

Prevalence and Risk factors for Work Related Musculoskeletal Disorders among Sonographer of Sindh Province Pakistan

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ABSTRACT

BACKGROUND: The common work related musculoskeletal disorders (WRMDs) among medical profession are pain in neck, elbow, shoulder wrist and back. Sonographers are more vulnerable to develop WRMDs as their work demands series of awkward repetitive movements.

OBJECTIVE: To determine the prevalence of work related musculoskeletal disorders (WRMDs) and to identify factors that may contribute to musculoskeletal disorders among sonologists of Sindh Province Pakistan.

METHODOLOGY: This questionnaire based study conducted at the Department of Radiology, Liaquat University of Medical & Health Sciences. The target population chosen for this study was sonologists from the Sind province of Pakistan. SPSS used to analyze the data, results presented as frequency for categorical variables and as mean for continuous variables. To identify predictor variable for WRMDs, multiple bivariate regression analysis was performed, the level of significant was set at $P < 0.05$.

RESULTS: Among 145 participants, 53.80% were University employed, while 56.54 were performing ultrasonography up to 10 hours. The prevalence of WRMDs disorder in this series was 75.17%, the mean duration of symptoms was 30.48 months. 45.9% reported it as severe. WRMDs were more prevalent and severe in those doing scanning of both abdomen and Obstetric. The Low back ache is the most common site of WRMDs found in this series (53.21%, $n=58$), followed by neck ache (24.77%) wrist joint (8.25%), finger (7.33%) and shoulder (6.42%). The result of bivariate analysis showed that severity of WRMDs correlated statistically significantly with primary area of expertise, duration of WRMDs, working experience and working hours.

CONCLUSION: The prevalence of WRMDs and its severity is significantly high among Sonographers of Sindh province.

KEY WORDS: Work related musculoskeletal disorder, sonographer, Ergonomic, Sindh.

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BACKGROUND

Work-related musculoskeletal disorders (WRMDs) is a term applied to all work related musculoskeletal pain; and is defined as "regional impairments of the muscles, tendons, nerves and joints that are associated with work-related mechanical trauma"¹. The common WRMDs among medical professionals are "pain in low back, "neck, shoulder, hand, wrist, elbow, and upper back"². The prevalence of WRMDs has been variably reported ranging from 80%³ to as high as 93%⁴. It has been estimated that in 20% of the cases, WRMDs among sonologists is severe enough to mandates change of the profession⁵.

Sonographers experience more work-related problems because ultrasound examinations involve a series of awkward repetitive movements such as: twisting the body; stretching to operate a keyboard and conduct a scan simultaneously; twisting and rotating the wrist of the hand being used for scanning;

and applying a downward pressure over the scanning hand. Even more pressure is required to conduct the tests when the patient is obese. The Sonographers should maintain various tortuous and extended body positions to achieve the angles necessary to use the transducer to assess the body parts being examined. In most of the examinations, the Sonographer is required to lean across the patient's body without shoulder or elbow support to view organs on the other side of the body⁶.

However, no studies have been conducted in Pakistan on this vulnerable population. Pakistan is one of the countries where the practice of sonography is carried out either by a medical doctor who is trained to perform ultrasound examinations, or by a radiologist. A medical doctor who performs ultrasound is known as sonologist. In contrast to the United States and Canada, there is no separate specialty certification or registration required, to perform ultrasound

examinations, in Pakistan. The reason may be that those involved in the ultrasound practices in Pakistan are licensed by Pakistan Medical & Dental Council as medical doctors, having sufficient knowledge of the human sectional anatomy and patterns of various diseases, fundamental for the practice of sonography. Sonologists working in Pakistan, during training, receives inadequate or no education regarding prevention of work-related injuries and the ergonomic factors responsible for work-related injuries. The undergraduate and post graduate courses in diagnostic radiology deal primarily with the radiation hazards to the radiologist, x-ray technologist and other radiology workers and patients. Nothing is taught in the curriculum about the work-related musculoskeletal hazards to the sonologists or other radiology workers and preventive measures. This study by inviting participants from the Sind province of Pakistan will help explore the prevalence of work related injuries and identify some of the factors that may contribute to musculoskeletal injuries to sonologists practicing in Pakistan. To best of our knowledge this is first study of its kind in Pakistan.

