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Ergonomics and Occupational Health Issues in Diagnostic Imaging: A Survey of the Situation at the Korle-Bu Teaching Hospital

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ABSTRACT

The practice of Radiology requires the performance of many labour-intensive tasks relating to the delivery of quality patient care. Poor working conditions could lead to increased adverse effects on the professional which, in turn may have deleterious effects on the work performance; hence the need to ensure effective working conditions. The study sought to assess the ergonomic situation of the various imaging units at the Korle-Bu Teaching Hospital (KBTH). The subjects were final year student radiographers, qualified diagnostic Radiographers, and Radiologists at the KBTH. A quantitative research design, using a descriptive survey, was conducted as the researcher sough to obtain information about what existed with respect to the conditions within the imaging departments. A response rate of 95% was achieved. The majority of the respondents (87.3%) lacked training on workplace ergonomics. Additionally, there were ergonomic injuries that existed among the participants and these affected their health. The ergonomic situations at most imaging units within KBTH were not up to standard and these affect the productivity and health of the professional in the form of musculoskeletal disorders, thus requiring attention.

Key words: Ergonomics, Radiographers, Radiologists, Sonographers, Musculoskeletal injuries

1. INTRODUCTION

Diagnostic imaging has become one of the fastest growing professions in terms of technology and machinery which requires high technical skills for its implementation. The quest to fulfill personal career goals and organizational objectives may expose employees to work-related conditions that are inimical to the health of the worker. There has been countless number of physical injuries reported by Radiographers and Radiologists, with majority of them complaining of discomfort, strains, and bodily pains during and after radiologic procedures (Long et al. 2006; Parker 2001).

The practice of Radiology requires many labour-intensive tasks relating to the delivery of quality patient care. Such activities include lifting, bending, pushing and maintaining awkward position for a prolonged period of time (Ballinger et al. 2008; Bork et al. 1996).

It has been reported that ergonomic injuries affect nearly 600,000 healthcare professionals annually which may include Radiographers and Radiologists (Parker, 2001).The U.S. Bureau of Labour Statistics reports that more than 60% of workplace illnesses, each year, are associated with Repetitive Stress Injuries (RSI) which arises from the job technicalities (Long et al. 2006). However, a conducive working environment with attention to the basics of workplace ergonomics has been found to reduce fatigue, increase productivity, job satisfaction and work efficiency (Goyal et al. 2009).

The researcher observed that most radiology professionals complain of discomfort, tiredness and bodily pains during and after work. Hence, the aim of the study was to assess the ergonomic situation of the diagnostic imaging units of the KBTH.

The study sought to answer the following questions:

- What is the ergonomic situation of the Radiology department of the KBTH?
- What ergonomic risk factors are associated with Radiology work place injuries?
- What ergonomic injuries or health issues exist within the Radiology profession?

Ergonomic stressors such as repetitive motion, awkward posture, and weight of object lifted may be related to the development of musculoskeletal disorders such as back pain (Sjogaard & Sogaard 1998; Latko et al. 1999; Keyserling 2000a; Keyserling 2000b). It has been reported that there is a causal association between work place exposures and the occurrence of injuries (Murphey & Coffin, 2002a). Job-related stressors have been reported to be on the top of list for causing work-related health issues (Ballinger et al. 2008).

Despite decades of ergonomic research, Musculoskeletal disorders (MSDs) are still considered to be one of the biggest problems facing workers (Neumann & Winkel 2004; Ballinger et al. 2008). Lack of attention to ergonomic design not only decreases efficiency and productivity but also causes harm in the form of RSI, eye strain, backache, neck and shoulder pain (Carter & Banister 1994).

Hence optimization of workplace ergonomics should be a consideration in the basic design of any modern radiology unit where safety practice is ensured (Harisinghani et al. 2004; Ballinger et al. 2008).

2. APPLICATION OF ERGONOMICS IN RADIOLOGY

A proper ergonomic environment comes with high economic gains (Kolb 2002) despite the high cost involved in its implementation (Runny 2000; Murphey & Coffin 2002a).

