ORIGINAL ARTICLE

Fatigue Dynamics in Healthcare Workers in Kuantan, Pahang: A Cross-Sectional Study

Sinar Arina Mansor[1], Mohd Zubairy Shamsudin[1]*

[1]Department of Biomedical Science, Kulliyyah of Allied Health Sciences, International Islamic University Malaysia, Pahang, Malaysia

Keywords:
Occupational fatigue; Healthcare workers; Intershift recovery; Fatigue management

ABSTRACT

Background: This study investigates the prevalence and factors contributing to chronic and acute fatigue, as well as intershift recovery among healthcare workers in a private hospital in Kuantan, Malaysia. **Methods**: Using a cross-sectional design, data were collected from 182 healthcare professionals through a structured questionnaire, including the Occupational Fatigue Exhaustion Recovery (OFER) Scale. **Results:** Results indicate that a significant proportion of participants experience moderate to high levels of chronic fatigue and low to moderate acute fatigue, with intershift recovery also rated similarly. Key sociodemographic factors such as age, gender, job profession, and sleep quality were found to significantly influence fatigue levels. Notably, younger healthcare workers reported higher chronic fatigue, while female workers exhibited greater acute fatigue compared to males. **Conclusion:** The findings highlight the urgent need for effective fatigue management strategies within healthcare settings to enhance worker well-being and patient safety. This research provides valuable insights into the challenges faced by healthcare workers in Malaysia and underscores the importance of addressing fatigue-related issues in the healthcare sector.

INTRODUCTION

Healthcare workers, including doctors and nurses, face immense mental and physical stress, leading to high fatigue levels. Research indicates that over half of Emergency Medical Services (EMS) personnel report fatigue during shifts, increasing the risk of work-related incidents (Patterson et al., 2014). Factors such as inadequate social support, age, and irregular shift schedules contribute to this issue. In Malaysia, night shifts and on-call duties have been linked to severe consequences like needlestick injuries and prescription errors. Despite its importance for patient safety, research on fatigue management in Malaysia is limited. This study aims to assess chronic and acute fatigue levels among healthcare workers at a private hospital in Kuantan.

MATERIALS AND METHODS

Study Design

A cross-sectional study was conducted among healthcare workers at a private hospital in Pahang. Data were collected using a structured survey with questionnaires distributed to participants across various departments, including clinical and administrative staff.

Sample Size Calculation

The sample size was determined using Charan and Biswas' (2013) formula, targeting a 95% confidence level and 5% precision, with a prevalence estimate of p = 0.887 from Abdalgeleel *et al.* (2023). Considering a 10% dropout rate, the final required sample size was 182 participants.

Sampling Method

Participants were selected through non-random convenience sampling based on their accessibility and availability (Etikan *et al*., 2016). This approach allowed for the efficient recruitment of healthcare workers from various departments.

Data Collection Instrument

The self-administered questionnaire comprised two main sections:

1. **Sociodemographic Characteristics:** This section assessed factors such as job profession, department, gender, age, education level, marital status, work experience, sleep issues, average sleep hours, exercise frequency, meal frequency, shift details, health conditions, and body mass index (BMI).

2. **Occupational Fatigue Exhaustion Recovery (OFER) Scale:** Adapted from Winwood et al. (2005), the OFER scale evaluates three dimensions of fatigue: chronic fatigue (Items 1–5), acute fatigue (Items 6–10), and inter-shift recovery (Items 11–15). Responses are measured on a 7-point Likert scale ranging from 0 (strongly disagree) to 6 (strongly agree). The OFER

* *Corresponding author.*
E-mail address: mohdzubairyshamsudin@iium.edu.my

scale demonstrated strong reliability with Cronbach's alpha coefficients ranging from 0.83 to 0.89.

PILOT STUDY

A pilot study involving 36 healthcare workers was conducted to assess the validity and reliability of the questionnaire using Cronbach's alpha. The subscales of the OFER scale showed acceptable to good reliability (Cronbach's alpha between 0.70 and 0.89) show in Table 1, confirming the instrument's suitability for the main study. This revised methods provides clearer organisation and detail while ensuring that all critical information is retained.

