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"UTILIZATION OF FACTOR ANALYSIS IN IDENTIFYING THE MAIN LATENTVARIABLES OF NURSING FATIGUE AMONG ICU NURSES"

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ABSTRACT:

Background- Nurse fatigue is a huge threat to patient safety; hence it is important to investigate the main latent variables leading to nursing fatigue.
Aims- The aim of the present study is (1) to measure the neurophysiologic symptoms of fatigue in ICU nurses. (2) to identify the main latent variables of nursing fatigue among ICU nurses. (3) to find out the association of selected socio demographic characteristics of the ICU nurses with fatigue level.
Methods- Non-experimental research design, active participated respondents were 132 ICU nurses selected from 4 private hospitals. Data were collected using a self administered questionnaire (2 sections) i.e. socio-demographic variables and fatigue scale.
Results and Conclusions- Mean value 99.8 indicate fatigue level of nurses to a great extent, Chi square value shows significant ($P \leq 0.05$) association with age, sex and years of experience. Multifactorial analysis was applied; main latent variables of fatigue level with high loading factors were related to fatigue is symptoms of tiredness. Findings shows that nurses experiences fatigue to a great extent and main variables related to fatigue is symptoms of tiredness.

Keywords: Latent variables, factor analysis, ICU nurses, nursing fatigue

1. Introduction

Nurses work long hours and play a critical role in keeping patients healthy. Many nurses feel that fatigue "comes with the territory" of such a high-stress, high-impact job. But what's really at risk when a nurse is fatigued. Nursing fatigue costs the United States billions of dollars each year. "Nurse Fatigue is a subjective feeling of tiredness (experienced by nurses) that is physically and mentally penetrative. It ranges from tiredness to exhaustion, creating an unrelenting overall condition that interferes with individuals' physical and cognitive ability to function to their normal capacity. It is multidimensional in both its causes and manifestations; it is influenced by many factors: physiological (e.g., circadian rhythms), psychological (e.g., stress, alertness, sleepiness), behavioral (e.g., pattern of work, sleep habits) and environmental (e.g., work demand). Its experience involves some combination of features: physical (e.g., sleepiness) and psychological (e.g., compassion fatigue, emotional exhaustion). It may significantly interfere with functioning and may persist despite periods of rest" (Canadian Nurses Association [CNA] & Registered Nurses' Association of Ontario [RNAO], 2010, p.12).

A nurse is expected to dedicate a considerable proportion of his/her time and emotional energy for patient care each day. While the nurse training prepares them well for this role, working so hard can cause exhaustion over time if self-care is not performed. Mental exhaustion can lead to mistakes, and when those mistakes affect the health and wellbeing of patients, the consequences can be devastating. Fatigue is a recognized concern for nurses, especially those caring for unstable and critically ill patients. Research shows that nurses working long hours and shift work, especially night shifts, are at risk for sleepiness and fatigue. Critical care nurses need to address factors contributing to fatigue and implement measures to reduce the effects of fatiguefor themselves and their patients.

2. Literatures related to the study-

Maria Wujtewicz et al. (2016), conducted study on 158 respondents of a group of 160 nurses. The study group was internally diversified. Study also demonstrated that the anesthesiology unit employees had a much greater length of service than those of the intensive care unit. Multifactorial analysis has shown that mental fatigue concentrated with changes in activeness, motivation and physical fatigue are strongly correlated with age, professional experience and education.

Mi Sun Kim et al. (2021), this study sought to identify the levels of physical and mental fatigue present among Korean female nurses and discern factors influencing their onset. This cross- sectional study analyzed data from the Korea Nurses' Health Study (KNHS). A total of 14,839 hospital nurses were assessed by hierarchical regression analysis. The mean scores of physical and mental fatigue were 12.57 and 5.79 points, respectively. After adjusting for confounding variables, the work department had a significant influence on both physical and mental fatigue, that is, nurses working in special care units experienced greater degrees of both physical and mental fatigue than those working in general units.

