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An Investigation of Fatigue among Jordanian Nurses Measured Using the FAS: A Primary Quantitative Study

Mahmoud Al-Masaeed[1*], Anthony Paul O'Brien[1], Muhammad Alqudah[1], Michelle Guilhermino[1] and Irniza Binti Rasdi[2]

[1]College of Health, Medicine and Wellbeing, University of Newcastle, Callaghan, Newcastle, Australia

[2]Faculty of Medicine and Health Sciences, University of Putra Malaysia, Serdang, Selangor, Malaysia

**Corresponding e-mail: Mahmoud.almasaeed@uon.edu.au*

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ABSTRACT

Significance and Aim: *This study aims to investigate the levels of physical and mental fatigue among Jordanian nurses. This is in a bid to understand the effectiveness of the existing fatigue mitigation and coping strategies. The obtained findings are valuable in informing future fatigue management and coping strategies formulation by the Jordanian Ministry of Health.* ***Methods:*** *The study was conducted through the collection of primary quantitative data. The data was collected through a closed-ended questionnaire distributed online through the REDCap platform and based on the Fatigue Assessment Scale (FAS) fatigue measurement tool. A random sampling strategy was used with the target population on two leading Jordanian hospitals; the Jordan University Hospital (JUH) and King Abdullah University Hospital (KAUH). A total of 517 respondents were used in this study.* ***Findings:*** *The findings were developed based on the FAS tool scoring manual. Findings indicate substantial fatigue levels for physical fatigue (33.62) and mental fatigue (22.59). The analysis indicates a significant relationship between physical fatigue and the nurses' age (-0.182) and the nurses' monthly income (-0.167). Finally, there exists a relationship between mental fatigue and age (-0.263) and years of experience (-0.237).* ***Conclusion:*** *The findings indicate that the physical and mental fatigue levels remain substantial. This means that there is a need to institute fatigue coping strategies by the respective hospitals and the Jordan ministry of health. For managing physical and mental fatigue among Jordanians should address the nurses' monthly income and enhance nurses' work experience and coping strategies.*

Keywords: Fatigue, Nurses, FAS, Coping

INTRODUCTION

Nurses are a crucial part of the delivery of quality healthcare services. They provide a crucial link and connection between the healthcare professionals and industry and the patients [1,2]. Thus, whenever the nurses cannot function at their optimum, the quality of healthcare services delivered is negatively affected. This is in the case of the exhausted nurse. Existing studies indicate that fatigued nurses have lower empathy, lower ability to deliver on their responsibilities, and an increased risk of medical errors. One of the tools used in assessing and measuring nursing fatigue is the Fatigue Assessment Scale (FAS) tool [3,4]. The FAS model analyses fatigue manifestation in two main levels: physical and mental fatigue. For nurses, physical fatigue is an inability to perform their physical duties such as moving equipment and physically caring for patients [5]. Physical fatigue is demonstrated by the presence of tiredness and muscles inability to function, the lack of enough energy, feeling exhausted easily, and having a general exhaustion

feeling. The long-term complications and implications include deteriorating health and reduced functionality and duties execution capabilities by the nurses [6-8].

One of the aspects and demonstrations of mental fatigue is a failure in concentration. The nurses cannot focus on delivering quality care to the patients for a more extended period. They are often distracted and, as such, impact the quality of care offered. Instances reported as demonstrating high mental fatigue prevalence are the decline in alarm response rates among nurses [9]. This is a result of alarm fatigue and lack of concentration among the nurses. Mental fatigue is further manifested through a lack of motivation and drive by the nurses. As a profession, the nursing profession is based on delivering care. Although training and education equip the nurses with the skills to deliver care, empathy and compassion are self-driven and require a positive individual attitude to deliver [5]. A high mental fatigue index is considerably associated with a decline in work drive and intrinsic motivation. This leads to low compassion empathy, lowering the quality of care provided [6-8].

A preliminary analysis of the existing literature indicates minimal focus in the Middle East countries and Jordan. This creates a literature gap and the need to evaluate if nurse fatigue is prevalent in Jordan and compares it with other countries and regions globally. This informed the study's development in the Jordanian context.

