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Do Engineers Know and Practice Ergonomics better than Healthcare Professionals or Vice-Versa?

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Ergonomics is a multidisciplinary field that seeks to promote the wellbeing of a person within a system, thereby fostering productivity with its concomitant economic effects. Professional training may impacts differently on the knowledge, awareness and practice (KAP) of certain constructs like ergonomics. Engineers and healthcare professional (HCP) are deeply involved in the promotion of ergonomics. However it is not known who among these two professionals have a greater knowledge and practice of Ergonomics. This study therefore assessed and compared the level of KAP of Ergonomics between engineers and HCPs. This cross-sectional comparative study assessed the KAP of Engineers and HCPs in Academics. Their KAP of Ergonomics were assessed using a self structured and content validated questionnaire. Data obtained were analyzed using descriptive statistics and independent t-test. The level of significance was set at 0.05. A total of 75 participants (42 engineers and 33 HCPs) took part in this study. More HCPs (30.3%) than engineers (26.2%) correctly reported that ergonomics does not fit workers to their work, whereas more engineers (28.6%) than HCPs (21.2%) correctly reported that document in a computer workstation should not be placed flat on the table. Overall, there was no significant difference (p>0.05) in the mean ergonomics knowledge (61.22±28.80 vs 58.01±27.65%), awareness (64.88±29.89% vs 68.18±30.79%) and practice (45.53±22.23% vs 46.21±30.79%) between the two groups (engineers vs HCPs respectively). While the knowledge and awareness of ergonomics among engineers and HCPs in Nigeria are fair, its practice is poor and similar among them. There is need for increased exposure of these professionals to ergonomics during their training phases.

Key words: Ergonomics, Knowledge and Practice, Engineers, Healthcare Professionals

INTRODUCTION

Professionals in the fields of engineering and health appear to be indispensible in the practice of ergonomics.

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While the Engineers typically design tools and other devices to suit the human user, their counterparts in health manage the sequel from a possible miss-match and/or poor application of ergonomics by the end user. It is therefore expected that professionals in the fields of engineering and health should not only have sound knowledge and awareness of the science of ergonomics; but also demonstrate good practice of ergonomics both in their work setting and otherwise. Academics are custodians of knowledge and researchers, and they transmit knowledge to budding professionals. By virtue of the job descriptions of academics in engineering and health science, one may argue that they are expected to have sound knowledge, awareness and practice of ergonomics.

Ergonomics is a discipline that applies information about human behaviour, abilities, limitations and other characteristics to the design of tools, machines, tasks, jobs and environments for productive, safe, comfortable and effective human use (Ekechukwu et al, 2018a). In other words, Ergonomics is designing a work to fit the worker so that work becomes safer and more efficient. A good "fit" would certainly decrease the risk of illness and injury to the worker thus, increase the worker's productivity, improve quality of the product or service as well as increase satisfaction among the workers. Ergonomics is also concerned with the science of preventing Work Related Musculoskeletal Disorders (WRMSDs); defined as disorders of body structures like muscles, ligaments, tendons joints, nerves, cartilage, spinal discs or a localized blood circulation system resulting from or aggravated by effects of the work environment where the work is carried out or the performance of work (Sharan, et al, 2018). A sound ergonomic job design should control for some abnormalities in postures and movements that may eventually reduce the risks of WRMSDs.

Ergonomics is known to be well established in many countries. However, in Industrially Developing Countries (IDCs) like Nigeria, it is less well known and less practiced (Ekechukwu et al, 2021). Academics are fountains of knowledge and are expected to dispense them. Professional exposures may however influence the degree of Knowledge Awareness and Practice (KAP) of a given construct like ergonomics that is multidisciplinary. Not only that the level of KAP among academics in Engineering and Health Sciences is unknown, comparison of these constructs between these two cohorts is yet to be established. This study therefore, assessed and compared the level of KAP of ergonomics between engineers and HCPs in Academics.

METHODS

Participants

This cross-sectional comparative study purposively sampled 75 (49 males and 26 females) Engineers and HCPs in Academics at the University of Nigeria. Thirty-three (33) HCPs and forty-two (42) engineers participated in the study. All participants gave their informed consent. Only registered lecturer in University of Nigeria Enugu, between the 18 to 60 years, with no apparent/known cognitive dysfunction.