Need of the study-

Nurse fatigue is an important consideration to monitor to ensure nurses' continued wellbeing as well as good patient safety levels. The above literatures take into consideration the serious problem of workload and fatigue among nursing personnel. Current scientific studies discuss this issue only to a small extent, especially the nurses working in general units. Tarnow – Mordi and co-authors found that risk-adjusted mortality rates were markedly higher in patients exposed to periods of high ICU workloads. Therefore, it is necessary to establish a

strategy to mitigate nursing fatigue while considering the characteristics of specific departments. In nursing practice, the introduction of a counseling program and guarantee of rest time that can alleviate the mental and physical fatigue of nurses working in special care units should be considered. The analysis of the level of workload in physical and psychological aspect is crucial considering worldwide shortage of nursing staff. According to recent studies, the number of nurses entering health care system is disproportionate to the number of these who leave the system. The investigator felt the need to identify the main latent variables of nursing fatigue among ICU nurses using multifacorial analysis.

Problem Statement-
"A non- experimental study using multifactorial analysis to find out the main latent variables of nursing fatigue among ICU nurses"

Aims of the study were -
1. To measure the neurophysiologic symptoms of fatigue in ICU nurses.
2. To identify the main latent variables of nursing fatigue among ICU nurses.
3. To find out the association of selected socio demographic characteristics of the ICU nurses with fatigue level.

Based on literatures, the following hypothesis framed
H01- There is no latent underline factors and that all variables are loaded equally
H02- There is no significant association of selected socio demographic characteristics of the ICUnurses with fatigue level.

3. Material and Methods

This study is non-experimental quantitative focusing on identification of main latent variables nursing of fatigue among ICU nurses. Data was collected using a self administered questionnaire. The questionnaire was divided into 2 sections, one covering the respondents demographic and the other assessing the fatigue level. On the basis of literature reviews 5 demographic variables were identified i.e. age, sex, professional education, years of experience and type of duty. A self administered 30 items 5 point likert scale was used to measure fatigue.The tool was developed after in depth literature review. The tool used in this study to measure neurophysiological symptoms of fatigue is based on thirty items classified under three sections

i.e. A. symptoms of tiredness, B. symptoms of weaken motivation, C. symptoms of physical fatigue. Study populations were the ICU nurses of both genders with at least 1 year of nursing experiences in ICU, serving in all shifts. Active respondents were 132 ICU nurses working in selected 4 private hospitals, convenient sampling technique used. The tool consisting of socio demographic variables and 5 five point likert scale consisting of 30 items to measures nursing fatigue were mailed for getting the data. Total 140 nurses participated in this study, only from 132 nurses correctly filled data received. Statistical method used descriptive (mean, SD and SEM) and inferential statistics i.e. multifactorial analysis to know the correlations, sample adequacy and highest loading factors of the variable and Chi square to find out association. The study was approved by ethical committee and from each hospital research permit was received, participation in the study was voluntary and no individual responded could be identified from the raw data or from the result of the study.

Data Analysis and Interpretation-

Research data were analyzed using SPSS software; frequency and percentage distribution were used to summarize the raw data. Findings of the socio demographic variables i.e. age, sex, professional education, year of experience and type of duty showed that majority of respondents were female (82%). The average age of responded was (37%), of these responded (92%) nursing staff were permanent employee and (72%) of them were working in 12 hours day shift. On an overage responded has 19 years of work experience of total. Overall the nursing staff reported great extent of fatigue with a mean score of 99.08. (N=132) Chi-square was used to find out the association of selected five demographic variables with fatigue level. There was significant association of nursing fatigue with age (df-9), sex (df-3), and years of experience (df-6) (chi square value was greater than p value at 0.05). Probability value was greater than chi square value with two variables i.e. professional education and type of duty, hence no significant association.