Aim

This study aims to establish the levels of physical and mental fatigue among Jordanian nurses and the influencing nurses' socio-demographic factors. In addressing the study aim, the study adopted the following specific objectives;

- To examine the level of physical fatigue among Jordanian nurses
- To examine the level of mental fatigue among Jordanian nurses
- To examine the relationship between Jordanian nurse socio-demographic factors on the physical and mental fatigue levels

METHODS

The study was based on the existing literature gap in the Jordan context. Thus, it relied on the use and collection of primary data. The study focused on establishing the prevailing fatigue levels among Jordanian nurses and how the nurses' demographic factors (age, gender, and the number of dependents, education level, weekly working hours, smoking and drinking patterns, marital status, earning level, and worked shifts) influenced and impacted on the fatigue levels. This meant establishing a relationship between the independent variables (nurses' socio-demographic variables) and the dependent variables (physical and mental fatigue). This necessitated the study adoption of a quantitative study design, thus collecting primary quantitative data [10,11]. The data collection process occurred in 2020, amidst the Covid-19 pandemic spread both in Jordan and globally. Thus, there was the need for the researcher to institute proper protective measures hence the use of the REDCap online platform as the avenue for its distribution of the study questionnaire [12]. The sample base was selected randomly through a simple random sampling probability-based strategy on nurses working in two leading hospitals in Jordan; KAUH and JUH, respectively. The study inclusion criteria were that the nurses had to be actively working in the selected hospitals (KAUH and JUH) and be Registered Nurses (RN) by the Jordan Nurses and Midwives Council (JNMC). Also, they need to have working experience as RN nurses for at least one year. The exclusion criteria were applied for the nurse who was on leave for more than six months (either medical or educational related off work leave). Also, those working on internships and with less than one year of working experience as RN nurses were excluded.

A sample base of 517 respondents was selected and used from an allowed minimum of 350 respondents threshold. The target sample was based on the Cohens Kappa coefficient analysis. Based on the formulae, a minimum sample size, a sample size of 350 eligible consenting participants was required. This ensured the study had 80% of the power to detect a relevant statistical difference between males and females at 0.3 standard deviations (i.e. a moderate effect size in terms of Cohen's coefficient, with a type 1 error rate of 5% using a two-sided two-sample equal-variance t-test, calculated using the sampis function in Stata, "sampsi 1 1.3, SD (1) power (0.8) alpha (0.05)". Assuming there were 1300 eligible nurses, a consent rate of ~25% was required to achieve the desired sample size. Thus, the study was developed based on a minimum threshold of 350 participants. However, it was permissible for the study to have a larger sample base. In addition, the study questionnaire was developed based on the FAS tool. The researcher used a

flyer that was distributed to the respective hospital management. The management then distributed the flyer through the respective hospitals' social media platforms for the nurses such as the hospital nurses' Whats App group and the hospitals' official Facebook pages. Those interested accessed the study through the provided URL link.

The FAS tool has a set of 10 questions developed through the 5 points Likert scale. The first set of five questions, 1-5, measures physical fatigue, and the following five questions, 6-10, measure mental fatigue. The merits of adopting the fatigue measurement tool over others are derivation and combination of the set-out questions with other existing models. For instance, it draws heavily from the WHOQOL, the Checklist Individual Strength (CIS), and the Fatigue Scale (FS), respectively [11,12]. Drawing from the different fatigue assessment models ensures that the FAS model is a comprehensive tool for analyzing the physical and mental fatigue aspects. Although not traditionally designed to target the nursing profession, its adoption has been adapted to analyze and measure nursing fatigue (physical and mental) among nurses over the years. This makes its adaptation and use in the study feasible and theoretically grounded.

The tool relies on the (physical and mental) fatigue were analyzed based on the FAS manual and guidelines. A higher score for the physical and mental fatigue types illustrated a higher fatigue level. In the FAS manual, as illustrated in the formulae below, the fatigue levels are analyzed on a scale of 0 to 50, with 50 indicating the highest fatigue level. In calculating the individual types of fatigue, namely physical and mental fatigue, the analysis multiplied the score by two to have a scale of a minimum of 10 and a maximum of 50. The FAS scale analyses the fatigue scores by combining all the variables of the fatigue scale to get the total score with a maximum of 50. For the subscales, including physical and mental fatigue, the totals are calculated, and the findings are multiplied by two to get the scores, as illustrated in the table below. In aligning and categorizing the fatigue levels, the filling guidelines from the FAS instrument use guidelines and materials manual were adopted.