Objectives: To determine the prevalence of work related musculoskeletal disorders (WRMDs) and to identify factors that may contribute to musculoskeletal disorders among sonologists of Sindh Province Pakistan.

METHODOLOGY

Questionnaire

The use of a questionnaire to identify potential ergonomic and work-related problems in the work environment is a well-established method⁷. The questionnaire chosen for this study was originally designed by the Healthcare Benefit Trust, Winnipeg. This questionnaire has also been used on larger scale by British Columbia Ultra Sonographer's Association, the Health Sciences Association and the Simon Fraser University-School of Kinesiology⁸. We acknowledge and give credit to the Winnipeg Health Sciences Centre, Department of Occupational and Environmental Medicine for permission to use this survey tool for current research study. Considering the population sample being researched for this study, with permission few modifications in this questionnaire were done. After modification, a small pilot survey was done, by principal investigator, administering this questionnaire to two senior sonologists, to assess the language and wording, the understanding of the questions and the completion time. After few modifications done and it is anticipated that the questionnaire will take approximately 45-60 minutes to complete.

Purpose and research questions

The purpose of this research study is to know the prevalence, nature and severity of musculoskeletal work-related injuries among sonologists in the Sindh Province of Pakistan; and to identify the factor(s) that may contribute for its development and severity. It is expected that the results of this study may help to develop strategy to prevent WRMDs among sonologists.

Study population

Radiological Society of Pakistan and Ultrasound Society of Pakistan were contacted to assist with the recruitment of participants for the study. The target population chosen for this study was the sonologists from the Sind province of Pakistan, those full filled following inclusion criteria were invited for the study.

1. The registered medical doctors having ultrasound professionals' skills and working in any hospital or privately owned clinic, in the Sind Province of Pakistan.
2. The sonographers practicing at least
 - a) General abdominal ultrasound or
 - b) Gynecological and Obstetrical ultrasound or
 - c) Both.
3. The participant must have not been diagnosed with any of the rheumatic like disorder affecting any part of body before beginning their practice in sonography.

The exclusion criteria were:

1. Those with diagnosed rheumatic disease before or after starting professional career.
2. Those who had experienced any kind of disease which causes pain in shoulder, neck, and arm, upper or lower back before the start of their profession as sonologist.
3. Retired persons who no longer practice sonography.
4. Cardiac and Ophthalmologic Sonologists.

Data collection procedures and process

Participants were invited through mail. The envelop contained invitation letter, informed consent form, questionnaire with instructions and a stamped and pre-addressed envelope to send the consent and survey back to the researcher. The questionnaire consists of 125 questions related to the demographic, work place, work load, type of the equipment in use, questions related to type, duration, frequency and anatomical location of pain and discomfort, and ergonomic factors. Three follow up reminders on fortnightly basis were made to encourage participation.

Upon receiving the response, the questionnaire separated from the consent form, so that the names of the participant may be kept private and confidential. A letter of thanks and appreciation for participation in the study was sent to each participant by postal service. The study number on the survey forms was used for

the input, analysis and summary of the data.

Duration & Place of the Study: This study conducted at Department of Radiology, Liaquat University of Medical & Health Sciences Jamshoro Pakistan from January 2014 to December 2015.

Data Analysis

SPSS software (version 16.0; SPSS Inc., USA) used to analyze the data. Demographic variables presented as mean \pm SD/ frequency and percentages. Categorical variables were compared by using inferential of Chi-Squared analysis while continuous variables were compared using t-test statistic. To identify predictor variable for WRMDs, multiple Bivariate regression analysis was done, the level of significant was set at $P < 0.05$.

Conflict of Interest: None.

Source of Funding: None.

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RESULTS

Demographic Data:

A total of 230 questionnaires were distributed, 190 received while only 145 were validly complete with a response rate of 63%. Male sonologists were 86 (56.31%) and female were 59 (40.68%); among these 145 participants' 102 were married. The commonest age group was between 40-59 years (53.78%), and least common age group was less than 30 years (9.65%) as shown in fig 1. The mean weight and height of all respondents was 146.67 SD \pm 24.86Lbs, and 165.35 \pm 9.448 cm.