The transition from film-based to a filmless PACS-based environment has resulted in improved workflow, increased productivity, job satisfaction and diagnostic accuracy (Reiner et al. 2001; Goyal et al. 2009). Outputs of Radiologists have improved with a shorter waiting time of patients who require radiological interpretation (Mehta et al. 2000; Hayt et al., 2001; Reiner et al. 2001).

Prabhu et al. (2005) however indicate that it is essential to optimize computer monitor screens in order to avoid eye strain, and therefore reduce fatigue and film reporting errors.

In separate studies by Henning et al. (1997) and Dababneh et al. (2001), it was identified that small breaks to adjust position and changing the focus of the eye away from the computer every 20 minutes reduce the incidence of musculoskeletal distress. This implies that with proper ergonomic environment, all these hazards could be avoided thereby enhancing productivity and efficiency of workers.

The Society of Diagnostic Medical Sonography (SDMS) reported that more than 80% of its members scan in pain and 20% of these professionals eventually experience a career-ending injury directly related to ergonomic issues (SDMS May 2003; Parhar, 2004).

A survey in Canada and the United State found that 57% of the sonographers had wrist injuries while 55% had finger injuries that were work-related (Murphey & Coffin 2002a). Research has also shown that prolonged grips of transducers with awkward postures lead to injuries of the upper extremities (Keyserling 2000a; Murphey & Coffin 2002a). Moreover, Murphey & Coffin (2002a) emphasized that ergonomically designed transducers should be well balanced, light in weight and appropriate in width to allow the Radiologist/Sonographer effective and comfortable manipulation of the transducer during scanning.

Studies have also shown that the use of overhead fluorescent lighting increases ambient light levels (Siegel et al. 2000; Wade & Brennan 2004). Again, the relative balance between monitoring light output and background reading room lighting plays a significant role in determining the degree of workers' fatigue as well as efficiency and productivity (Harisinghani et al. 2004; Wade & Brennan 2004).

According to Long et al. (2006), problems such as headaches and eyestrain may result from improper workplace lighting.

Similarly, bad seating and awkward posture may have a deleterious effect on the body. In a study by Vanderpool et al. (1993) among sonographers, awkward posture correlated positively with physical symptoms, contrary to upright posture.

Repeatedly looking at reference materials at the side of viewing screen, looking at a keyboard for prolonged periods of time, and high monitor placements lead to neck and shoulder pain from the continuous tilting of the head (Harisinghani et al. 2004; Prabhu et al. 2005).

Ergonomically designed chairs not only distribute a person's weight evenly to avoid back and neck strain but can also be adjusted to the user's height to ensure that the feet rest flat on the ground or a surface (Harisinghani et al. 2004; Prabhu et al. 2005)

3. OCCUPATIONAL HEALTH ISSUES IN RADIOLOGY

Occupational hazards may be in the form of a physical health issue that affects the nerves, muscles, joints, tendons and ligaments originating from manual exertions, awkward repetitive movements, poor working posture and equipment placement (Ransom 2002; SDMS May 2003). This implies that, the job description of radiology professionals also expose them to these symptoms (Ransom 2002; Bergeron et al. 2006).
Studies in the United Kingdom showed that 71% of Radiographers had MSDs believed to be job-related (Ransom 2002). Additionally, studies report that about 137 workers are believed to die daily on work-related diseases (Ezedunka 2009). In Australia, the overall incidence of work related musculoskeletal disorders(WRMSDs) among sonographers is estimated to be 205 per 1000 persons per year, with 95.4% of sonographers reporting some degree of musculoskeletal pain related to their job (Murphey & Coffin 2002a).

