Asian Journal of
Science, Technology, Engineering, and Art

e-ISSN : 3025-4507
p-ISSN : 3025-5287
Index : Harvard, Boston, Sydney University, Dimensions, Lens, Scilit, Semantic, Google, etc

https://doi.org/10.58578/AJSTEA.v1i2.1869

ERGONOMIC RISK ASSESSMENT FOR MUSCULOSKELETAL DISORDERS AMONG ULTRASONOLOGISTS OF PESHAWAR: A CROSS- SECTIONAL SURVEY

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Article Info:

Submitted:	Revised:	Accepted:	Published:
Oct 11, 2023	Oct 30, 2023	Nov 5, 2023	Nov 11, 2023

Abstract

Background: Ergonomics is the study of analyzing the demands of a task and aligning them with the abilities of the worker to establish an optimal work environment that minimizes the likelihood of injuries while maximizing efficiency. In safety and ergonomic literature, risk factors and consequent risks are common conceptions. Ergonomics has an impact on the adapted posture of workers developed due to the demand of their work procedure. Disorders related to bad posture and usage of different equipment and tools in a workplace can be solved through better ergonomics. Objective: To determine the ergonomic risk assessment for musculoskeletal disorders among Ultrasonologists of Peshawar. Methods: A cross-sectional study was conducted on a total of 117 participants from both public and private sector hospitals of Peshawar. Census sampling technique was used to select the participants. Consent was obtained and data was recorded using the Rapid Upper Limb Assessment (RULA) questionnaire. Results: Among the participants (n=117), majority were from the age group 31-40 years, n=48 (41%) with a mean age of 36 ± 7. Regarding the gender distribution, males were greater in number, n=88

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(75.2%). The ergonomic risk for musculoskeletal disorders reveals that, majority of the participants fall in the medium risk, followed by low risk, negligible risk and very high risk, respectively. The analysis showed statistically significant association of ergonomics risk with age, gender, working hours, organization and work experience. Conclusions: It was concluded that the ergonomic risk for musculoskeletal disorders among Ultrasonologists is moderate to low followed by high risk. Males have higher ergonomic risk compared to females. Further investigations are needed

Keywords: Ergonomics, Musculoskeletal disorders, Ultrasonologists, Rapid Upper Limb Assessment (RULA), Workplace ergonomics, Risk factors, Ergonomic risk assessment

INTRODUCTION

Ergonomics is the study of analyzing the demands of a task and aligning them with the abilities of the worker to establish an optimal work environment that minimizes the likelihood of injuries while maximizing efficiency (Alshuwaer, 2019). People generally consider ergonomics in the domain of manual work, like changing body position during an activity or changing material setting, such as modifying dimensions of work bench and stools at the workplace. However, it is the knowledge-based implementation of drafting and designing physical environments and workstations (Brusin, 2011). Musculoskeletal disorders (MSDs) are one of the main job-related disorders in the world ranging from 20% to 60 % in United States, Europe and Australia (Bello, 2019). The estimated prevalence of Work Related Musculoskeletal Disorders (WRMDs) is estimated in a range of 63% – 91% for health workers in comparison to the general population which is 13% – 22% (Cavalini et al, 2017). Correspondingly, sonographers are reported to have a high prevalence of work related musculoskeletal disorders such body aches, pain in back, upper extremities and neck (García-Lallana et al, 2011). In Solography, which is a technique of medical imaging; ultrasonic waves are passed through body areas to produce images/pictures of different structures in the body. The work of Ultrasonologists demands prolongs posture during scanning processes. Ultrasonologists spend most of their working hours in an ergonomically bad sitting position. Functioning in a prolonged awkward position compresses the inter-vertebral discs in the lumber region due to unusual load and repetitive stress. This load in sitting position is approximately 40% times more than the load sustained during standing position. For the development of injuries, unchanging posture is a major

risk because it causes ischemia, compromising the flow of blood and reducing oxygen level to muscles of the body. In the instance when muscle power and strength is sixty percent greater than the paramount capacity of muscle, the flow of blood in that particular area is interrupted and as a result, anaerobic respiration starts and by- products are released which triggers pain, aches, and fatigue in muscles (Horkey & King, 2004).

