Human Engineering: Predictors of Cognitive Ergonomics for Nurses

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Abstract

Background/Objectives: Ergonomics is becoming more of a priority in today's work environment. Ergonomics is now focused on health care sector, where the environment has loaded the work for nurses. This in turn affects the quality of health care, and patient healing. This study focuses on analysing the role of work environment, task (job) and mental workload on nurses towards their personal well-being.
Methods/Statistical analysis: This study was conducted at Chennai city a hub for medical tourism and multispecialty hospitals . The data were collected from 100 samples of Nurses in health care sector through Questionnaire and a technique multiple regression analysis (Enter Method) was applied to measure the combined effects of independent variables on the dependent softwarewith SPSS 21.0.
Findings: The studies found that cognitive ergonomics depends significantly on mental workload and Work Environment. Whereas the Tasks done by Nurses have no significant dependency on cognitive ergonomics.

Keywords: Cognitive Ergonomics, Task, Mental Workload, Work Environment.

1. Introduction:

Ergonomics was derived from two Greek words ergon, and nomoi. Ergo means work, and nomoi, means natural laws. Jointly they can be called as science of job (work) ie a human's relationship to his work. Sometimes, it can be referred to as a science of fitting the work to the user. International Ergonomics Association (IEA) defines ergonomics as a profession on principles, data, methods, theories to enhance well-being of human and their performance.

Ergonomics is other ways termed as Human-factors engineering with three domains:physical mental and Organizational . According to IEA, Cognitive ergonomics is concerned with mental processes such as memory, perception, motor response and reasoning, as they affect communications between humans and other elements of a system. It ensures suitable communications amongst human works, needs ,capabilities, environments, products, and limitations.

At work, human system interacts with cognitive abilities and boundaries, thereby it becomes a practice. Human computer interaction, work stress, reliability, performance skills, mental workload are all discussed in cognitive ergonomics with reference to human. Briefly, to optimize human well-being and performance, cognitive ergonomics educates intellect at work and sets its operations in order.The emerging knowledge from intellectual sciences such as the attention, perception, decision-making, memory and learning is employed in cognitive ergonomics.

Cognition encloses handling information and processing in human brain. It evolves as encoding, maintaining, rehearsing, recalling and transforming information. Cognitive functions are imperative in nature. They are relevant to specific tasks that are relevant to a specific task or work, and to maintain the work environment appropriate for their job.

The general aim of human engineering within the health care domain is to maximize the system's overall performance .It is meant to promote the safety, quality, and comfort of the work lives of health care workers.(Santa M, Gurses AP, 2012)

Procedia Manufacturing (2015) says that an ergonomics program needs to be proactive to earn sustainability. Ergonomics prepares to prevent from anticipation of undesirable events Organisations have sought to enforce such programs, because it promotes the quality work life , reducemedical expences , employee turnover ,reduced production and absenteeism due to workers' illness.

2. Ergonomics

Ergonomics cults the following,

- Ensures that the employee work safe,
- Employee comfort ability and health,
- Train the individual to use the workplace, facility and equipment properly,
- Should bemore efficient in their workplace,
- Creates better safety culture.

The IEA says ergonomics Practitioners contribute to the design and development of products, jobs, tasks, environments and organisations in order to make them companionable with the abilities, limitations and needs of the people.

Ergonomics is becoming more of a priority in today's work environment, where organisations are more proactive rather than reactive (dealing with it only when injuries or near-misses occur). In every organisation employers are expressing concerns with their employee's health and well-being as it relates to ergonomics. This means ensuring the conditions of equipment (e.g. tools, furniture, and workstation) and the work environment do not negatively impact the employee. To this end, many organisation have taken steps towards developing and implementing an ergonomics program aimed at minimizing musculoskeletal disorder (MSD), or ergonomic, risk. While some employers succeed, others, unfortunately, fail to get their program off the ground and implement adequate change within the workplace.

2.1. Work Environment

Work environment comprises ,of work area design humidity system, lighting, , acoustic system and many more. The process of designing a workstation should consider several factors, especially ergonomic factors (Yeow and NathSen, 2003; Mohamad Khan et al., 2005). The failure to enforce the principles of ergonomics can lead to emotional, physical, production and quality detoriation (Shikdar and Sawaqed, 2003).

Hassal et al.(2015) specified the main objective is the examination of the working environment in expressions of ergonomic phases. It not only guarantees health and safety of employees, but also creates a working environment for them where they can activate physical appearance,biological and psychological abilities effectively. Ergonomics would be possible to increase the productivity of the employees and the quality of work.

