years on average. About 31% of the shift workers were from the emergency department, 26% from the intensive care unit, 23% from the surgical department, and 21% from the internal medicine department. Most of the daytime workers were from the outpatient department (89%), whereas the rest were from the surgical department (11%).

About 72% of the nurses showed evidence of work stress, with a stress ERI ratio >1. Table 2 demonstrates that there were significant differences according to the number of years worked between the two groups. However, there were no statistically significant differences according to the department they were working in.

Table 3 notes that GI symptoms were more common among nurses experiencing stress, where 43% reported mild-to-severe abdominal pain, and 41% reported mild-to-moderate heartburn. Forty-one percent also reported mild-to-severe bloating, 46% reported

Table 1: Characteristics of the study participants (shift workers vs. daytime workers)

Personal	Mean ± SD		*P*
	Shift workers	Day time workers	
Age	28.2 ± 4.2	32.9 ± 5.3	<0.0001
Number of years worked	4.9 ± 3.3	10.7 ± 6	<0.0001
Department, *n* (%)			
Surgical department	44 (22.7)	6 (10.7)	<0.0001
OPD	0	50 (89.3)	
ER	60 (30.9)	0	
Medical	40 (20.6)	0	
ICU	50 (25.8)	0	

SD: Standard deviation, OPD: Outpatient department, ER: Emergency medicine department, ICU: Intensive care unit

Table 2: Factors associated with stress (effort-reward imbalance)

Personal	Mean ± SD		*P*
	Workers with stress	Workers with no stress	
Age	29.2 ± 4.6	29.2 ± 5.6	0.97
Work experience (years)	6.5 ± 4.9	5.3 ± 4.2	0.03
Marital status (married), *n* (%)	129 (71.7)	43 (61.4)	0.11
Smoking status (smoker), *n* (%)	9 (5)	2 (2.9)	0.45
Use of antacid (yes), *n* (%)	31 (17.2)	7 (10)	0.15
Use of NSAID (yes), *n* (%)	38 (21.7)	10 (14.3)	0.18
Department, *n* (%)			
Surgical department	38 (21.1)	12 (17.1)	0.53
OPD	40 (22.2)	10 (14.3)	
ER	41 (22.8)	19 (27.1)	
Medical	27 (15)	13 (18.6)	
ICU	34 (18.9)	16 (22.9)	

SD: Standard deviation, NSAID: Nonsteroidal anti-inflammatory drugs, OPD: Outpatient department, ER: Emergency medicine department, ICU: Intensive care unit

mild-to-severe nausea, 39% reported mild-to-severe loss of appetite, 38% reported mild-to-severe flatulence, and 33% reported mild-to-severe constipation (compared to 27%, 15%, 11%, 25%, 18%, 26%, and 17%, respectively, among nurses with no work stress). All differences were statistically significant.

Work stress of >1, as measured by the ERI scale, was strongly associated with both upper and lower GI symptoms, with odds ratios of 5.7 (confidence interval [CI]: 3.3–7.9) and 2.2 (CI: 1.8–4.3), respectively. The average total GI symptom score of the shift workers was higher than that for the daytime workers, with means of 7.8 ± 6.9 and 5.4 ± 5.1, respectively ($P = 0.005$).

In multiple regression analysis, ERI (stress) was found to mainly affect the total and upper GI indices after adjustment for multiple factors where the estimates were 4.65 and 1.8, respectively. Furthermore, shift work was significantly affected by the total and upper GI indices [Table 4].

Discussion

In this study, the average total GI symptom score of the shift workers was significantly greater than that for the daytime workers, which is consistent with the results of other studies.[24-26] This might be explained by the irregular meal schedules and stress among nurses doing shift work.[27-32] Furthermore, this study has shown that many shift nurses used GI medications to relieve their symptoms. However, the use of NSAIDs among the shift nurses may contribute to their high prevalence of

Table 3: The prevalence of gastrointestinal symptoms among nurses according to stress measure (effort-reward imbalance)

GI symptoms	Stress, *n* (%)	No stress, *n* (%)	*P*
Abdominal pain			
None	102 (56)	51 (73)	0.056
Mild-moderate	69 (38)	16 (23)	
Severe	9 (5)	3 (4)	
Heartburn			
None	106 (59)	59 (84)	0.001
Mild-moderate	60 (33)	8 (11)	
Severe	14 (8)	3 (4)	
Bloating			
None	106 (59)	62 (89)	0.01
Mild-moderate	59 (33)	7 (10)	
Severe	15 (8)	1 (1)	
Nausea			
None	98 (54)	52 (74)	0.015
Mild-moderate	72 (40)	15 (21)	
Severe	10 (6)	3 (4)	
Loss of appetite			
None	110 (61)	57 (81)	0.018
Mild-moderate	61 (34)	12 (17)	
Severe	9 (5)	1 (1)	
Flatulence			
None	111 (62)	52 (74)	0.034
Mild-moderate	56 (31)	18 (26)	
Severe	13 (7)	0 (0)	
Constipation			
None	121 (67)	58 (83)	0.046
Mild-moderate	52 (29)	11 (16)	
Severe	7 (4)	1 (1)	
Indices, mean ± SD			
Upper GI index	0.26 ± 0.21	0.14 ± 0.15	0.01
Lower GI index	0.11 ± 0.17	0.06 ± 0.13	0.03
Total GI index	6.89 ± 5.8	3.5 ± 4.2	0.01