- **In summary**

FAS scores 10-21: No fatigue (normal)

FAS scores 22-50: Substantial fatigue

- **2 subgroups**

Fatigue: scores 22-34

Extreme fatigue: scores ≥ 35

A finding of a score below 21 means that the fatigue levels are not significant and that the exiting coping strategies have been effective. This is in contrast to a finding of between 22 to 34 that shows that fatigue prevails among the nurses. This necessitates the need for changing the existing fatigue coping strategies. Finally, a score of between 35 to 50 means the fatigue levels are high and pose the risk of the nurses experiencing the effects and consequences of high prevalent fatigue levels.

The final step was data analysis. The findings were analyzed statistically through an SPSS application, and the findings were presented graphically to enhance understanding.

The ethical approval was obtained from both the University of Newcastle (UoN) (Ref No. H-2020-0082) and the Universiti Putra Malaysia (UPM) (Ref No. JKEUPM-2020-306), Faculties of Medicine and Health Sciences (FMHS). Equally, approval by the KAUH and JUH hospitals was obtained through their respective Institutional Review Board (IRB).

RESULTS AND FINDINGS

Descriptive Analysis

The first step in the analysis was an examination of the nurse's fatigue levels based on the physical and mental fatigue levels. This was scored using the FAS tool scoring as illustrated in the above discussions in the methods section.

The findings in the analysis were as illustrated in Table 1.

Table 1 The scores of physical and mental fatigue based on the FAS tool

	Descriptive Statistics					
	N	**Min**	**Max**	**FAS Score**	**Level**	**Std. Deviation**
FAS (Physical fatigue)	517	10.00	50.00	33.6248	Substantial fatigue	7.46714
FAS (Mental fatigue)	517	10.00	50.00	29.5938	Substantial fatigue	9.23243
FAS Tool average	517	10.00	50.00	31.6093	Substantial fatigue	7.56023
Valid N (Listwise)	517					

From the above table findings, it is evident that physical fatigue had a 33.62 score while mental fatigue had a 29.59 score. Both fall in the category where the score is >22, meaning that there is substantial fatigue. Equally, they fall within the 22-34 sub-scale, meaning that the fatigue is significant but not extreme. The overall FAS fatigue score is 31 indicating substantial fatigue presence.

Relationship between Socio-demographical Variables and Work Characteristics Based on the FAS Tool

The analysis for the relationship between age, shift BC, monthly income, experience years, and the weekly working hours on the nurses' fatigue was analyzed through the Spearman rank while the relationship between the nurse's employment status and nurses' fatigue levels was analyzed through the point bi-serial correlation analysis. This was developed at a significance level (0.05). The findings below indicate the results for the variables with a significant correlation index.

Age significantly correlated with both the nurses' physical and mental fatigue levels. This was equally the same for monthly income levels. However, years of experience, weekly working hours, and Shift B only significantly affected the nurses' physical fatigue. Finally, the nurses' employment status had a significant correlation with the nurses' mental fatigue (Table 2).

Table 2 An analysis of the correlation between chronic, acute, and inter-shift recovery with nurses socio-demographic variables

Socio-Demographic Variable correlation to gender	**Physical Fatigue**		**Mental Fatigue**	
	r/r_{pb}	**p-value**	r/r_{pb}	**p-value**
Age	-0.212**	p<0.010	-0.190**	p<0.010
Shift BC	0.143**	p=0.010		
Monthly Income	-0.183**	p<0.010	-0.135**	p=0.002
Experience Years	-0.092*	p=0.037		
Employment Status			-0.097*	p=0.028
Weekly working hours	0.124**	p=0.050		
*: significant at p<0.05; **: Significant at p<0.02				

A key finding to note in the analysis is that gender had no relationship to either physical or mental fatigue. On age, there was a negative correlation with both types of fatigue. On physical fatigue, there was a weak correlation (r_{pb}= -0.212). As age increased, there was a decrease in the level of physical fatigue. Although the inverse would have been expected as a finding (age is associated with declining physical power and strength), the findings indicate that as the nurses' advance in age, especially in the Middle Ages, they learned to manage and cope with fatigue, thus reducing their fatigue exposure risks. This equally applies to the correlation between age and mental fatigue (r= -0.190).