Materials

The material used for this study was a self structured but validated questionnaire. The questionnaire had two sections; the first section assessed the participants' socio-demographics such as sex, educational level, department, rank and post qualification experience. The second section assessed the participants' knowledge, awareness and practice of ergonomics; this section had seven close-ended questions on knowledge of ergonomics and 8 close-ended questions each for the awareness and practice of ergonomics.

Procedures

Firstly, the protocol for the study was explained to the participants, and their informed consents sought and obtained. The questionnaire was then administered to the participants, and the completed questionnaire was retrieved and stored.

Data Analysis

Data obtained were analyzed using frequency, percentage, mean, standard deviation and independent t-test. This was done using statistical package for social sciences (SPSS) version 23. The level of significance was set at 0.05.

RESULTS

Demographic Characteristics of the Participants

A total of 75 academics (33 HCPs and 42 engineers) participated in this study and majority of them were males (65.3%), although there were more female HCPs (45.5%) than female engineers (26.2%). Most of the participants attained post graduate educational level (73.6%) and were at the rank of lecturer I/II (51.4%). The Post Qualification Experience (PQE) for most of the participants was less than 11 years (55.9%) but more HCPs (51.6%) had PQE of 11 – 20 years as shown in table 1.

Knowledge of Ergonomics among Engineers and HCPs in Academics

Most of the participants reported to have heard of ergonomics before the survey (82.7%), yet very few participants correctly reported that ergonomics does not fit workers to their work (13.3%). More engineers than HCPs (engineers vs HCPs) correctly reported that ergonomics prevents injuries to workers (76.2% vs 72.7%), improves job satisfaction (78.6% vs 66.7%), does not decreases overall performance (71.4% vs 57.6%), and does not increases cost (45.2% vs 27.3%).

Table 1. Demographic Characteristics of the Participants

Variables	Categories	Engineers (n=42)	HCPs (n=33)	Total (n=77)
Sex	Male	31 (73.8%)	18 (54.5%)	49(65.3%)
	Female	11 (26.2%)	15 (45.5%)	26(34.7%)
Education	B.Sc	16 (39.0%)	3 (9.7%)	19(26.4%)
	M.Sc	13 (31.7%)	14 (45.2%)	27(37.5%)
	Ph.D	12 (29.3%)	14 (45.2%)	26(36.1%)
Rank	GA/ASL	13 (33.3%)	7 (22.6%)	20(28.6%)
	L II/L I	16 (41.0%)	20 (64.5%)	36(51.4%)
	SL	9 (23.1%)	4 (12.9%)	13(18.6%)
	Ass.Prof/Prof	1 (2.6%)	-	1(1.4%)
PQE	< 11yrs	25 (67.6%)	13 (41.9%)	38(55.9%)
	11 – 20yrs	9 (24.3%)	16 (51.6%)	25(36.8%)
	21 – 30yrs	2 (5.4%)	2 (6.5%)	4(5.9%)
	>30yrs	3 (2.7%)	-	1(1.5%)
	Mean	9.97±7.77	12.81±6.09	11.26±7.14

Keys: HCPs = Health Care Practitioners; f = frequency; % = percentage

Table 2. Summary of the Knowledge of Ergonomics among Engineers and HCPs in Academics

Items	Questions	Affirmative Responses; f (%)		
		Engineers (n = 42)	HCPs (n = 33)	Total (n = 75)
Q1	Have you heard of Ergonomics before?	35 (83.3%)	27 (81.8%)	62 (82.7%)
Q2	Ergonomics fits workers to their work (incorrect)	4 (9.5%)	6 (18.2%)	10 (13.3%)
Q3	Ergonomics cuts across all disciplines	29 (69.0%)	27 (81.8%)	56 (74.7%)
	Effects of Ergonomics include :			
Q4	Prevents injuries to workers	32 (76.2%)	24 (72.7%)	56 (74.7%)
Q5	Improves job satisfaction	33 (78.6%)	22 (66.7%)	55 (73.3%)
Q6	Decreases overall performance (incorrect)	30 (71.4%)	19 (57.6%)	49 (65.3)
Q7	Increases mechanization and cost (incorrect)	19 (45.2%)	9 (27.3%)	28 (37.3%)
Scores	≤ 39% = Very poor	6 (14.3%)	6 (18.2%)	12 (16.0%)
	40 – 59% = Poor	10 (23.8%)	11 (33.3%)	21 (28.0%)
	60 – 79% = Good	13 (31.0%)	7 (21.2%)	20 (26.7%)
	≥ 80% = Excellent	13 (31.0%)	9 (27.3%)	22 (29.3%)
	Mean ± Std. dev.	61.22±28.79	58.01±27.65	59.81±28.15