Table 1: Cronbach's Alpha for all variables tested

Items	Cronbach's Alpha	Cronbach's Alpha Based on Standardised Items	n of items
Chronic Fatigue	0.866	0.868	5
Acute Fatigue	0.731	0.728	5
Inter-shift Recovery	0.710	0.730	5

RESULTS

Sociodemographic Characteristics

Sociodemographic data were collected from 182 respondents, focusing on factors such as age, gender, department, job profession, education level, marital status, work experience, sleep issues, sleep hours, exercise frequency, general health, meals per day, shift work, and BMI. Key findings are summarised in Table 2.

The sample was predominantly female (79.1%), with males comprising 20.9%. Most participants held clinical roles (67.7%), while administrative and operations staff represented 15.9%. Nursing staff accounted for 47.3%, followed by allied health professionals at 25.3%. The majority were 30-40 years old (42.9%), and over half of the healthcare workers had a diploma (52.7%).

Regarding marital status, 69.2% were married, 67.0% had over five years of work experience. Most participants had no sleep problems (77.5%) and an average of five hours of sleep per night (57.7%). Among healthcare workers, 47.8% reported exercising 1-3 times per week, and 53.3% reported consuming three meals daily. The majority (83.5%) worked shifts of less than 12 hours, and 54.9% had a body mass index (BMI) within the normal range.

Table 2: Sociodemographic characteristics of healthcare workers

Sociodemographic Characteristics	Frequency (n)	Percentage (%)
Department		
Clinical	**123**	**67.6**
Clinical Support	30	16.5
Non-Clinical	29	15.9
Job Profession		
Nursing	**86**	**47.3**
Allied Health	46	25.3
Administration and Operations	50	27.5
Gender		
Male	38	20.9
Female	**144**	**79.1**
Age		
<30 Years Old	77	42.3
30-40 Years Old	**78**	**42.9**
>40 Years Old	27	14.8
Educational Level		
Higher Secondary School	32	17.6
Diploma	**96**	**52.7**
Degree	34	18.7
Postgraduate	20	11.0
Marital Status		
Married	**126**	**69.2**
Single/Divorce/Widow	56	30.8
Years of Working Experience		
>6 Months - <1 Year	17	9.3
1-5 Years	43	23.6
>5 Years	**122**	**67.0**
Sleep Problems		
Yes	41	22.5
No	**141**	**77.5**
Sleep Hours Per Day		
5 Hours	**105**	**57.7**
More than 7 Hours	76	41.8
Less than 3 Hours	1	0.5
Exercise Frequency in a Week		
Never	77	42.3
1-3 Times Per Week	**87**	**47.8**
More than 3 Times Per Week	18	9.9
Meals Per Day		
1	3	1.6
2	68	37.4
3	**97**	**53.3**
4	11	6.0
5	3	1.6
Common Shift Length		
Less than 12 Hours	**152**	**83.5**
More than 12 Hours	30	16.5
General Health		
Good	**143**	**67.6**
Excellent	42	23.1

Fair/Poor	17	9.3
Body Mass Index (BMI)		
Underweight	0	0.0
Normal	**100**	**54.9**
Overweight	62	34.1
Obese	20	11.0

Note: Highlighted in bold is the highest frequency of the sociodemographic characteristics recorded

Occupational-Related Fatigue Levels

Chronic Fatigue

In assessing chronic fatigue (Table 3), approximately 39% of respondents expressed neutrality regarding feelings of being "*at the end of my rope*" with work. Neutral responses were also prevalent for statements such as "*I often dread waking up to another day of work*" (35.2%) and "*Too much is expected of me at work*" (32.4%).

Acute Fatigue

For acute fatigue (Table 4), 26.9% agreed with the statement, "*After a typical work period I have little energy left*" while 28.6% somewhat agreed with "*I usually feel exhausted when I get home from work*" Neutral responses dominated for other items, including "*My work drains my energy completely every day*" (29.7%).

Intershift Recovery

Intershift recovery (Table 5) responses showed a trend towards neutrality: 34.1% felt neutral about lacking recovery time, and 36.8% felt refreshed for the next shift.