The age variable and its relationship to physical and mental fatigue (negative correlation) present the years of working experience variable correlation to fatigue. The years of experience by the respondent nurses had a negative correlation to physical (r= -0.92) fatigue levels.

The third relationship variable was on working hours. The analysis indicated a positive correlation between the working hours and the levels of physical fatigue among Jordanian nurses (r=0.124). This implied that as the nurses worked for more working hours per week, their level of physical fatigue increased. The descriptive analysis indicated that the level of fatigue increased with extended working hours. This increased exponentially as the weekly working hours progressed to beyond 40 hours per week. Fourthly, there was a direct negative correlation between employment status and the nurses' mental fatigue levels. The biserial point correlation indicates that as nurses' employment status shifted from part-time to full-time employment, the level of mental fatigue reduced significantly.

An additional variable was the monthly income index. The variable indicated a negative correlation between monthly income on physical (r= -0.183) and mental (r= -0.135) fatigue types, respectively. This result suggests that those that had reasonable pay and earnings monthly mitigated and addressed both physical and mental fatigue more effectively than their peers who were paid less. A descriptive analysis is applicable in explaining the variables, using the Independent sample t-test to evaluate the mean comparisons between the primary category that was 0-500 JD and 500-800 JD. The findings are illustrated in the output Table 3 below.

Table 3 Nurses socio-demographic correlation analysis on FAS instrument

Group Statistics					
	Monthly Income	**N**	**Mean**	**Std. Deviation**	**Std. Error Mean**
Mental Fatigue-FAS	Less than 500 JD	94	3.1766	0.96514	0.09955
	From 500-800 JD	367	2.9439	0.90125	0.04704
Physical Fatigue-FAS	Less than 500 JD	94	3.5234	0.81655	0.08422
	From 500-800 JD	367	3.3853	0.72887	0.38050

From the statistical analysis, participants earning less than 500 JD registered a higher mean value on both mental and physical fatigue dimensions. The mean variances were mental fatigue (0.2327) and physical fatigue (0.13812). These results explain a negative correlation between monthly income and physical and mental fatigue levels. Finally, there was a positive correlation between working in the Shifts BC and nurses' physical fatigue (0.142). Unlike the other shifts with a lower number of hours, the shift BC, which comprises a 16 hours shift, directly impacted physical fatigue.

Regression Analysis

Physical fatigue: Findings from the correlation analysis indicate that the only variables that were found significantly correlated with physical fatigue were age, years of working experience, weekly working hours, monthly income, and working on the BC shifts, respectively. Multiple regression analyses were run to analyze the relationship between each of the above-mentioned independent variables with physical fatigue while accounting for the other independent variables. The findings were recorded and analyzed in Table 4.

Table 4 Nurses socio-demographic variables regression analysis on physical fatigue

Model	**Unstandardized Coefficients**		**Standardized Coefficients**	**t**	**Sig.**	**Collinearity Statistics**	
	B	**Std. Error**	**Beta**			**Tolerance**	**VIF**
1(Constant)	3.742	0.184	<0.01	20.355	p<0.010		
Age (years)?	-0.182	0.060	-0.170	-3.022	p=0.003	0.581	1.72
Experience years?	0.009	0.007	0.072	1.238	p=0.216	0.542	1.846
Weekly working hours?	0.005	0.003	0.075	1.705	p=0.089	0.961	1.041
Monthly income?	-0.167	0.070	-0.120	-2.396	p= -0.017	0.738	1.355
Shift BC 16 hours?	0.117	0.072	0.075	1.614	p=0.107	0.863	1.159
Dependent Variable: Physical Fatigue-FAS							

The adjusted R^2 value was 0.056 (5.6%). This meant that the dependent variables on shift BC weekly working hours and monthly income and age changes impacted the fatigue levels among Jordanian nurses. An ANOVA analysis demonstrated a significance value of $p<0.01$. This is a significant value below the set statistical confidence value of 0.05. As such, it meant that the regression and the relationship between the variables were significant. This led to the study evaluation of the actual regression dimensions.