Multifactorial analysis was used to find out the main components of nursing fatigue among ICU nurses. Principal component factoring was applied, because a theoretical underlying factor structure was expected on the basis of the systematic literature review. The determinant value E-007 is greater than 0.001, it showed that each items is associated (correlated) with each of other questions. In correlation matrix there is diagonal line in which every item has 1.000 value. The rotation technique applied was the varimax method with Kaiser normalization. In varimax rotation, the factors are rotated for the best factor solution, which was the aim in this study. The Kaiser-Meyer-Olkin test value for the responses was good (0.841), and the Bartlett's test of sphericity result was highly significant (.000) in the (Table 1.2), thereby confirming that factor analysis was appropriate for these items. This factor solution had 30 items, all of which met the correlate over 0.3. A cut-off point 0.3 is generally selected for the correlations and loadings, as used in this study, too. The loadings over 0.3 show us the items will be included as elements of the factor.

Table 1.1 Descriptive Statistics

	Mean	Std. Deviation	Analysis N
VAR00001	2.4621	1.14188	132
VAR00002	2.4015	1.16475	132
VAR00003	4.1136	.87935	132
VAR00004	2.9924	1.37311	132
VAR00005	3.0227	1.22609	132
VAR00006	2.6894	1.27293	132
VAR00007	3.9091	.69298	132
VAR00008	3.0833	1.22967	132
VAR00009	2.5227	1.13559	132
VAR00010	2.5833	1.31371	132
VAR00011	3.9091	.78589	132

VAR00012	3.2197	1.37210	132
VAR00013	3.1364	1.32948	132
VAR00014	3.1742	1.31053	132
VAR00015	3.0227	1.51565	132
VAR00016	4.0985	.64037	132
VAR00017	3.4091	1.07685	132
VAR00018	3.4924	1.08069	132
VAR00019	3.5833	1.09155	132
VAR00020	3.6515	1.01127	132
VAR00021	3.0227	1.29865	132
VAR00022	2.8182	1.34685	132
VAR00023	4.0682	.93444	132
VAR00024	3.9091	1.03713	132
VAR00025	2.9015	1.56712	132
VAR00026	3.9621	1.07295	132
VAR00027	3.7576	.91736	132
VAR00028	3.8485	.95298	132
VAR00029	2.6742	1.37311	132
VAR00030	3.6364	1.23729	132

Table-1.2 KMO and Bartlett's Test

Kaiser-Meyer-Olkin Measure of Sampling Adequacy.	.841
Approx. Chi-Square	1720.178
Bartlett's Test of Sphericity	
df	435
Sig.	.000

The exploratory factor analysis resulted in nine factors describing nurses' fatigue. The analysis of main components indicated 9 factors; the eigenvalues of these 9 factors measured explained variences greater than 1.0 (Table 1.3), which is a common criterion for a factor to

be useful. Factors are rotated so that easier to interact. The rotated factor matrix table is key for understanding the results of analysis. The items were shorted so that the items that have the highest loading from factor one is item 1 with a loading of 0.987, in factor two the highest loading factor were items 2,3,4, 5 (Table 1.4) .

Table-1.3 Total Variance Explained

Component	Initial Eigenvalues			Extraction Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	8.457	28.191	28.191	8.457	28.191	28.191
2	2.188	7.295	35.486	2.188	7.295	35.486
3	1.790	5.967	41.453	1.790	5.967	41.453
4	1.510	5.032	46.485	1.510	5.032	46.485
5	1.362	4.539	51.024	1.362	4.539	51.024
6	1.319	4.395	55.419	1.319	4.395	55.419
7	1.259	4.198	59.616	1.259	4.198	59.616
8	1.154	3.846	63.462	1.154	3.846	63.462
9	1.050	3.500	66.962	1.050	3.500	66.962
10	.993	3.309	70.271			
11	.901	3.002	73.273			
12	.820	2.733	76.006			
13	.774	2.580	78.586			
14	.706	2.353	80.939			
15	.644	2.146	83.085			
16	.609	2.031	85.115			
17	.556	1.854	86.970			
18	.535	1.785	88.755			
19	.473	1.577	90.332			
20	.396	1.320	91.652			

21	.384	1.278	92.930			
22	.330	1.099	94.029			
23	.319	1.064	95.093			
24	.295	.984	96.076			
25	.267	.891	96.967			
26	.254	.847	97.814			
27	.220	.734	98.548			
28	.186	.619	99.166			
29	.143	.477	99.644			
30	.107	.356	100.000			

Extraction Method: Principal Component Analysis.