Bhatti et al. (2010)The reasons leading to stress is work environment. Stress is held more in both intra/extra organization. Organization refers various variables as a cause beneath the workplace stress.

Hakanen and Schaufeli, (2012) emphasised on understanding resources and its demands on specific work environment contribution. Work engagement extends to increased engagement, healthy state and clinical engagement behaviour. (Eldor ,2016).

2.2. Mental Workload:

Ehsanollah Habibi (2016) Mental workload is a multidimensional construct which is interaction between cognitive demands of a task , characteristics of the person and the situation (e.g., temporary pressure). The characteristics of the task must be mentioned along with temporary pressures and work pace, functions to be performed, autonomy, and the interpersonal relations .

Díaz D,(2012) found that high mental workload among nurses leads to negative outcomes in their physical and mental wellbeing. Among the six mental workload scales, frustration had the lowest value but the physical stains are highly significant.

2.3. Task

Gallagher and Callaghan, (2015) suggests the postural movements play a role in decreasing eventual pain. Sit, Stand workstations are more common to interact in a specific task. Job rotation, sequencing and decentralization aid to reduce pain and comfort the employee.

In 2018, verdicts the inferences of job rotation. More research needs to be carried on to fully assess a variety of tasks to recommend the cognitive tasks. These skill set acquired can help maintain the postural movements.

3. Research Methodology

The plan for the study is to carry out a data collection in Chennai through structured questionnaire. The Sample size is 100 respondents. The questionnaire contained closed end questions consisting of 44 items with five point Likert like scale with intensities varying through Very Often, Often, Occasionally, Rarely and Never.(G. Rajini 2016). . Multiple choice was drafted for collecting demographic details.

Four variables were generated namely Task (10 items) , Mental Workload (10 items) , Work Environment (15 Items) and Cognitive Ergonomics (9 items). The data were analysed with SPSS 21.0 where Demographics, reliability, multiple Regression (Enter Method), were used in addition to descriptive statistics.(Rajini and M. Krithika, 2016) .

3.1 Sample Characteristics

Demographic characteristics of the respondents are as follows. (Table 1) In age distribution, less than 25yrs was 52% those in their 26-30 years took up 27%, then followed by those in their 31-35 years, 19%, those in their 36-40 years , 0%, those in their 40 and above constituted 2%. In educational qualification BSC the largest part of respondents 53%, followed by GNM 39%, and MSC 8 %.

Total year of experience 0-1 yrs, was 10.0%, 1-5 yrs, 47.0%, 6-10 yrs, was 25.0%, 11-15 yrs 16.0%. Present designation Single grade 58.0%, Head Nurse 23.0%, Nursing Superintendent17.0%, Deputy Nursing superintendent 2.0%. Current Positing Critical Care 13.0%, Emergency Room 32%, General ward34%, Operation Theatre 16%, Others 5%. The Monthly salary of respondents varied from INR 12,000-15,000 was 48.0%, INR 15,001-20,000 was 13.0%, INR 20,001–25,000 was 19%, and above INR 25,000 was 20%.

Table-1 Demographic characteristics of Respondents

Sample Characteristics	Category	Frequency	Percent
Maturity	<25 yrs	52	52.0
	26yrs-30yrs	27	27.0
	31yrs-35yrs	19	19.0
	36yrs-40yrs	0	0
	>40yrs	2	2.0
Educational Qualification	ANM	0	0
	GNM	39	39.0
	BSC	53	53.0
	MSC	8	8.0
	OTHERS	0	0
Total year of experience	0-1 yrs,	10	10.0
	1-5 yrs	47	47.0
	6-10 yrs	25	25.0
	11-15 yrs	16	16.0
	Above 15 yrs	2	2.0
Present Designation	Single grade	58	58.0
	Head Nurse	23	23.0
	Nursing superintendent	17	17.0
	Deputy Nursing superintendent	2	2.0
	Others	0	0
Current posting	Critical care	13	13.0
	Emergency room	32	32.0
	General Ward	34	34.0
	Operation Theatre	16	16.0

Salary	Others	5	5.0
	RS 12,000-RS 15,000	48	48.0
	RS 15,001-RS 20,000	13	13.0
	RS 20,001-RS 25,000	19	19.0
	Above RS 25,000	20	20.0

Table-2 Reliability

S.No	Description	No.of.Items	Cronbach's Alpha value
1	Task	10	0.822
2	Mental Workload	10	0.737
3	Work Environment	15	0.825
4	Ergonomics	9	0.774
5	Total	44	0.934

3.2. Results:

Cronbach's Alpha value is 0.934, for the total scale . The questionnaire is reliable and the items internally consistent. The result is expressed in Table-2

3.3. Multiple Regressions

H_0- Cognitive Ergonomics does not depend on Task, Mental Workload and Work environment.