Keys: HCPs = Health Care Practitioners; f = frequency; % = percentage

On the other hand, more participants in the HCPs than engineers (HCPs vs engineers) correctly reported that ergonomics does not fit workers to their work (18.2% vs 9.5%) but cuts across all disciplines (81.8% vs 69.0%). Overall, majority of the engineers had a good knowledge of ergonomics (31.0%), while most of their HCPs counterparts had a poor knowledge of Ergonomics (33.3%) as shown in table 2. However, there was no significant difference in mean knowledge of ergonomics (t=0.489, p=0.627) between the engineers (61.22±28.79) and their HCPs counterparts (58.00±27.65) as shown in table 2 and 5.

Awareness of Ergonomics among Engineers and HCPs in Academics

Majority of the participants in this study correctly reported

Table 3. Summary of the Awareness of Ergonomics among Engineers and HCPs in Academics

Items	Questions	Affirmative Responses; f (%)		
		Engineers (n = 42)	HCPs (n = 33)	Total (n = 75)
	To prevent WRMSDs, I try to :			
Q1	Prevent awkward postures	35 (83.3%)	27 (81.8%)	62 (82.7%)
Q2	Prevent repetitive movements	14 (33.3%)	16 (48.5%)	30 (40.0%)
Q3	Avoid constrained positions	26 (61.9%)	28 (84.8%)	54 (72.0%)
Q4	Switch between sit and stand work posture	27 (64.3%)	24 (72.7%)	51 (68.0%)
Q5	Avoid work for some days (incorrect)	26 (61.9%)	21 (63.6%)	47 (62.7%)
Q6	Buy expensive furniture (incorrect)	32 (76.2%)	22 (66.7%	54 (72.0%)
Q7	Observe work breaks	32 (76.2%)	23 (69.7%)	55 (73.3%)
Q8	Perform stretches during the work	27 (64.3%)	20 (60.6%)	47 (62.7%)
Scores	≤ 39% = Very poor	7 (16.7%)	7 (21.2%)	14 (18.7%)
	40 – 59% = Poor	4 (9.5%)	-	4 (5.3%)
	60 – 79% = Good	14 (33.3%)	12 (36.4%)	26 (34.7%)
	≥ 80% = Excellent	17 (40.5%)	14 (42.4%)	31 (41.3%)
	Mean ± Std. dev.	64.88±29.89	68.18±30.79	66.33±30.13

Keys: HCPs = Health Care Practitioners; f = frequency; % = percentage

that prevention of awkward postures was a way of subverting WRMSDs (82.7%). However more of the HCPs than engineers (HCPs vs engineers) correctly reported that preventing repetitive movements (48.5% vs 33.3%), avoiding constrained positions (84.8% vs 61.9%), switching between sit- and stand-work postures (72.7% vs 64.3%), and not avoiding work for days (63.6% vs 61.9%) as some methods of preventing WRMSDs. Meanwhile more Engineers than HCPs (Engineers vs HCPs) correctly reported that preventing awkward posture (83.3% vs 81.8%), observing work breaks (76.2% vs 69.7%), performing stretches during work (64.3% vs 60.6%) but not necessarily buying expensive furniture (76.2% vs 66.7%) were some of the ways to prevent WRMSDs as shown in table 3. In general, More HCPs (78.8%) were aware of ergonomics than their colleagues in engineering (73.6%). On the contrary, there was no significant difference in the mean ergonomics awareness scores (t=0.468, p=0.641) between of HCPs (68.18±30.79) and their counterparts, the Engineers (64.88±29.89) as shown in table 5.