In a study by Vanderpool et al. (1993), 86% of sonographers reported having carpal tunnel syndrome. Additionally, Ugwu et al. (2007) reported that Radiographers in South-Eastern Nigeria experience work-related biomechanical stress symptoms in almost all anatomical regions examined. Upper back pain was the most prevalent with in the study. In a similar study involving medical students, 83.4% experienced musculoskeletal symptoms which were attributed to stress related work overload (Egwu et al. 2006).
Comparing various research works, about 40% of the healthcare workforce tends to experience low back pain (LBP) during the year with an average of 74.5% of Radiographers having experienced one form of workplace injuries or the other (Bergeron et al., 2006) particularly those with heavy workloads (SDMS May 2003). Research by Mercer et al. (1997) showed associations between various aspects of the job and symptoms such as eyestrain, muscle strain, carpal tunnel syndrome and stress. The authors attributed muscle strain and injury of the low back to performing ultrasound scans with a poor sitting posture or pushing the ultrasound machine. Similarly, Radiographers who perform computerized modalities such as Computed Tomography (CT) and Magnetic Resonance Imaging (MRI) are more likely to experience spinal stress from sitting at a console for long hours and RSI from intensive keyboard work (Long et al., 2006).
Khair (2003) has indicated that Radiographers suffer high incidence of work-related injuries compared to other health professionals. Compared to Physiotherapists, Radiographers were more at risk (Khair 2003). Occupational health issues are also reported to be generally more prevalent in males than females (Khair, 2003; Raj, 2006). Among Radiographers, according to Weinberg and Creed (2000), females have better and sharper coping abilities than males. Khair (2003) had indicated that these injuries are more prevalent in males than females.

4. METHODOLOGY

4.1 Research Design

A descriptive survey using a quantitative research design was used for this study as the research sought to obtain information about what existed with respect to the conditions of the imaging units (Key 1997).

4.2 Study Site and subjects

The study was conducted at the Radiology department of the KBTH, Ghana. The Hospital in Ghana has the most number of radiology professionals. It is the largest and only teaching hospital in Ghana where Radiographers are trained. All diagnostic Radiographers and Radiologists at post at the KBTH were recruited to participate in the study. In addition, final year student Radiographers who have had at least a year of clinical radiology experience were involved in the study.

4.3 Sample size and sampling method

The entire population of Radiographers, Radiologists and final year student Radiographers were the targeted subjects. This was because the population was too small to select from. In total, fifty-eight (58) subjects were targeted out of which 55 responded to the questionnaire, which included 34 Radiographers, 11 student Radiographers and10 Radiologists. A convenient sampling method was used since sampling was done based on subjects who were present at the time of questionnaire administration.

4.4 Research tool

A structured questionnaire, with both open and closed ended questions was used in the data collection.

4.5 Inclusion and exclusion criteria

Qualified Radiographers and Radiologists as well as final year student Radiographers with at least a year of clinical radiology experience were considered. Therapy Radiographers and non-final year student Radiographers were excluded. This is because students with less than a year of clinical experience may not be fully exposed to rigorous routines of the professional duties.

4.6 Pilot Study

A random selection of five subjects from the prospective respondents was used to assess the validity of the questionnaire to expose any ambiguity (Bailey 1997). However, there was no modification to the questions as no ambiguity was detected. The five respondents were excluded from the main research.

4.7 Data Collection and Analysis

The questionnaires were personally administered to the participants within a week after offering them an explanation on the aim of the study and how to complete it. An informed consent form stating the purpose of the study as well as assuring the participants of the confidentiality of their information was also attached to the questionnaire. In all, 58 questionnaires were administered to the respondents. The data collected was entered into a database and statistically analyzed using Microsoft Excel 2010 statistical software package. The results were presented pictorially in the form of graphs and tables, with percentages and proportions in the quantitative aspect to aid in data summary.

5. RESULTS AND ANALYSIS

A response rate of 95% was achieved. More males (58%) participated in the study than females. Majority of the respondents (53%) were below thirty years. 12.7% of the respondents who were solely Radiographers had received training on workplace ergonomics. 95% rated the ergonomic standard at their various units to be poor. 65% of the respondents reported often experience workplace injuries.