Table 3: Distribution of responses on chronic fatigue statements among healthcare workers

Statements	Strongly Disagree (%)	Disagree (%)	Somewhat Disagree (%)	Neutral (%)	Somewhat Agree (%)	Agree (%)	Strongly Agree (%)
I often feel 'at the end of my rope' with my work	16(8.8)	17(9.3)	8(4.4)	**71(39.0)**	44(24.2)	17(9.3)	9(4.9)
I often dread waking up to another day of my work.	20(11.0)	27(14.8)	9(4.9)	**64(35.2)**	31(17.0)	20(11.0)	11(6.0)
I often wonder how long I can keep going at my work.	14(7.7)	15(8.2)	11(6.0)	**59(32.4)**	46(25.3)	27(14.8)	10(5.5)
I feel that most of the time I'm "living to work".	9(4.9)	23(12.6)	9(4.9)	**58(31.9)**	37(20.3)	36(19.8)	10(5.5)
Too much is expected of me at work.	8(4.4)	14(7.7)	13(7.1)	**59(32.4)**	41(22.5)	36(19.8)	11(6.0)

Note: Highlighted in bold is the highest frequency recorded

Table 4: Distribution of responses on acute fatigue statements among healthcare workers

Statements	Strongly Disagree (%)	Disagree (%)	Somewhat Disagree (%)	Neutral (%)	Somewhat Agree (%)	Agree (%)	Strongly Agree (%)
After a typical work period I have little energy left	6(3.3)	14(7.7)	17(9.3)	46(25.3)	35(19.2)	**49(26.9)**	15(8.2)
I usually feel exhausted when I get home from work	6(3.3)	9(4.9)	11(6.0)	40(22.0)	**52(28.6)**	38(20.9)	26(14.3)
My work drains my energy completely every day.	10(5.5)	22(12.1)	18(9.9)	**54(29.7)**	37(20.3)	21(11.5)	20(11.0)
I usually have lots of energy to give my family or friends.	15(8.2)	37(20.3)	48(26.4)	**64(35.2)**	9(4.9)	6(3.3)	3(1.6)
I usually have plenty of energy left for my hobbies and other activities after I finish work.	12(6.6)	33(18.1)	49(26.9)	**57(31.3)**	16(8.8)	10(5.5)	5(2.7)

Note: Highlighted in bold is the highest frequency recorded

Table 5: Distribution of responses on intershift recovery statements among healthcare workers

Statements	Strongly Disagree (%)	Disagree (%)	Somewhat Disagree (%)	Neutral (%)	Somewhat Agree (%)	Agree (%)	Strongly Agree (%)
I never have enough time between work shifts to recover my energy completely	13(7.1)	20(11.0)	43(23.6)	**62(34.1)**	15(8.2)	23(12.6)	6(3.3)
Even if I'm tired from one shift, I'm usually refreshed by the start of the next shift.	9(4.9)	7(3.8)	7(3.8)	**67(36.8)**	58(31.9)	26(14.3)	8(4.4)
I rarely recover my strength fully between work shifts.	7(3.8)	20(11.0)	46(25.3)	**68(37.4)**	19(10.4)	17(9.3)	5(2.7)
Recovering from work shifts isn't a problem for me.	5(2.7)	11(6.0)	18(9.9)	**73(40.1)**	49(26.9)	22(12.2)	4(2.2)
I'm often still feeling fatigued from one shift by the time I start a new one.	9(4.9)	28(15.4)	56(30.8)	**57(31.3)**	13(7.1)	13(7.1)	6(3.3)

Note: Highlighted in bold is the highest frequency recorded

Level of Chronic Fatigue, Acute Fatigue and Intershift Recovery Among Healthcare Workers

Table 6 summarises the levels of fatigue and recovery among healthcare workers:

a) Chronic Fatigue: Moderate to high levels were reported by 38.5%.
b) Acute Fatigue: Low to moderate levels were observed in 43.4%.
c) Intershift Recovery: Low to moderate recovery levels were noted in 65.4%.

Table 6: Category of Occupational Fatigue Exhaustion/ Recovery scale among healthcare workers

Category	Frequency (n)	Percentage (%)
Chronic fatigue		
Low	24	13.2
Low/Moderate	64	35.2
Moderate/High	**70**	**38.5**
High	24	13.2
Acute fatigue		
Low	11	6.0
Low/Moderate	**79**	**43.4**
Moderate/High	78	42.9
High	14	7.7
Intershift recovery		
Low	6	3.3
Low/Moderate	**119**	**65.4**
Moderate/High	49	26.9
High	8	4.4

Note: Highlighted in bold is the highest frequency recorded

Correlation Between Chronic Fatigue, Acute Fatigue and Intershift Recovery of Occupational-Related Fatigue Among Healthcare Workers

Pearson correlation analysis revealed significant relationships among chronic fatigue, acute fatigue, and intershift recovery (Figures 1, 2, and 3):

a) A positive correlation between chronic and acute fatigue ($r = +0.553$, $p<0.001$).
b) Negative correlations between chronic fatigue and intershift recovery ($r = -0.511$, $p<0.001$) and between acute fatigue and intershift recovery ($r = -0.437$, $p<0.001$).