Table-3 Model Summa

Model	R	R^2	Adjusted R^2	Standard Error of the Estimate	CHANGE STATISTICS				
					R^2 Change	F Change	df1	df2	Sig.F Change
1	.807ᵃ	.651	.640	1.64240	.651	59.572	3	96	.000

Predictors: (Constant), Task, Mental workload, Work Environment
b. Dependent Variable: Cognitive Ergonomics

Table-3 provides inference that the ability of prediction for model was articulated by R value 0.807 and R^2 value 0.651 which shows 65.1% of variance exist in the dependent variable is from the independent variables. F- value is 59.572 showing that there exists a relationship between work environment, mental work load and task with ergonomics

Table-4 ANOVA

Model		Sum of Squares	Df
1	Regression	482.082	3
	Residual	258.958	96
	Total	741.040	99

a. Dependent Variable: Cognitive Ergonomics
b. Predictors: (Constant), Task, Mental workload, Work Environment

From above Table 4, the regression was tested by using T-test and the coefficient was used to compare as well as resolve the percentage of variation that exist in the dependent variable. F –value was used to know the significance of the F distribution (Rajini.G. 2011). The ability of prediction of the model (Table-4) was expressed by value 0.640 which shows 64.0% of the variance of from the independent variable. The p-value is 0.000 which is <0.05 showing a significant relationship between work environment, mental work load, task with ergonomics. Hence from the above test we conclude that work environment, mental work load and task significantly predict ergonomics.

From the above table 5 it is inferred that the beta value is 0.224 for variable 1 (work environment) and 0.191 for variable 2 (Mental workload) and 0.131 for variable 3 (Task). There is a significant relationship between work environment and cognitive ergonomics (P value = .000) at 5 % level and there is a significant relationship between and Ergonomics (P value = 0.046) at 5% level. There is no significant relationship found between Task and Ergonomics since the P value is >0.05 which is 0.137.Thereby the final regression equation is derived by the incorporating the coefficients as follows :

Cognitive Ergonomics = -9.705 + 0.224 (**Work Environment**) +0.197 (**Mental Workload**) +0.131 (Task)

4. Conclusion:

This study was conducted among nursing. Reliability was assessed by checking internal consistency of the research with cronbach's alpha values around 0.93 which is good. Work environment plays a very important role in the organisation. From the study it is found that there is a significant relationship between work environment and ergonomics justifying that if the hospital environment is comfortable for the nurse he/she is capable of performing much better.

Similarly mental workload also found to be significant with ergonomics. Mental workload could cause a person to face problems such as anxiety; high blood pressure increased stress and could burnout the nurse. If the hospital creates measures to equally distribute the work among others the work load of the nurses will decrease and nurses would be more comfortable avoiding health problems at work.

The ergonomics analysis of nursing workplaces, assisting in identifying problematic factors that can lead to job related musculoskeletal symptoms. Ergonomics helps to be more comfortable at work, reducing stress and injury caused by incorrect positioning and repetitive tasks. As a employee need to use ergonomics as it give big influence in work life. Some of the studies found that were observed that mental workload for cognitive demands and complexity of tasks exists. The dimensions Characteristic of the task, Work space and Health consequences produced medium-high mental loads. When measuring workload; there is a need to recognize the critical link between the characteristics of the nurse and of the work environment and the impact of these personal and environmental factors on patients, nurses, and the system as a whole.

These days the work seems more hectic than ever and demands a lot of mental ability as well as physical demands. The increase in cognitive demands emphasises the need to have ergonomics that supports the mental workload of the employees. Excess workload can result in ineffective work and affects the performance of the employees since humans of limited capability for processing the information. The organisations should aim to assess the work load periodically to ensure that the workload is distributed in an equal manner.

Table-5 Coefficientsᵃ

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	9.705	2.316		4.191	.000
	Task	.131	.088	.175	1.500	.137
	Mental workload	.197	.097	.240	2.020	**.046**
	Work environment	.224	.054	.446	4.174	**.000**

a. Dependent Variable: Cognitive Ergonomics

Ergonomics in work environment leads to positive work life for the employees and increase the work productivity of the employees. When the job job task is too physically taxing on the worker, they may not perform their job like they were trained. It should be understood that when an organisation is putting forth their best efforts to ensure their health and safety and if an employee does not experience fatigue and discomfort during their work hours it can drastically reduce turnover, decrease

absenteeism, improve morale and increase employee involvement.

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