Neck and lower back injuries were the most prevalent reported by student Radiographers and their counterpart qualified Radiographers. On the contrary, injuries to the shoulder (100%), eye (100%), wrist/ hand (90%) were the most prevalent reported by Radiologists.

Table 1.1 illustrates that students and qualified Radiographers sustained injuries in almost all the activities. Moreover, all the Radiologists reported sustaining injuries from film reporting and the gripping of ultrasound transducer. It is also evident that all the three groups mostly engage in sitting and standing for long hours. Most of the respondents reported poor condition of the working environment as illustrated in Table 1.2.

6. DISCUSSION

Majority of the students Radiographers were males. This observation could stem from the erroneous impression in Ghana that science-related professions are best suited for males. It may also be the fear of radiation hazards related to child birth among females of child bearing age hence, leaving the profession at an early age. 53% of respondents were below the age of thirty years which might be that majority of the youth in Ghana prefer the health sector where there is a ready job offer as compared to other sectors of the economy.

Almost all the respondents have a considerable knowledge about workplace ergonomics. Most of the respondents, (students 100%, Radiographers 79.4% and Radiologists 50%) reported to have some level of knowledge about workplace ergonomics. However, when it came to the point that respondents were asked to define or state the purpose of workplace ergonomics, the majority could not. Most were either left blank or inappropriately defined which contradict their previous response that they have knowledge of workplace ergonomics. This trend could be due to the respondents' inability to undergo any form of in-service training or workshops in order to abreast themselves with current ergonomic issues. Only 12.7% out of the total respondents reported having received training on workplace ergonomics. In addition, 95% of the respondents reported the ergonomic standard at the various imaging units to be poor. This may be attributed to the high estimated cost of implementation of ergonomic standards and its training (Runny 2000; Murphy & Coffin 2002a).

6.1 Ergonomic Risk Factors and Workplace Injuries

Result from Table 1.1 shows that the respondents experience work-related biomechanical stress injuries in almost all the anatomical regions examined. A similar situation had also been identified by (Murphey & Coffin 2002a; Ugwu et al. 2007).

Lower back musculoskeletal symptoms were the most prevalent reported by Radiographers (85.3%) followed by neck and shoulder symptoms. This was in contradiction to that reported by Ugwu et al. (2007), where most respondents experienced such symptoms in the upper back. The finding that low-back was found to be the body part with the highest involvement of musculoskeletal disorders among the respondents may imply that the low-back is more exposed to mechanical injury.

It may also be that respondents who engage in lifting and positioning of patients are not using the right posture in the performance of their jobs (Ransom 2002). Again, the findings could be related to the assumption of awkward posture and the use of old working methods (Bergeron et al. 2006; Tella et al. 2009). The accompanying prevalence of shoulder and neck pain could be due to strain of the neck muscles in the course of moving the x-ray tube (Harisinghani et al. 2004; Ugwu et al. 2007). Furthermore, injuries to the neck, shoulder and the back may be due to the fact that chairs are not ergonomically designed to distribute a person's weight evenly (Harisinghani et al. 2004).

In addition, only 24% of Radiographers reported of eyestrain compared to radiologists. This is because this group of radiographers do not involve in film interpretation unlike their counterpart Radiologists (Ugwu et al., 2007). The fewer number of Radiographers who did might be those who engage in computerized modalities such as CT and MRI scanning which involve the use of computer monitor screens.

At the KBTH, film reporting and ultrasound are solely performed by Radiologists. This may account for the high prevalence of eyestrain (100%) since most of the Radiologists' time is spent on film interpretation (Table 1.1). Additionally, problems such as eye-strain might be that computer monitor screens for medical use and film viewing boxes used in film reporting are not highly optimized for use (Prabhu et al. 2005). It may also be as a result of Radiologists who focus the eyes for a long time on monitor screens and viewing boxes during ultrasound scanning and film reporting (Dababneh 2001).