Associations with Sociodemographic Factors

Department

The Kruskal-Wallis test (Table 7) showed no significant association between department types and chronic fatigue scores ($p=0.531$). However, significant associations were found for acute fatigue scores ($p=0.034$) and intershift recovery scores ($p=0.001$), with *post-hoc* tests revealing significant differences between clinical support and non-clinical staff.

Post-hoc tests (Table 8) found significant associations for acute fatigue scores between Clinical and Clinical Support ($p=0.014$), and Clinical Support vs. Non-Clinical ($p=0.035$). For intershift recovery scores, significant associations were found between Clinical and Clinical Support ($p<0.001$), and Clinical and Non-Clinical ($p<0.001$).

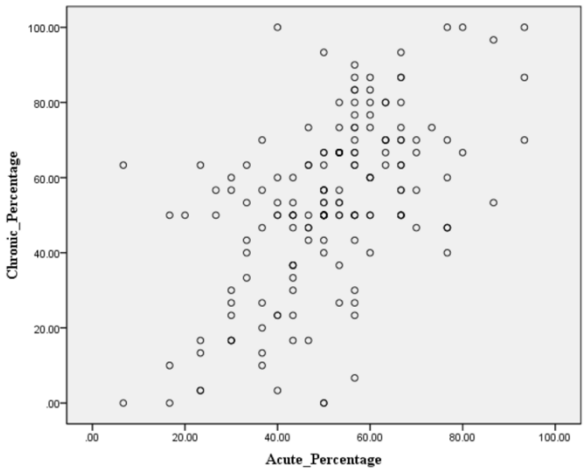

Figure 1: Scatter plot of chronic fatigue and acute fatigue

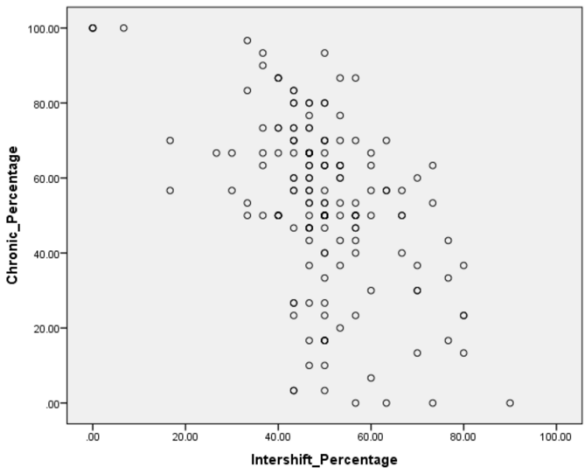

Figure 2: Scatter plot of chronic fatigue and intershift recovery score

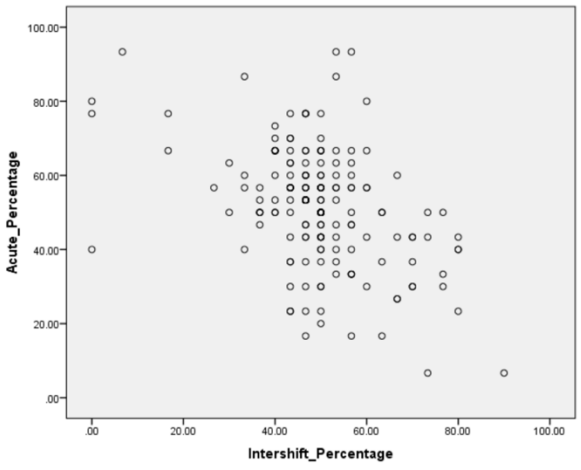

Figure 3: Scatter plot of acute fatigue score and intershift recovery score

Job profession

ANOVA results (Table 9) showed significant associations between job profession and chronic fatigue (p=0.003) and intershift recovery *(p*=0.034), but not acute fatigue (*p*=0.487). Allied Health professionals reported the highest chronic fatigue levels.