Practice of Ergonomics among Engineers and HCPs in Academics

In response to the question on how best to lift a heavy object from the floor, more HCPs than engineers (HCPs vs engineers) correctly reported that not bending the back over the object while standing (60.6% vs 40.5%), not moving the object away from the body (39.4% vs 38.1%) not raising the objects with the back muscles (51.5% vs 38.1%) were the proper techniques for carrying out the task. On the other hand, more engineers (83.3%) than HCPs (66.7%) correctly reported that firmly holding onto the object was an important lifting technique. In response to the principles to be observed while working with the computer, more engineers than HCPs (Engineers vs HCPs) correctly reported that the screen should not be above eye level (57.1% vs 48.5%), keyboards should not be on the same level with the screen (61.9% vs 48.5%) and documents should not be placed flat on the table (14.3 vs 9.1%). On the other hand, more participants in HCPs than engineers (HCPs vs engineers) correctly reported that work stations should be positioned perpendicular to the window in an office (51.5% vs 42.9%). In general majority of both the engineers (61.9%) and HCPs (70.8%) poorly observed the practice of ergonomics as shown in table 4. Also, there was no significant difference (t=0.122, p=0.903) in the practice of ergonomics between engineers (45.53±22.23) and their counterparts, the HCPs (46.21±25.86) as shown in table 5.

DISCUSSION

The importance of the knowledge, awareness and practice of ergonomics for both the medical and engineering field cannot be over emphasized. Findings in this study revealed that more males than females were found to in the Engineering in a ratio of 3:1; whereas there was an almost equal distribution of male and female participants among the health care practitioners

Table 4. Summary of the Practice of Ergonomics among Engineers and HCPs in Academics

Items	Questions	Affirmative Responses; f (%)		
		Engineers (n = 42)	Engineers (n = 42)	Engineers (n = 42)
	To lift a heavy object from the floor, I			
Q1	Bend over the object while standing (incorrect)	17 (40.5%)	20 (60.6%)	37 (49.3%)
Q2	Hold firmly onto the object	35 (83.3%)	22 (66.7%)	57 (76.0%)
Q3	Move the object away from the body (incorrect)	16 (38.1%)	13 (39.4%)	28 (37.3%)
Q4	Raise the object with my back muscles (incorrect)	16 (38.1%)	17 (51.5%)	33 (44.0%)
	In working with computer, the following should be observed			
Q5	Screen should be above eye level (incorrect)	24 (57.1%)	16 (48.5%)	40 (53.3%)
Q6	Keyboard should be on the same level with the screen (incorrect)	26 (61.9%)	16 (48.5%)	42 (56.0%)
Q7	Windows should be at right angle to the work station	18 (42.9%)	17 (51.5%)	35 (46.7%)
Q8	Document should be placed on the table (incorrect)	6 (14.3%)	3 (9.1%)	9 (12.0%)
	≤ 39% = Very poor	17 (40.5%)	16 (48.5%)	33 (44.0%)
	40 – 59% = Poor	9 (21.4%)	4 (12.1%)	13 (17.3%)
Scores	60 – 79% = Good	15 (35.7%)	11 (33.3%)	26 (34.7%)
	≥ 80% = Excellent	2 (6.1%)	2 (6.1%)	3 (4.0%)
	Mean ± Std. dev.	45.53±22.23	46.21±25.86	45.83±23.73

Keys: HCPs = Health Care Practitioners; f = frequency; % = percentage

Table 5. Comparison of Knowledge, Awareness and Practice between Engineers and HCPs in Academics

Variable	Engineers (n =42)	HCPs (n = 33)	t	P
Ergonomics Knowledge (%)	61.22±28.79	58.00±27.65	0.489	0.627
Ergonomics Awareness (%)	64.88±29.89	68.18±30.79	0.468	0.641
Ergonomics Practice (%)	45.53±22.23	46.21±25.86	0.122	0.903

Key: HCPs = Health Care Practitioners

(HCPs). In a similar study in the United States of America, Silbey (2016) reported a similar sex disproportion among engineers, they described it as a male dominated profession with women making only 13% of the workforce (i.e. about 6:1). This disproportion may be attributed to the nature of work tasks in engineering profession that require manual material handling (manual energy input) compared to the health professions. On the other hand, some health based professions like nursing sciences, appears to be female dominated (Barrett-Landau & Henle, 2014).