As a radiation protection measure, radiology professionals are beseeched to put on lead rubber protective gowns during special examinations such as hysterosalpingography, micturating cystourethrogram and interventional procedures. The weight of lead rubber aprons may account for the high prevalence (100%) of shoulder injuries among the Radiologists. Injuries to the wrist and hand may be due to prolonged grips and awkward position of the wrist during ultrasound scanning (Murphey & Coffin, 2002a). In addition, the high prevalence of injuries to the wrist/hand (90%) reported by doctors and radiologists may result from film interpretation which involves a lot of writing/typing.

65% of the respondents often experienced workplace injuries while 92.7% of the total respondents attributed the injuries to the nature of job done. These revelations were in agreement with the findings of Ransom (2002) and Murphey & Coffin (2002a). Lack of training on workplace safety could be one reason for such observations. Because most of the respondents have not had any training on workplace ergonomics, they have difficulty in recognizing early signs of work-related injuries and how to report them.

Similarly, 83% of respondents revealed that the workplace injuries affected their health and work output. These result in decrease in patient throughput and the delay in film reporting. Some of the effects reported by the respondents were:

"I occasionally absent myself from work due to the pains and stress"

"I easily commit unpardonable errors due to frequent pains and tiredness"

"I find it difficult performing other personal activities after work due to the pains''

The decrease in patient throughput may be due to stress placed on the few professionals available, since KBTH is the only Teaching hospital in Ghana where Radiology professionals are trained. Low optimization of computer monitor screens and film viewing boxes may also account for errors incurred from computerized modalities and film reporting (Prabhu et al. 2005).

6.2 Conditions of Working Environment

It was evident that all the participants work under adverse conditions. The study shows high level of disagreement in most of the working conditions the respondents found themselves.

Table 1.2 shows the working conditions of the various units were not conducive which may be due to the high cost involved in the implementation of ergonomic standards. The bad conditions reported could be the reason for the high prevalence of injuries sustained by the respondent in almost all activities involved.

Problems with seating could result in awkward posture which increases the incidence of back pain and neck strain as indicated by the respondents (Harisinghani et al. 2004). Lack of servicing and maintenance of equipment and accessories could be due to the absence of frequent servicing and proper quality assurance programmes at the various units which leads to the frequent break-down of the machines. The absence of rest rooms in most of the imaging units implies that most of the respondents find it difficult to rest when they are tired and therefore are likely to commit errors. The conditions reported not only pose health threat to the participants but could also reduce productivity, job satisfaction and diagnostic accuracy (Reiner 2001; Goyal et al. 2009). Examination/ reporting rooms were reported to be less spacious which limits the number of staff and students accommodated at a time. Furthermore, the congestion makes it difficult for easy manoeuvring which hampers workflow.

However, 69% of the respondents reported good lighting conditions in their various units. The manual lifting and transfer of patients aggravate the injuries of patients, and also expose the professional to musculoskeletal injuries. In addition, lack of break time during work was found to be a problem in some sections of the respondents (48%) due to shortage of professionals and large patient turnout. Safety, comfort and efficiency are greatly affected due to the persistence of these workplace hazards. It is thus not surprising that 63% of the respondents felt uncomfortable in their working environment. Below are some of the recommendations from the respondents concerning the circumstances under which they work:

"Old equipment and accessories should be replaced with new ones while faulty ones are frequently serviced"

"Restrooms should be provided and adequately furnished"

"Break-time should be instituted with specific periods"

"Quality assurance programmes should occasionally be carried out at the various units"

7. CONCLUSION

The results showed that the ergonomic situation at most of the imaging units were not up to standard and thus affected the productivity and health of the professional, hence requires attention. Most of the radiology professionals lacked training in workplace ergonomics, hence, had little or no knowledge concerning it. There were ergonomic injuries that existed among the participants which affected their health. Also, most of the imaging units were not in good condition.