Professional Data:

In the present study 70% of the respondents were sonologists without any qualification of radiology, while 30% were qualified radiologist. The clinical experience of all participants ranges from 0.25 to 22 years with a mean of 7.99 SD \pm 4.7661years. More than 50% (53.80%) of the respondents were associated either with University or District Hospital, others were working at private clinic (14.50%), private hospital (11.03%) and rural health centers (8.96%). Those sonologists working at more than one work place constituted 11.72%. The respondents were engaged daily in sonography for variable time ranging from 4 hours to 12 hours. The 31.03% respondent were doing sonography daily for up to 4 hours, 27.58% for 4-8 hours, 28.96% between 8-10 hours and 12.41% were doing scanning for more than 10 hours. The comparison of demographic and professional data of sub-set of those reported as no WRMDs and those reported as having WRMDs is shown in table 1.

	No WRMDs (n=36)	WRMDs (n=109)	P Value
Age			
20-30	10	8	0.0141*
31-40	18	30	0.1311*
41-50	8	61	0.0396*
51-60	-	10	----
Height (cm)	166.7779 \pm 4.542	166.88 \pm 10.566	0.2981¶
Weight (Lbs.)	147.3611 \pm 24.006	146.56 SD \pm 25.243	0.8676¶
Gender			
Male	26	60	0.4577*
Female	10	49	0.3002*
Clinical Experience	3.7014 SD \pm 1.80359 (0.25-7years)	9.4128 SD \pm 4.58906 (4-22 years)	< 0.0001¶
Employment			
University Hospital	3	46	0.0088*
District Hospital	3	26	0.1434*
Rural Health Center	9	04	0.0021*
Private Hospital	9	07	0.0181*
Private Clinic	10	11	0.0548*
More than 1 place	2	63	
Working Hours			
Up to 4 hours	22	23(31.03 %)	0.0040*
From 4-8 hours	10	30(27.58%)	0.8538*
From 8-10 hours	4	38(28.96%)	0.0553*
From 10-12 hours	---	18(12.41%)	

*=chi square test, ¶= t-test

Musculoskeletal symptoms:

The prevalence of WRMDs disorder in this series was 75.17% (109/145). The gender predilection showed that it was more prevalent (55.05%) in male Sonographers as compared to female (44.95%). The mean duration of WRMDs reported was 30.48 months (ranging from 2 to 120 months), which affects daily routine life of 64.22% Sonographer. To know the severity of pain visual analogue score (VAS) on Likert Scale from 1-10 was used, however for statistical purpose the variable was converted into ordinal as mild (1-4), moderate (5-7) and severe (8-10). Overall the WRMDs disorder was reported as severe by 45.9%, moderate by 33% and mild by 21% of the participants. Among 109 Sonographers 63 (57.80%) sonologist with their primary responsibilities were doing scanning at other place as well for example private hospitals while 46 (42.20%) were restricted to their primary assignment only. The severity of WRMDs reported as "severe" by 80% of those discharging services at more than one place and 20% reported it as moderate.

Among those fulfilling only single assignment, none reported it as severe, 50 % (n=13) reported it moderate and 50% (n=13) ranked it mild.

The 74.31% participants relate their musculoskeletal pain to work, while 25.68% considered their symptoms' unrelated to work. According to the area of expertise, the WRMDs found more prevalent (65%, n=71) among those Sonographer performing scanning of both Obstetric/ Gynecological (Obs/Gynae) and abdomen; followed next in frequency (29.35%, n=32) for those doing exclusively Gynae and Obs examination while it was least prevalent (5.5%, n=6) for Sonographer doing examination of abdomen. The results also showed that the reported severity of WRMDs disorder is not only more prevalent but also more severe among those sonologist performing sonography both of the abdomen and Obs/Gynae. Among 50 Sonographers who reported severity as severe, 38 Sonographers involved in scanning of both abdomen and Obs/Gynae examination as shown in Fig 1. Among those engaged in more than 1 working place also reported WRMDs.