Table 7: Association between different types of departments with chronic fatigue, acute fatigue and intershift recovery scores (n= 182)

Variable	Department	n	Median	IQR	*p*-value
Chronic fatigue	Clinical	123	53.33	26.67	0.531
	Clinical Support	30	56.67	13.33	
	Non-Clinical	29	50.00	23.33	
Acute fatigue	Clinical	123	53.33	20.00	***0.034**
	Clinical Support	30	43.33	21.67	
	Non-Clinical	29	53.33	6.67	
Intershift recovery	Clinical	123	46.67	6.67	
	Clinical Support	30	55.00	17.50	****0.001**
	Non-Clinical	29	50.00	6.67	

** Significant in <0.05, ** Significant in <0.001*

Table 8: Multiple comparison of acute fatigue and intershift recovery score between different types of departments

Variable	Departments		*p*-value
Acute fatigue score	Clinical	Clinical support	**0.014**
		Non-Clinical	0.548
	Non-Clinical	Clinical support	**0.035**
Intershift recovery score	Clinical	Clinical support	****0.001**
		Non-Clinical	****0.001**
	Non-Clinical	Clinical support	0.530

** Significant in <0.05, ** Significant in <0.001*

Post-hoc analysis (Table 10) showed significant chronic fatigue differences between Nursing and Allied Health (*p*=0.037), and Allied Health versus Administration and Operations (*p*=0.003), with Allied Health reporting greater chronic fatigue. The lowest intershift recovery *p*-value was Nursing versus Administration and Operations (*p*=0.054).

Table 10: Multiple comparison (Post Hoc) of chronic fatigue and intershift recovery score between different types of job profession

Variables	Job professions		*p*-value
Chronic fatigue score	Nursing	Allied Health	***0.037**
		Administration and Operation	
	Administration and Operation	Allied Health	
Intershift recovery score	Nursing	Allied Health	1.000
		Administration and Operation	
	Administration and Operation	Allied Health	

** Significant in <0.05*

Table 9: Association between different types of job profession with acute fatigue score (n= 182)

Variable	Job Profession	n	Mean	SD	*p*-value
Chronic fatigue score	Nursing	86	52.17	21.16	****0.003**
	Allied Health	46	62.10	20.36	
	Administration and Operation	50	47.20	23.21	
Acute fatigue score	Nursing	86	52.98	15.06	**0.487**
	Allied Health	46	50.65	19.21	
	Administration and Operation	50	49.87	12.97	
Intershift recovery score	Nursing	86	48.06	10.79	**0.034**
	Allied Health	46	47.68	17.58	
	Administration and Operation	50	53.60	11.60	

*SD = standard deviation, ** Significant in <0.001*

Table 11: Comparison of chronic fatigue, acute fatigue and intershift recovery score between gender of healthcare workers (n= 182)

Variable	Male (n= 38)		Female (n= 144)		Mean differences (95% CI)	*p-value*
	Mean	SD	Mean	SD		
Chronic fatigue	49.56	18.51	54.31	22.95	-4.74 (-12.69,3.21)	0.241
Acute Fatigue	46.84	17.24	52.78	15.06	-5.94 (-11.52, -0.35)	***0.038**
Intershift Recovery	52.11	9.25	48.79	14.01	3.31 (-1.43,8.05)	0.170

*SD = standard deviation, * Significant in <0.05*

Gender

Independent t-tests (Table 11) indicated a significant association between gender and acute fatigue (p=0.038), with females experiencing higher levels compared to males.

Age

Significant differences (Table 12) were found across age groups for chronic fatigue (*p*=0.001), acute fatigue (p= 0.021), and intershift recovery (*p*=0.022). Workers under age 30 reported higher levels of chronic and acute fatigue.

Mann-Whitney *post-hoc* analysis indicated significant age-related differences in fatigue levels (Table 13). For chronic fatigue, significant pairs were: <30 vs. 30-40 years (*p*=0.043), <30 vs. >40 years (*p*<0.001), and 30-40 vs. >40 years (*p*=0.020). For acute fatigue, a significant difference was found between <30 and 30-40 years (*p*=0.011). In intershift recovery, significant pairs were <30 vs. >40 years (*p*=0.007) and 30-40 vs. >40 years (*p*=0.003).

Table 12: Association between age with chronic fatigue, acute fatigue and intershift recovery score

Variables	Age	n	Median	IQR	*p*-value
Chronic fatigue	<30	77	60.00	23.33	****0.001**
	30-40	78	50.99	17.50	
	>40	27	43.33	53.33	
Acute fatigue	<30	77	56.67	16.67	***0.021**
	30-40	78	50.00	14.17	
	>40	27	50.00	23.33	
Intershift recovery	<30	77	46.67	10.00	***0.022**
	30-40	78	50.00	7.50	
	>40	27	50.00	20.00	

** Significant in <0.05, ** Significant in <0.001*

Marital status

Marital status (Table 14) was significantly associated with chronic fatigue (*p*=0.030), with single or divorced workers reporting higher levels compared to married individuals.