According to a survey, the frequency of occupation-related musculoskeletal complaints in Ultrasonologists has been recorded as high as 80-90 %. The neck, low back, wrist, and shoulder are the common symptomatic areas reported in the past surveys (Haghshenas et al, 2018). Some authors reported the commonest symptomatic areas like neck and low back but some of the authors highlighted that the highest prevalent area is upper extremity (Ismail et al, 2009). In Ultrasonologists, the MSDs have also been stated as a predecessor to long-term disorders and this ratio of injuries are increasing with the work experience in Ultrasonologists (Irurhe et al, 2013). The ergonomic risk related to occupation is a major cause of work related disability and pain among ultra-sonographers. There are multiple risk factors like applied force, repetition, vibration and awkward posture for prolong time, gender, BMI and mental stress level which causes work related musculoskeletal disorders (WRMDs) among sonographers who are performing ultrasonography for more than 10 years (Jaffar et al, 2011).

Previous literature focused on ergonomic risk assessments among various employees. However, to the best of authors' knowledge there was no such study among health care workers, particularly Ultrasonologists. Therefore, the aim of this study was to determine and assess the ergonomic risk among Ultrasonologists in both public and private hospital of Peshawar.

METHODS

It was a cross- sectional study that was conducted over time span of six months at different public and private Tertiary hospitals care hospitals of Peshawar. Census was done to include all the Ultrasonologists in the study and a total of 117 Ultrasonologists using ultrasound for different medical purposes (diagnosis, Treatment) were included in this study. Both male and female participants working in government and private hospitals of Peshawar, with a age limit of 25- 60 years, having working experience ≥ 1 year performing ultrasonography procedure for 5 hours or more were included in this study . Similarly

participants with a recent history of major trauma, surgery, orthopedic conditions any known systematic diseases. (Arthritic changes, Myalgia, blood) or hormonal disorders etc. Moreover subjects who have history of trauma such as Road Traffic Accidents (RTAs) or fall from high surfaces or sonographers who were irregular (< 60% attendance) were excluded from the study.

The proposed study was initially approved by Graduate committee (GC) of the Institute of Physical Medicine and Rehabilitation, Khyber Medical University. After that it was approved by Advance Studies and Research Board KMU. Ethical certificate was obtained prior; to proceed with research study .Permission was obtained from the concerned heads of the hospitals for data collection. All the willing participants were screened according to the inclusion and exclusion criteria. Those meeting the criteria were briefed about the study and an informed consent was signed by them. After signing a consent form, participant's data was collected through a questionnaire named, Rapid Upper Limb Assessment (RULA). RULA is questionnaire that is used to assess ergonomic risk for musculoskeletal discomfort with excellent validity and reliability (Khajehnasiri et al, 2021). RULA scale is mainly comprised of 4 categories (Negligible, Mild, moderate and severe) based on its scoring sinologist with score 1-2 are place in no risk category, similarly 3-4 are placed in category of low risk, while 5-6 in category of medium risk while on the other hand 6 plus were place in category of very high risk of MSK related issues. Demographic data was asked from each participant at the start of data collection, after signing of informed consent.

RESULTS

The mean age of participants was 36±7. Out of all n=117, majority of the participants were from the age group of 31-40 years n=48 (41%). Greater number of participants were male n=88 (75.2%) that participated in the study and only n=29 (24.8%) were females. Among the participants, 6.8% were underweight, 56.4 %were in the normal range, followed by 36.8% overweight and no obese participants were found.

Based on education distribution, the highest number of the subjects were bachelors in the radiology field n= 54(46.2%), followed by consultant doctors n= 52 (44.4%), Ph.D. group n=8 (6.8%), while a fewer number of the subjects were from the category of technicians n= 3 (2.6%). Most of the participants n=54 (46.2%) had a working experience of 1-5 years

followed by n=29 (24.8%) had a work experience of 6-10 years. A detailed description is mentioned in Table 1.