The Low back ache is the most common site of WRMDs found in this series (53.21%, n=58), followed by neck ache (24.77%. n= 27) wrist joint (8.25% n=9), finger (7.33%, n= 8) and shoulder (6.42%, n= 7). The site of pain with respect to gender is shown in Fig 2. The most frequently reported nature of the pain was aching (32.1%), followed by tingling sensation (22.9%) and sharp by 11.9%. The least reported nature of pain was cramping, spastic and boring, while 8.3% were unable to exactly describe the nature of the exactly. The triggering factor for pain was variably reported by the participants. The most common triggering factor was repetitive twisting of neck and trunk (26.6%) followed by sitting (14.7%) and shoulder abduction (11%). The pain was annoying enough to affect routine daily life of 56% (n=62) sonologist necessitating frequent rescheduling of routine work; 34.86% (n=38) were using NSAID regularly and 14.84% (n=14) were taking hot fomentation and massage as a remedy for their symptoms'. The 23.85% participants were able to take out leisure time for themselves regularly for 5-7 times/week, while other were sparing time less frequently and 45.87% were quite unable to spare time to be involve in some leisure activity.

Predictor for WRMDs

The crowding of various factors related to WRMDs and its severity is very puzzling. To identify the predictor variable(s) responsible for the severity of WRMDs, multiple Bivariate regression analysis was

performed with various independent demographic and work related variables and the level of significance was set to 0.05. The results with Pearson correlation coefficient and 2-tailed significance are shown in table no 2. It can be predicted that severity of WRMDs disorder is more severe among those sonologist who are involved with scanning of both abdomen and Obs/ Gynae examination, working experience. The severity of WRMDs disorder correlated statistically significantly with primary area of expertise, duration of WRMDs, working experience, working hours. The WRMDs was significant enough to affect daily "off the work" quality of the life of the sonologist. As expected the severity of WRMDs disorder remained unaffected even in those sonologist performing routine physical activity as few sonologist were able to spare sufficient time to do routine physical activity.

As shown in table no 2, the severity of WRMDs disorder increases as the experience of the sonologist and duration of WRMDs increases, it is more severe in those engaged with scanning of both abdomen and Obs/Gynae examination, working at more than one place, requiring frequent rescheduling of the work assignment yet affect routine daily life of the sonologist. It is not affected by work place and doing physical exercise.

TABLE II:

Predictor Variable	Pearson's' Correlation Coefficient	p value
Age	-0.110	0.257
Gender	-0.091	0.345
Present position	-0.030	0.758
Work Place	-0.126	0.193
More than one work Place	0.819	0.000
Working Hours	-0.815	0.000
Working Experience (years)	-0.282	0.003
Physical Activity	-0.127	0.187
Rescheduling of Working hours	0.661	0.000
Pain affect daily Living	0.585	0.000
Duration of WRMDs	-0.357	0.000
Primary Area of Expertise	-0.236	0.013

P value (2 tail) significant at <0.05

FIGURE I:

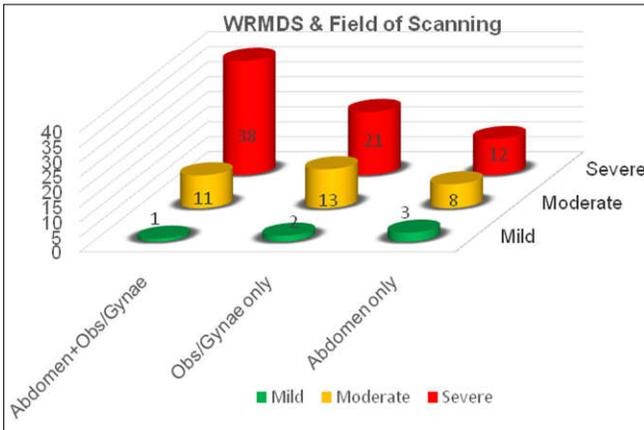
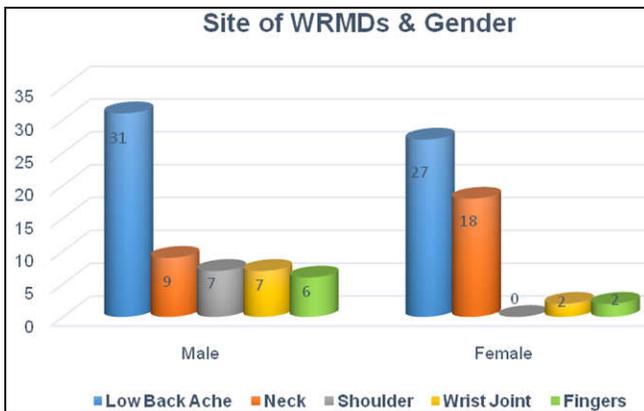