Table 13: Multiple comparison (*Post Hoc*) of chronic fatigue, acute fatigue and intershift recovery score (Age)

Variable	Ages		*p*-value
Chronic fatigue	<30	30-40	***0.043**
		>40	****0.001**
	30-40	>40	***0.020**
Acute fatigue	<30	30-40	***0.011**
		>40	0.052
	30-40	>40	0.596
Inteshift recovery	<30	30-40	0.322
		>40	****0.007**
	30-40	>40	***0.033**

** Significant in <0.05, ** Significant in <0.001*

Table 16: Association between general health with chronic fatigue, acute fatigue and intershift recovery score (n= 182)

Variables	General Health	n	Median	IQR	*p*-value
Chronic fatigue	Excellent	42	50.00	26.67	***0.003**
	Good	123	53.33	23.33	
	Poor/Fair	17	63.33	35.00	
Acute fatigue	Excellent	42	50.00	20.83	***0.041**
	Good	123	53.33	16.67	
	Poor/Fair	17	56.67	35.00	
Intershift recovery	Excellent	42	50.00	10.00	***0.035**
	Good	123	50.00	10.00	
	Poor/Fair	17	43.33	25.00	

** Significant in <0.05*

Table 14: Association between marital status with chronic fatigue, acute fatigue and intershift recovery score (n= 182)

Variable	Single/Divorce/Widow (n= 56)		Married		(95% CI)	*p*-value
	Mean	SD	Mean	SD		
Chronic Fatigue	58.63	20.08	50.95	22.67	7.68 (0.74, 14.62)	***0.030**
Acute Fatigue	51.73	14.11	51.46	16.38	0.27 (-4.71, 5.25)	0.915
Intershift recovery	48.27	13.33	50.03	13.17	-1.75 (-5.94, 2.44)	0.410

*SD = standard deviation, * Significant in <0.05*

Table 15: Comparison of chronic fatigue, acute fatigue and intershift recovery score regarding sleep problem of healthcare workers (n= 182)

Variable	Yes (n= 41)		No (n= 141)		Mean differences (95% CI)	*p*-value
	Mean	SD	Mean	SD		
Chronic fatigue	64.63	16.49	50.02	22.51	14.61 (7.14,22.08)	****0.001**
Acute Fatigue	16.41	2.56	49.91	15.13	7.25 (1.85,12.65)	***0.009**
Intershift Recovery	44.15	9.85	51.04	13.68	-6.89 (-11.42,-2.37)	***0.003**

Note. SD: standard deviation, CI: confidence interval, Significant in <0.05, ** Significant in <0.001*

Sleep problem

Significant associations (Table 15) were found for chronic fatigue (*p*=0.001), acute fatigue (*p*=0.009), and intershift recovery (*p*=0.003). Workers with sleep problems reported higher chronic fatigue but lower acute fatigue.

General health

Statistically significant differences (Table 16) were found for chronic fatigue (*p*=0.003), acute fatigue (p=0.041), and intershift recovery (*p*=0.035), indicating that those in excellent health experienced lower fatigue levels.

Post-hoc Mann-Whitney tests (Table 17) found chronic fatigue differences between excellent and fair/poor health (p=0.001), and good and fair/poor (p=0.009). For acute fatigue, significant pairs were excellent and good (p=0.042), excellent and fair/poor (p=0.031). For intershift recovery, significant differences were excellent and fair/poor (p=0.014), good and fair/poor (p=0.036).

Table 17: Multiple comparison (*Post Hoc*) of chronic fatigue, acute fatigue and intershift recovery score (n= 182)

Variables	General Health		*p*-value
Chronic fatigue	Excellent	Good	0.098
		Fair/Poor	****0.001**
	Fair/Poor	Good	***0.009**
Acute fatigue	Excellent	Good	***0.042**
		Fair/Poor	***0.031**
	Fair/Poor	Good	0.227
Intershift recovery	Excellent	Good	0.222
		Fair/Poor	***0.014**
	Fair/Poor	Good	***0.036**