Table 1: Basic Demographic characteristics of Participants

Age Categories	**Frequency**	**%**
25-30 years	42	35.9
31-40 years	48	41.0
41-50 years	16	13.7
51-60 years	11	9.4
Qualification	**Frequency**	**%**
MBBS Or MD	52	44.4
Diploma in ultrasound	3	2.6
BS in radiology	54	46.2
Ph.D./ specialization	8	6.8
Organization	**Frequency**	**%**
Private	86	73.5
Government	31	26.5
No of patients scanned per day	1-10	43.6
	10 above	56.4
Participants at Ergonomics Risk	**Frequency**	**%**
Very High Risk	7	60
Medium Risk	59	50.4
Low Risk	30	25.6
Negligible Risk	21	17.9

Association of Ergonomic Risk with Age, Gender and Working Experience

Participants with the age of 31- 40 years were at "very high risk" than the 25-30 years' age category. A statistically significant association was found between different age categories and ergonomics risk levels as the p value was 0.002, shown in table 2. Likewise, a significant association existed between gender and ergonomics risk demonstrated by the p value of 0.05. Work experience and ergonomics risk showed a significant association demonstrated by p value of 0.00 which employs that sinologists who have more work experience are

prone to very high ergonomic risks, as compared to those who have less work experience. Details are shown in Table 2.

Table 2: Association of Ergonomic risk with Age, Gender and Working Experience

Age Group	Negligible Risk	Low Risk	Medium Risk	Very High Risk
25-30 Years	7	17	17	1
31-40 Years	5	12	26	5
41-50 Years	5	0	10	1
51-60 Years	4	1	6	0
Gender	**Negligible Risk**	**Low Risk**	**Medium Risk**	**Very High Risk**
Female	5	14	10	0
Male	16	16	49	7
Experience	**Negligible Risk**	**Low Risk**	**Medium Risk**	**Very High Risk**
1-5 years	10	23	21	0
11-15 years	4	1	12	4
16-20 years	5	1	7	0

Association of ergonomic risk with BMI, working hours and patient scanned per day

Regarding body mass index, greater percentages of individuals were found in the low risk and medium risk categories which shows that there is no statistical association between ergonomic risk and BMI i.e. value is > 0.05. Furthermore, upon application of the Chi-square test for statistical association between ergonomic risk and organization, a statistically significant association was found (p=0.000). While finding the association of ergonomic risk with working hours, a statistically significant association between the said variables, p=0.004. A greater number of the participants were in the medium risk and very high-risk category. The frequency of "medium risk" and "very high risk" for individuals who worked for five hours is n=29 and n=2, respectively. While those subjects who worked for more than 5 hours, the frequency ratio was "medium risk" and very high risk" (n=40) and (n=6) respectively. In the same way cross-tabulation of the next two variables, ergonomics risk and number of patients seen per day was analyzed as shown in figure 2 The calculated value of the chi square test is greater than 0.05 (p > 0.05) which indicates that there is no statistically significant association between the two variables.

DISCUSSION

Ergonomic risk leads to different musculoskeletal disorders (MSDs) which in turn lead to hospitalization, absenteeism from work, and loss of work productivity. This study was conducted in both private and public health sector hospitals of Peshawar to observe ergonomics risk among Ultrasonologists who use ultrasound imaging procedures as a diagnostic medical technique. Many research studies are conducted globally to find out the ergonomic risk in health workers, particularly those who are working for prolonged hours and have night shifts (Morton & Delf, 2008).

Our study found out that most of the health sector workers of the radiology department are in medium ergonomics risk which is 43.6% and 15.4% for private and government hospitals respectively and a significant association existed among different variables such as ergonomics risk with age categories, gender, work experience, and working hours but no statistically significant association was found between ergonomics risk with body mass index (BMI) and other demographic variables like an ergonomics checklist and the number of patients seen per day. This study found out that ergonomics risk is higher in male participants (47.9%) as compared to female workers, which is quite unusual as majority of the literature revealed that the risk of MSDs is higher in the female gender. The reason may be the low percentage of females in the study (F= 25%, M=75%) or less duration of working hours and taking breaks in extended work procedures (Muir et al, 2004). It is statistically significant that ergonomic risks are observed more in senior health care workers, the results of which are similar to a study done on office workers by Rahman et al (2018). Another disagreement of ergonomic risk with BMI cross tabulation indicates that these variables are not statistically significant which is against the literature available for the association of these two variables. The inferences of our study are different from the studies present in the literature. The reasons may be their less work experience, healthy diet, taking breaks between ultrasound procedures, and changing their positions after they get tired in a single position (Rahman et al, 2018).