Although the study yielded some very useful information, it does have limitations that should be addressed in future studies. The sample population consisted of students, Radiographers and Radiologists at the KBTH, which does not represent the whole country. There was limited literature resource in the local journals and libraries, compelling the researcher to over-rely on literature from external sources. In this study, conditions of workplace settings were studied. Future research could focus on quality assurance programming of the Radiology department. Further research comparing the application of ergonomics in the radiology setting with other health care professions could be performed on a larger sample population.

8. RECOMMENDATIONS

The incessant underinvestment in the health sector coupled with poor working conditions could lead to decline in job satisfaction which in turn can have deleterious effects on work performance. Radiology as a profession presents inherent risks to practitioners, while for employers there are direct and indirect costs of managing problems that do not only affect practitioners but also have consequences on trainees and patient care. For a discipline that already has a shortage of professionals, this is a serious issue. The following are therefore recommended:

- Establishing positive practice environments across health sectors is essential to guarantee health workers' wellbeing as well as patient safety.
- It is imperative that authorities give staff the needed training on workplace ergonomics and safety measures to minimize injuries sustained and to enhance efficiency.
- There is also the need for proper maintenance of equipment and utilities to enhance workflow rate and reduce stress on the practitioner.

- Finally, regular medical examination of radiology professionals should be encouraged at to avert degenerative psychosocial and musculoskeletal stress conditions.

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Figure 1.0: Gender distribution among participants

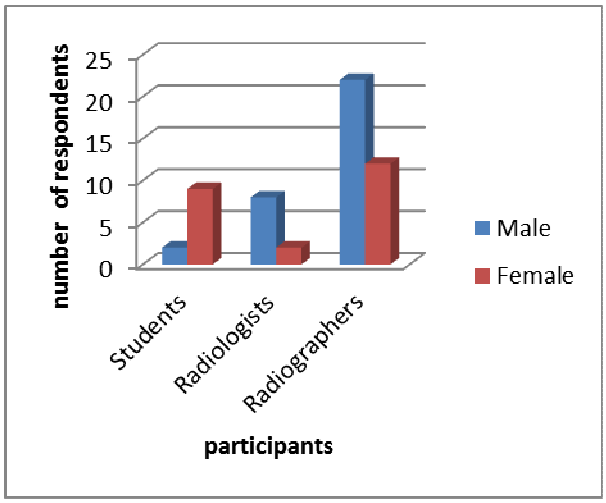

Table 1.0: Anatomical regions injury was experienced

Students N=11 *Radiologists N=10* *Radiographers N=34*

Anatomical region	Students	Radiologists	Radiographers
Neck	4	5	21
Shoulder	3	10	16
Hip/Thigh	2	2	10
Upper back	2	3	11
Middle back	1	0	12
Lower back	5	4	29
Elbow	0	0	2
Wrist/Hand	1	9	11
Eyes	0	10	8

Table 1.1: Suspected causes of the injury

Students N=11 *Radiologists N=10* *Radiographers N=34*

Activities	Student	Radiologists	Radiographers
Reaching overhead to move X-ray tube	0	0	20
Lifting or wearing of lead apron	5	9	19
Moving /pushing of objects/ equipment	7	3	18
Sitting/standing for long hours	8	10	20
Patient positioning	9	3	26
Intensive computer and keyboard work	0	3	7
Lifting and carrying of objects	9	0	23
Film reporting	0	10	0
Gripping of ultrasound transducer	0	10	3

Table 1.2: Condition of working environment

N=55

CONDITIONS AT THE UNIT	AGREE	%	DISAGREE	%
Proper working conditions of equipment and accessories used	20	36	35	64
Good lighting conditions	38	69	17	31
Comfortable seats/chairs in the duty/reporting area	12	22	43	78
Proper arrangement of equipment and accessories exist	23	42	32	58
Frequent servicing and maintenance of equipment	14	25	41	75
Frequent check-up of electrical wirings	6	11	49	89
Spacious examination/reporting rooms	14	25	41	75

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