** Significant in <0.05, ** Significant in <0.001*

DISCUSSIONS

Level of Chronic Fatigue, Acute Fatigue, and Intershift Recovery

The study conducted in a private hospital in Kuantan indicates that healthcare workers experience moderate to high levels of chronic and acute fatigue, accompanied by low to moderate levels of intershift recovery. This pattern aligns with findings from Alsayed *et al.* (2022) and Mohd Fauzi *et al.* (2020), who reported similar fatigue levels among healthcare professionals. Notably, chronic fatigue levels surpassed acute fatigue, contrasting with previous research indicating an inverse relationship (Alsayed *et al.,* 2022; Ismail et al., 2021).The elevated fatigue levels may be due to inadequate intershift recovery, essential for preventing fatigue accumulation. Contributing factors include staffing, workload, psychosocial influences like leadership and motivation, and personal factors such as gender and health conditions. Research by Cai *et al.* (2023) highlights the progression of untreated acute fatigue into chronic fatigue, underscoring the need for effective recovery protocols.

Correlation Between Chronic Fatigue, Acute Fatigue, and Intershift Recovery

This study reveals insights into the relationship between intershift recovery and fatigue among healthcare workers. Moderate negative correlations between intershift recovery and both chronic fatigue and acute fatigue suggest that elevated fatigue levels hinder effective recovery. This aligns with Alsayed *et al.* (2022), emphasising the role of recovery in mitigating fatigue. Additionally, the moderate positive correlation between chronic and acute fatigue raises concerns about the potential progression of acute fatigue into chronic fatigue if not addressed promptly. This notion is supported by previous research from Winwood *et al.* (2005), Sagherian *et al.* (2016), and Min *et al.* (2021), highlighting the necessity for early intervention.

Work-Related Factors Associated with Chronic Fatigue, Acute Fatigue, and Intershift Recovery

The study highlights that healthcare workers in clinical departments experience significantly higher levels of acute fatigue compared to those in support roles. Key factors contributing to this include job stress, workload, and patient-facing responsibilities, as noted by Han *et al.* (2014). This finding aligns with Ross *et al.* (2021), who observed greater fatigue levels among nurses than those engaged in indirect care roles. Moreover, Allied health professionals reported higher chronic fatigue than nurses and non-clinical staff due to the physical demands associated with patient handling. Clinical staff in high-demand environments often face limited opportunities for intershift recovery, exacerbating their fatigue levels.

Individual-Related Factors Associated with Chronic Fatigue, Acute Fatigue, and Intershift Recovery

The study identifies significant associations between occupational fatigue and factors such as age, sleep quality, marital status, gender, and general health. Notably, younger healthcare workers reported higher levels of fatigue and poorer recovery compared to older colleagues, suggesting they may be more susceptible to greater physical workloads. Poor sleep quality emerged as a critical factor among high-acuity staff working irregular hours who experienced notably higher fatigue levels. Additionally, single or divorced workers reported increased fatigue while married women—especially those with family responsibilities—faced heightened fatigue levels. Data revealed that female workers generally reported more acute fatigue than males; interestingly, those in excellent health exhibited lower fatigue levels and better recovery outcomes due to greater energy reserves to meet job demands.

Limitations

This study acknowledges several methodological considerations that require careful interpretation of the findings. First, the sampling approach utilised a convenience sampling method, which potentially introduces selection bias. This non-probabilistic sampling technique means participants were selected based on accessibility rather than through a randomised process, potentially limiting the sample's representativeness of the broader healthcare worker population.

The questionnaire's administration exclusively in English

might have presented significant language-related challenges for participants from diverse linguistic backgrounds. Non-native English speakers may have experienced difficulties in fully comprehending complex questions, potentially leading to misinterpretation of survey items or incomplete responses. This linguistic barrier could compromise the accuracy and depth of data collected, particularly in a multicultural healthcare environment.

Moreover, the sample composition reveals certain variations in professional representation, which could significantly influence the comprehensive understanding of findings across different healthcare roles. Specifically, the uneven distribution of participants from various healthcare professions may introduce sampling bias, potentially overemphasizing the perspectives of certain job roles while understating others.

These methodological implications underscore the importance of considering contextual factors when interpreting the study's outcomes. Future research should address these limitations by implementing more diverse sampling strategies, providing multilingual survey options, and ensuring a more balanced representation of healthcare professionals.