Most of the research articles' findings coincide with the results of our study that workers who spent more time in a sustained posture for prolonged hours, have greater ergonomics risk and moreover their statistical association declares that they are more vulnerable to MSDs (Scholl & Salisbury, 2017).

Most of the literature discloses that, at large, radiologists are scanning more than 10 patients daily and there is a positive association between ergonomic risk and the number of patients seen per day (Vanaclocha et al, 2017), but in our study applying the cross-tabulation, there is no statistically significant association between these two variables. Whereas study conducted by MR Val George et al found a positive association between ergonomics risk and patient visits to the hospital (Choi & Brings, 2016).

According to the recent research study of Cathie Scholl, more than 25% of the radiologists are facing barriers in their work, greater patients flow, patients increased BMI, portable exams, and non-cooperative patients. Some of the blockades are not under the control of radiologists, such as patient obesity and patient response, while other hurdles can be moderately controlled such as patients seen per day and equipment selection according to their work needs. The risk of WRMDs can be controlled among sonographers if the focus is being kept to control adjustable barriers (Roll, 2012). In this modern world, the prevalence of WRMDs becomes a job of concern. In order to control these musculoskeletal disorders working environments are modified i.e. ergonomics education, stretching exercises between working hours breaks periods and concerning physical e issues arising due to the work environment (Val et al, 1998).

CONCLUSION

It is concluded that the ergonomics risk for musculoskeletal disorders among Ultrasonologists is moderate to low followed by high risk. Males have a higher ergonomic risk compared to females. Further investigations are needed to evaluate each risk factors i.e. abnormal posture, repetitive movements of transducer and high BMI separately and their direct effect on body of Ultrasonologists. Furthermore it is also recommended that the entire health care workers must be trained about ergonomics and its importance in their daily life and office work.

REFERENCES

Alshuwaer, T. A. (2019). Prevention of Shoulder Injuries in Sonographers: A Systematic Review. *Journal of Diagnostic Medical Sonography*, *35*(5), 392-399. https://doi.org/10.1177/8756479319850140

Brusin, J. H. (2011). Ergonomics in radiology. *Radiologic technology*, *83*(2), 141-157. https://doi.org/10.1016/j.crad.2008.08.003

Bello, I. (2019). Women, ergonomics and repetitiveness. In *Safety and health for workers-Research and practical perspective*. IntechOpen. https://dx.doi.org/10.5772/intechopen.82065

Cavalini, M. A., Berduszek, R. J., & van der Sluis, C. K. (2017). Construct validity and test–retest reliability of the revised Upper Extremity Work Demands (UEWD-R) Scale. *Occupational and Environmental Medicine*, *74*(10), 763-768. https://doi.org/10.1136/oemed-2017-104370

Choi, S. D., & Brings, K. (2016). Work-related musculoskeletal risks associated with nurses and nursing assistants handling overweight and obese patients: A literature review. *Work*, *53*(2), 439-448. https://doi.org/10.3233/wor-152222

De Bortoli, M. M., Oellingrath, I. M., Fell, A. K. M., Burdorf, A., & Robroek, S. J. (2021). Influence of lifestyle risk factors on work ability and sick leave in a general Working population in Norway: a 5-year longitudinal study. *BMJ open*, *11*(2), e045678. https://doi.org/10.1136/bmjopen-2020-045678

Evans, K., Roll, S., & Baker, J. (2009). Work-related musculoskeletal disorders (WRMSD) among registered diagnostic medical sonographers and vascular technologists: a representative sample. *Journal of Diagnostic Medical Sonography*, *25*(6), 287-299. https://doi.org/10.1177/8756479309351748

García-Lallana, A., Viteri-Ramírez, G., Saiz-Mendiguren, R., Broncano, J., & Aquerreta, J. D. (2011). Ergonomía del puesto de trabajo en radiología. *Radiología*, *53*(6), 507-515. https://doi.org/10.1016/j.rx.2011.06.007

Horkey, J., & King, P. (2004). Ergonomic recommendations and their role in cardiac sonography. *Work*, *22*(3), 207-218. https://doi.org/10.1177/1071181311551223

Hoe, V. C., Urquhart, D. M., Kelsall, H. L., Zamri, E. N., & Sim, M. R. (2018). Ergonomic

interventions for preventing work-related musculoskeletal disorders of the upper limb and neck among office workers. *Cochrane Database of Systematic Reviews*, (10). https://doi.org/10.1002/14651858.cd008570.pub3