Most of the participants in this study reported to have heard of ergonomics prior to this study; however, only few of these participants correctly reported that ergonomics fits workers to their work. Only one out of ten engineers and one out of five HCPs knew that it was meant to be the reverse (i.e. ergonomics fits work to the worker). Designing a work to fit the worker in order to improve their efficiency and optimize safety is considered as one of the key objectives of ergonomics (Oluka et al, 2020). Failure to correctly respond to this question may be a strong indicator of poor knowledge of ergonomics among these cohorts. Relatively, this knowledge was lower among the engineers than the HCPs, although the difference in their general knowledge of ergonomics was not significant. A sound knowledge of ergonomics begets a sound application of ergonomics, engineers and HCPs who design workstations and manage the outcome of

poor workstation design respectively are expected to have sound knowledge of ergonomics. A study by Oladeinde et al (2015) that assessed the knowledge of ergonomics among medical laboratory scientists in Nigeria similarly reported a poor knowledge of ergonomics among these cohorts. Also, a Malaysian study that assessed the knowledge of ergonomics among civil and structural engineers, reported a poor knowledge of ergonomics particularly on “Prevention through Design (PTD)” principles (Ibrahim & Belayutham, 2020). There is an need to advance the knowledge of ergonomics among engineers and health practitioners in Nigeria.

It was noted that more HCPs than engineers were aware that (i) preventing repetitive movements, (ii) avoiding constrained postures, (iii) switching between sit and stand work postures and (iv) not absconding from work for days; were some strategies of WRMSDs prevention. The fact that these factors are also health related work hazards may be responsible for the greater awareness among HCPs. Similar to the generally low level of awareness found among the participants in this study, Daruis & Ramli (2013) that the office workers in Malaysia had beginners level of ergonomics awareness.

Engineers and HCPs were reported to poorly observe the practice of ergonomics with no significant difference between the two cohorts. This is similar to the low practice levels reported by Fauziyah & Handayani (2017) and Siddiqui, et al. (2016) among Indonesian industrial workers and Pakistani dental practitioners respectively. A common denominator among these studies is technological advancement; there were all done in low and middle income countries (LMICs). A sound ergonomic practice is an effective way to reduce exposure to the risk factors of WRMSDs (Quellet & Vezina, 2014; Middlesworth, 2015; Ekechukwu et al, 2018b). The lack of this may be responsible for the increasing WMSD prevalence in this population that has been termed “an impending epidemic” (Epstein, et al., 2018). Physiotherapists, Nurses, Dentists and other healthcare workers are involved in a wide range of physically demanding manual jobs which could pose a great risk of WRMSDs (Waters, 2010). This is due to long hours involving repetitive movements, less time to rest, static and awkward postures and challenges with work environments (Gadjradj et al, 2020). When HCPs are affected with WRMSDs, this would reduce the workforce and pose a threat to the health of individuals and the nation at large (Ekechukwu et al, 2020).

Safety professionals in engineering apply ergonomics in designing products for human users. Research has proven that sound ergonomic design is one of the most effective ways to reduce exposure to risk factors that are known to causes WRMSDs (Quellet & Vezina, 2014; Middlesworth, 2015). These are one of the major causes of occupational morbidities and are usually associated with financial and psychosocial burden (Egwuonwu et al, 2016). It is therefore important that ergonomists in these fields strive to establish ‘functional partnership’ with other professionals involved in addressing the challenging problem of improving such sub-optimal working conditions. Finally, it is pertinent that academics in engineering and health, and the harbingers of knowledge be richly informed about the subject matter ‘ergonomics’ in order to impart this knowledge onto budding professionals.

Conclusion

Engineers and HCPs have a fair knowledge/awareness of ergonomics but its practical application among these cohorts is poor. There is no significant difference in the knowledge, awareness and practice of ergonomics between engineers and health care workers. There is need for increased exposure of these professionals to ergonomics at the early stages of their training.

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