CONCLUSION

This study highlights significant levels of chronic and acute fatigue among healthcare workers at a private hospital in Kuantan, with inadequate intershift recovery exacerbating these issues. Factors such as job roles, age, gender, and sleep quality were found to influence fatigue experiences, with younger workers and females reporting higher levels of fatigue. Addressing these challenges is crucial for enhancing worker well-being and ensuring safe patient care. Future research should explore the long-term impacts of fatigue and recovery practices in this population.

ACKNOWLEDGEMENT

This research was not funded by any grant.

REFERENCES

Abdalgeleel, S.A., Moneer, M.M., Refaee, A.S. *et al.* Depression and fatigue among Egyptian health care workers: cross-sectional survey. *J Public Health (Berl.)* **32**, 2153–2162 (2024). https://doi.org/10.1007/s10389-023-01974-6

Alsayed, S. A., Abou Hashish, E. A., & Alshammari, F. (2022). Occupational Fatigue and Associated Factors among Saudi Nurses Working 8-Hour Shifts at Public Hospitals. *SAGE Open Nursing*, *8*, 237796082210781. https://doi.org/10.1177/23779608221078158

Cai, X., Li, G., Feng, H., Wang, X., He, L., Luo, D., … & Qiu, S. (2023). Association of perceived stress with depression among vaccinated healthcare workers during the sars-cov-2 variant outbreak: the mediating role of compassion fatigue. Psychiatry Investigation, 20(4), 307-314. https://doi.org/10.30773/pi.2022.0238

Charan, J., & Biswas, T. (2013). How to calculate sample size for different study designs in medical research? *Indian Journal of Psychological Medicine*, *35*(2), 121. https://doi.org/10.4103/0253-7176.116232

Etikan, İ., Musa, S. A., & Alkassim, R. S. (2016). Comparison of convenience sampling and purposive sampling. American Journal of Theoretical and Applied Statistics, 5(1), 1. https://doi.org/10.11648/j.ajtas.20160501.11

Han K, Trinkoff AM, Geiger-Brown J. Factors associated with work-related fatigue and recovery in hospital nurses working 12-hour shifts. Workplace Health Saf. 2014 Oct;62(10):409-14. doi: 10.3928/21650799-20140826-01. Epub 2014 Sep 3. PMID: 25199168.

Ismail, K., Al-Masaeed, M., Alsababha, R., Alomari, A., & Alqudah, M. (2021). An Investigation of Work-Related Fatigue Levels and Related Factors among Emergency Nurses: A Primary Quantitative Study. *International Journal of Research in Nursing*, *12*(1), 3–10. https://doi.org/10.3844/ijrnsp.2021.3.10

Min, A., Hong, H. C., & Kim, Y. M. (2021). Work schedule characteristics and occupational fatigue/recovery among rotating-shift nurses: a cross-sectional study. Journal of Nursing Management, 30(2), 463-472. https://doi.org/10.1111/jonm.13511

Mohd Fauzi MF, Mohd Yusoff H, Mat Saruan NA, et al. Fatigue and recovery among Malaysian doctors: the role of work-related activities during non-work time. BMJ Open 2020;**10**:e036849. doi: 10.1136/ bmjopen-2020-036849

Patterson, P. D., Buysse, D. J., Weaver, M. D., Suffoletto, B. P., McManigle, K. L., Callaway, C. W., & Yealy, D. M. (2014). Emergency healthcare worker sleep, fatigue, & alertness behaviour survey (SFAB): Development and content validation of a survey tool. *Accident; Analysis and Prevention, 0,* 399-411. https://doi.org/10.1111/nhs.12777

Ross, A., Geiger-Brown, J., Yang, L., Flynn, S., Cox, R., Wehrlen, L., & Lee, L. J. (2021). Acute and chronic fatigue in nurses providing direct patient care and in non-direct care69 roles: A cross-sectional analysis. *Nursing & Health Sciences*, *23*(3), 628–638. https://doi.org/10.1111/nhs.12862

Sagherian, K., Clinton, M., Huijer, H. A., & Geiger-Brown, J. (2016). Fatigue, work schedules, and perceived performance in bedside care nurses. Workplace Health

&Amp; Safety, 65(7), 304-312. https://doi.org/10.1177/2165079916665398

Winwood, P. C., Winefield, A. H., Dawson, D., & Lushington, K. (2005). Development and Validation of a Scale to Measure Work-Related Fatigue and Recovery: The Occupational Fatigue Exhaustion/Recovery Scale (OFER). *Journal of Occupational and Environmental Medicine*, *47*(6), 594–606. https://www.jstor.org/stable/45009206