A coefficient index analysis indicates that of all the variables, age ($p=0.003$), monthly income ($\beta=0.017$) are significantly correlated. However, the variables of experience years ($p=0.216$), weekly working hours ($p=0.089$), and working in shift BC ($p=0.107$) all were not statistically significant, as their significance value was below 95% confidence (0.05 significance level). Thus, in developing the regression equation for physical fatigue among Jordanian nurses, the variables were excluded. A collinearity analysis demonstrates that the collinearity value for all the statistically significant relationships was below 10, meaning no collinearity was detected. The following regression model was established.

- Physical fatigue among Jordanian Nurses=3.742-0.182 × age-0.167 × Monthly income

Mental fatigue: When evaluating the variables with a relationship and impact on mental fatigue, a preliminary correlation analysis demonstrated that the variables with a significant influence were age, years of experience, employment status, and income levels, respectively. These were the variables used in developing the study's multivariate regression analysis. A collinearity analysis was also developed. The findings were recorded and analyzed below (Table 5).

Table 5 Nurses socio-demographic variables relationship to nurses mental fatigue levels

Model Summary				
Model	**R**	**R^2**	**Adjusted R^2**	**Std. the error of the Estimate**
1	0.230[a]	0.053	0.046	0.90195
[a]: Predictors: (Constant), What is your current employment status?, age (years)? , Monthly Income?, How many years of experience do you have in current work area?				

The adjusted R^2 value was 0.046 (4.6%). This meant that the predictor value was significant, implying that a change in the dependent variables impacted the independent variable on fatigue. An ANOVA analysis demonstrated a significance value of $p<0.01$. This is a significant value below the set statistical confidence value of 0.05. As such, it meant that the regression and the relationship between the variables were significant. This led to the study evaluation of the actual regression dimensions.

Table 6 Nurses socio-demographic variables relationship to nurses mental fatigue Levels

Coefficient[a]							
Model	**Understand Coefficients**		**Standardized Coefficients**	**t**	**Sig**	**Collinearity Statistics**	
	B	**Std. Error**	**Beta**			**Tolerance**	**VIF**
Constant	4.122	0.269		>0.001	p>0.001		
Age (Years)?	-0.263	0.074	-0.200	-3.564	p>0.001	0.585	1.710
Years of experience?	0.009	0.008	0.059	1.031	p=0.303	0.560	1.787
Monthly income?	-0.130	0.086	-0.075	-1.506	p=0.133	0.740	1.351
Employment status?	-0.237	0.106	-0.097	-2.239	p=0.026	0.995	1.005
[a]: Dependent Variable: Mental Fatigue. FAS							

From the above analysis (Table 6), it is clear that age (significance $p<0.01$) and employment status (significance $p<0.1$) had a significant correlation with the nurses' mental fatigue levels. The others, experience years ($p=0.303$) and monthly income ($p=0.133$), had their significance values above the significance of 0.05. Thus, they were excluded

from the final multiple regression equation developed for the analysis. The following equation was derived: The higher income variable at the correlation stage illustrated a negative correlation with fatigue. This had implied that as income increased, the levels and exposure to fatigue declined. This could be due to reasons such as access to exercise and wellness programs, among others. However, the p-value in the regression analysis for income and mental fatigue was below 95% confidence. Thus it was not included in the final regression analysis model.

- Mental fatigue among Jordanian Nurses=4.122-0.263 × age-0.237 × h years of experience

DISCUSSION

The FAS tool's analysis tool evaluated the relationship between physical and mental fatigue with the nurses' socio-demographic factors. For physical fatigue, the analysis indicated a relationship with age (negative), years of experience (negative), weekly working hours (positive), monthly income (negative), and working in the shift BC (positive). The findings reflected and contrasted to the existing literature [5,13]. Literature denotes a positive correlation between age and nurses' physical fatigue. This means that an increase in age leads to a corresponding rise in physical fatigue. This is due to the reducing physical resilience among nurses with advanced age, thus leading to the ease of physical fatigue [14,15]. However, in the findings on the Jordan context, age harmed physical fatigue, meaning there is lower physical fatigue as the nurses advance in age. This is a finding explained by the prevailing social values and norms across the nation. The elderly are often respected and cared for. Thus, even in the nursing profession, the elderly and advanced in age are allocated a lower amount of physical work requiring much physical energy and strain.