Upper GI index: Number of GI symptoms in the individual which include 21 (abdominal pain in common, abdominal pain-postprandial, abdominal pain-fasting, abdominal pain doesn't decline with defecation, epigastric pain-in common, epigastric pain-daytime, epigastric pain-night, heartburn, regurgitation, abdominal rumbling, bloating, empty feeling, nausea, vomiting, loss of appetite, postprandial fullness, belching, flatulence, hematemesis, dysphagia-liquid, dysphagia-solid). Lower GI index: Number of lower GI symptoms which include 11: Melena, bloody stool, stool with mucus, frequent hard stool, loose watery stool, alternately solid and loose, constipation, stool with frequent pain, urging, incomplete, steatorrhea, SD: Standard deviation, GI: Gastrointestinal

GI symptoms as NSAIDs irritate the gastric mucosa causing gastritis and peptic ulcers.

Using a questionnaire, we found that GI symptoms are common among nurses with shift working. The GI symptom questionnaire is a valid, easy to administer, and inexpensive instrument and has been recommended by other researchers.[33,34]

Table 4: Multivariable determinants of gastrointestinal indices

	Unadjusted estimate			Adjusted estimate		
	Estimate	95% CI	*P*	Estimate	95% CI	*P*
Determinants of total GI index						
Stress (ERI)	4.62	2.8-6.5	<0.001	4.65	2.8-6.5	<0.001
Shift work	2.39	0.7-4	0.005	3.22	1.4-5.1	0.001
Experience	0.01	−0.13-0.15	0.9	−0.14	−0.3-0.02	0.09
Determinants of upper GI index						
Stress (ERI)	1.8	1.1-0.24	<0.001	1.8	1.1-2.4	<0.001
Shift work	0.1	0.4-0.17	0.001	0.13	0.06-0.19	<0.001
Experience	0.00	−0.0-0.01	0.484	−0.00	−0.01-0.00	0.18
Determinants of lower GI index						
Stress (ERI)	0.09	0.03-0.14	0.071	0.09	0.03−0.14	0.071
Shift work	0.02	−0.03-0.07	0.463	0.05	−0.0-0.11	0.099
Experience	−0.003	−0.01-0.00	0.222	−0.01	−0.01-0.0	0.053

Experience: Means number of years worked, GI: Gastrointestinal, CI: Confidence interval, ERI: Effort-reward imbalance

The researchers have also found that work stress is strongly associated with GI symptoms. The total GI symptom scores of the shift workers were higher than those of the daytime workers. Moreover, ERI was associated with total and upper GI indices after adjustment for multiple factors. The reason why these predictors affect the upper GI rather than the lower GI may be attributable to the number of symptoms in each index; the upper GI index has 21 items, whereas the lower GI index includes only 11.

Several studies have been conducted in different regions of Saudi Arabia concerning job satisfaction and its relation to stress and chronic GI diseases (such as the high prevalence of irritable bowel syndrome among shift nurses). In these studies, researchers used various tools other than ERI.[31,32,35] Therefore, the results of these studies might not be fully comparable, and further multicenter studies with a specific instrument are suggested.

Creating healthier workplace environments and more convenient schedule schemes would help nurses cope with the harmful stressors they face. Furthermore, establishing employee assistance programs would be very useful – offering a counseling service to assist employees with their personal and/or work-related problems, which may impact their job performance, health, and mental and emotional well-being.

This study implemented a cross-sectional design in which the cause-specific relationship cannot be definitively established between the risk factors and the health outcome. That is, work stress can affect health, causing GI disturbances, but, at the same time, having an employee with an illness can make the work environment more stressful. The healthy worker effect should be considered in any occupational study. However, the current authors attempted to minimize this effect by selecting the daytime nurse group from the same hospital as a comparison group for the shift workers – comparing the rates of the health outcome (GI disturbance) between both the groups. Future studies are required to explain the combined effect of work stress and work shift on GI symptoms.

Conclusions

Shift work among nurses was associated with a high prevalence of GI symptoms. Nurses doing shift work were found to be more stressed and have more GI symptoms when compared to day workers. Stress increases the risk of GI disturbance in nurses. Controlling work stress is necessary because it affects nurses' physical and social health, as well as their performances at work and the quality of patient care they generate.

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Conflicts of interest

There are no conflicts of interest.

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