Haghshenas, B., Habibi, E., Haji Esmaeil Hajar, F., Ghanbary Sartang, A., van Wijk, L., & Khakkar, S. (2018). The association between musculoskeletal disorders with mental workload and occupational fatigue in the office staff of a communication service company in Tehran, Iran, in 2017. *Journal of Occupational Health and Epidemiology*, *7*(1), 20-29. https://doi.org/10.29252/johe.7.1.20

Ismail, S. A., Tamrin, S. B. M., & Hashim, Z. (2009). The association between ergonomic risk factors, rula score, and musculoskeletal pain among school children: a preliminary result. *Global Journal of Health Science*, *1*(2), 73. https:// doi: 10.5681/hpp.2013.005

Irurhe, N. K., Okafor, U. C., Adekola, O. O., Odebiyi, D. O., Habeebu, M. Y. M., & Sowunmi, A. C. (2013). Work Related musculoskeletal discomforts (WRMD) in ultrasonologists: prevalence and risk factors. *World Journal of Medical Sciences*, *8*(3), 199-204. https://doi: 10.5829/idosi.wjms.2013.8.3.73100

Jaffar, N., Abdul-Tharim, A. H., Mohd-Kamar, I. F., & Lop, N. S. (2011). A literature review of ergonomics risk factors in construction industry. *Procedia engineering*, *20*, 89-97. https://doi.org/10.1016/j.proeng.2011.11.142

Khajehnasiri, F., Zaroushani, V., & Poursadeqiyan, M. (2021). Macro ergonomics and health workers during the COVID-19 pandemic. *Work*, *69*(3), 713-4. https://doi: 10.3233/WOR-210412

Morton, B., & Delf, P. (2008). The prevalence and causes of MSI amongst sonographers. *Radiography*, *14*(3), 195-200. https://doi.org/10.1016/j.radi.2007.02.004

Muir, M., Hrynkow, P., Chase, R., Boyce, D., & Mclean, D. (2004). The nature, cause, and extent of occupational musculoskeletal injuries among sonographers: recommendations for treatment and prevention. *Journal of Diagnostic Medical Sonography*, *20*(5), 317-325. https://doi.org/10.1177/8756479304266737

Mirmohammadi, S. J., Mehrparvar, A. H., Olia, M. B., & Mirmohammadi, M. (2012). Effects of training intervention on non-ergonomic positions among video display terminals (VDT) users. *Work*, *42*(3), 429-433. https://doi.org/10.3233/wor-2012-1400

Roll, S. C. (2012). Injuries and prevention in health care providers. *Work (Reading, Mass.)*, *42*(3), 309-310. https://doi.org/article/med/22741189

Rahman, M. N. A., Razak, N. S. A., Hassan, M. F., & Adzila, S. (2018). Relationship Between Musculoskeletal Symptoms and Ergonomic Risk Factors Among Office Workers. *Advanced Science Letters*, *24*(1), 587-591. https://doi.org/10.1166/asl.2018.11765

Scholl, C., & Salisbury, H. (2017). Barriers to performing ergonomic scanning techniques for sonographers. *Journal of Diagnostic Medical Sonography*, *33*(5), 406-411. https://doi.org/10.1177/8756479317726768

Sethi, J., Sandhu, J. S., & Imbanathan, V. (2011). Effect of Body Mass Index on work related musculoskeletal discomfort and occupational stress of computer workers in a developed ergonomic setup. *Sports Medicine, Arthroscopy, Rehabilitation, Therapy & Technology*, *3*(1), 1-7. https://doi.org/10.1186/1758-2555-3-22

Vanaclocha-Vanaclocha, V., Sáiz-Sapena, N., Ortiz-Criado, J. M., & Vanaclocha, N. (2017). Peripheral Nerve Entrapment and their Surgical Treatment. In *Peripheral Nerve Regeneration-From Surgery to New Therapeutic Approaches Including Biomaterials and Cell-Based Therapies Development*. IntechOpen. https:// doi: 10.5772/67946

Val Gregory, M. I. R., & Dmu, M. (1998). Musculoskeletal injuries: an occupational health and safety issue in sonography. *Educational Supplement*, 1-3. https://doi.org/10.1177/8756479304266737