Consequently, due to their age when allocating tasks, age hurts the nurses' physical fatigue levels prevalence. However, the analysis argues that if the nurses were allocated equal tasks to their other younger peers without considering their age, the findings would positively correlate between age and physical fatigue. The second influencing socio-demographic variable is the years of experience. The correlation established was negative and is a reflection of the existing literature. With increased experience, the nurses have the skills and expertise to manage and mitigate fatigue. Experienced nurses are better at managing their fatigue in executing their tasks, and as such, they often experience lower fatigue levels than their relatively newly registered peers. The same applied hedged on the level of income. Findings demonstrated that as nurses' earning levels increased, they were intrinsically motivated, had access to exercise and fitness programs, and their fatigue levels declined. This is because nurses in Jordan are paid based on their experience and expertise. Thus, those that are highly paid are often highly experienced and thus better in handling tasks and managing their fatigue. Finally, there was a positive correlation between physical fatigue and working on the Shift BC. This is the most extended working shift with 16 hours per shift. Previous studies indicate that nurses work for 8 hours with fatigue rising when they work for the 12 and 16 hours shifts. Thus, for the nurses working for 16 hours with minimal rest in between the shifts, they were bound to experience physical fatigue.

Finally, there was a negative correlation with the variables of age, employment status, and monthly income on mental fatigue. With increased age and experience, existing literature demonstrates that nurses develop resilience to mental fatigue [13,15]. Over time, nurses learn coping strategies and ways to avoid mental fatigue, thus creating a negative correlation between it and age. Similarly, a higher income meant that the nurses had enough resources at their disposal to explore the mental fatigue mitigation strategies such as seeking professional help and taking vacations to help address mental fatigue [16,17]. Regarding the employment status, the negative correlation was a result of the coding strategy applied. The coding was 1 for part-time employment and 2 for permanent employment. Thus, the findings indicated that mental fatigue was higher among part-time working staff and lower among full-time permanent nurses. This is a reflection of the existing literature. Existing literature indicates that full-time employed nurses and staff are less worried about their job security than part-time employees constantly worried about their job security and earnings [16]. In addition, the part-time staffs have to work in additional non-nursing jobs, which escalate their mental fatigue levels in the long-run period.

CONCLUSION

In summary, the study findings demonstrated substantial fatigue prevalence for both the physical and mental fatigue types among Jordanian nurses. Overall, the high fatigue index indicates the need for corrective measures and the institution for coping and mitigation strategies. The Jordanian ministry of health should consider instituting fatigue coping strategies to aid the nurses in managing their physical and mental fatigues. Consideration should be made

to ensure that the developed strategies and policies account for the nurses' socio-demographic factors influence on fatigue levels. For instance, in mitigating physical fatigue, the ministry should institute measures that focus on monthly incomes as one contributor to physical fatigue for the lack of enough earnings for the nurses to pay for exercise and other relevant programs.

DECLARATIONS

Ethics Approval and Consent to Participate

The ethical approval was obtained from both, the University of Newcastle (UoN) (Ref No. H-2020-0082) and the University Putra Malaysia (UPM) (Ref No. JKEUPM-2020-306), Faculties of Medicine and Health Sciences (FMHS). Moreover, approval by the KAUH and JUH hospitals was obtained through their respective Institutional Review Board (IRB). Furthermore, all participants were required to read an information sheet and consent form before answering any of the study questions. The participants were requested to sign a written formal consent form that is a template provided by the University of Newcastle (UoN) and the University Putra Malaysia (UPM) for Jointly Awarded Doctorate Degrees (JADD) programs.

All the study methods in data sourcing, collection, analysis, and presentation were all done ethically in accordance with the University of Newcastle (UoN) and the University Putra Malaysia (UPM) Faculties of Medicine and Health Sciences (FMHS) research guideline and requirements.

Conflict of Interest

The author(s) declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

Authors' Contributions

All authors performed the analyses of the data reviewed, revised the manuscript, and approved the final manuscript as submitted.

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