So the null hypothesis is rejected as there are latent variables with different loadings.(Table-1.4)

Table 1.4 Component Transformation Matrix

Component	1	2	3	4	5	6	7	8	9
1I would like to lie down	**.987**	.055	-.015	.066	.075	-.094	.059	-.026	.008
2 I feel sleepy	-.073	**.631**	.535	.318	.334	.176	.252	-.049	-.001
3 I feel dizzy	.068	**.569**	-.314	-.310	-.319	.488	-.264	-.006	.260
4 My eyes are tired	-.072	.152	-.296	**.712**	-.127	-.336	-.306	-.201	.337
5 I feel languid	-.046	.201	-.083	-.368	**.655**	-.396	-.441	.133	.135
6 My legs are tired	-.030	-.147	**-.450**	.181	.397	.300	.429	.415	.371
7 My movements areclumsy	.047	.026	.242	.200	-.241	-.021	-.318	**.853**	-.102
8 My whole body feelstired	.064	-.400	.487	-.019	.057	.297	-.293	-.135	**.635**
9 My head feels heavy	.039	-.170	-.152	.288	.342	**.523**	-.451	-.140	-.500

Extraction Method: Principal Component Analysis. Rotation Method: Varimax with Kaiser Normalization.
The results showed (Table 1.4) that the main variables of nursing fatigue with highest loading comes under section A (symptoms of tiredness) of fatigue scale. Items under these section A with high loading item 1 (factor 1) and under factor 2 items were 2, 3, 4, 5 with loading values
from .712 to .569.

Limitations-
There are number of study limitations including limited number of setting, non random sampling technique. The study was limited to selected study group i.e. ICU nurses working in private hospitals.
The researcher was not permitted to distribute the data collection tools directly to the study population, but was restricted to relying on the mail to distribute the fatigue scale consisting of 30 items questionnaire to the nurses. Therefore, the researcher is not aware of how many nurses had actually filled by them only. The participants' interpretations of survey questions presented alimitation in collection of data.

4. Conclusion

The objectives of the study in identifying the main latent variables of nursing fatigue was achieved based on the responses to fatigue scale, symptoms of tiredness i.e. would like to lie down, feel sleepy, eyes are tired, and legs are tired were the main latent variables of nursing fatigue. Result showed that there was significant association of nursing fatigue with 3 demographic variables i.e. age, sex, year of experience. Also the mean value showed that ICU nurses had fatigue to a great extent at work place.

Recommendations
Considering the increased acuity of patients today, the desire for quality patient care and the growing nursing shortage, the retention of experienced nurses should be a top priority. This study illustrate the main variables of nursing fatigue i.e. is tiredness. Future research is recommendedto discover other contributing factors to fatigue. The negative impact of fatigue on performance should also be explored further. Hospital administrators should focus on improving nursing working conditions so that nurses are less fatigued, therefore better able to remain vigilant and provide safe care to patients. Fatigued nurses present a risk to patients (Scott, Hofmeister, Rogness, & Rogers, 2010). Additionally, nurses may benefit from education related to self-care options to combat fatigue. Future research is recommended to explore the effectiveness various options to combat fatigue while at work such as quiet spaces for relaxation on each unit, use of essential oils or offering a brief chair massage during work breaks.

Conflict of interest
The authors of this manuscript report, no conflict of interest in this study

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