FIGURE II:



DISCUSSION

The origin of musculoskeletal pain due to work is multi-factorial. These may be considered as “predisposing (e.g. anthropometry, anxiety, job satisfaction), precipitating (e.g. trauma, long work hours), or perpetuating (e.g. poor ergonomics, poor health, fatigue, chronic pain)”⁹. Therefore, a study based on a questionnaire can neither adequately address nor accurately measure the “exposure-effect relationship”, yet such studies are useful for epidemiological purpose and draws attention towards the problem.

The overall response rate for this study was excellent (82.60%), which is comparable to response rate of 96%¹⁰, 93%¹¹, 80%¹² and 76.4%¹³ from internationally published literature. However, few questionnaires were not duly completely filled and finally 63.04% questionnaires were available for data analysis. It is estimated that prevalence of musculoskeletal disorders among general population is 13%-22%, in contrast to the high prevalence of WRMDs among sonologists, ranging from 63% to 91%¹⁴. In the present study we found prevalence of WRMDs among

sonologists high as 75.17%.

Among those experiencing WRMDs majority (74.31%) were familiar with the ergonomic factor and relate their illness to work. In the current study, the height, weight and gender were compared between those having WRMDs and those reported no WRMDs as shown in table 1, the difference was statistically insignificant which is in contrast to the study of P.A. Schulte et al¹⁵ but in agreement with other studies¹⁶. The review of the literature showed conflicting results regarding association between WRMDs with weight, height and gender. Necas Martin¹⁷ reported that WRMDs has no any association with weight and height, however found that female sonographer suffers more, and with marked severity than their male colleagues. This is in sharp contrast to this study where we found it more prevalent among male sonographer. The probable explanation may be that in our study male Sonographers outnumber female Sonographers, while finding of Necas may be attributed to small sample size of their study. We found strong association between age, clinical experience and severity of WRMDs; a self-explanatory fact. With increasing age, experience and work load increases, however at the cost of increasing severity of WRMDs. These findings endorse results of the previous studies^{16,18}; however, Smith et al¹⁹ had reported that there is no association between age and WRMDs among cardiac Sonographers. The results of current study showed that 65% (n=71) participants were doing scanning of both abdomen and Gynae / Obs, among these more than 50% (n=38) reported WRMDs as severe. Although tight gripping of the transducer, leaning forward, repeated twisting of the wrist are required in both these subset of the patients; the perpetuating factors may be the anthropometry combine with improper or poor adjustment of the position of the sonographer for these two subsets of the patients. Scanning of full term lady may require full abduction of 120° at shoulder in contrast to shoulder abduction between 30°-60° while doing scanning of abdomen. It has been estimated with shoulder abduction of 120°, muscles are fatigued within 5 minutes as compare to 60 minutes with shoulder abduction of 30°²⁰. Among those working at more than one place, 80% reported WRMDs as severe and 20% as moderate; this is in sharp contrast to those working at single place where none reported WRMDs as severe. Here ergonomics of the machine, examination table and chair combine with psychosocial working condition can be perpetuating factors as these may not be identical at two different work places. The objective significance of

psychosocial work environment has recently been reported by Inger Arvidsson et al²¹ by studying “associations between occupational factors and musculoskeletal pain in women teachers, nurses and sonographers”. They assessed workload using mechanical exposure index while psychosocial work environment was recorded using Job Content Questionnaire. They concluded that not only physical work load but also psychosocial work environment contributes significantly for development of WRMDs; although the contribution of these two varies for pain in different parts of the body. In the current study, the back ache was the most frequent site of WRMDs (53.21%) followed by the neck ache (24.77%) while pain affect upper limb in 22% of the sonologists. This finding is in agreement with other studies^{11,22} however D.E. Basseyy et al²³ from Nigeria reported “shoulder pain” as the most frequent site of WMSDs; and found that it could be the result of performing scan upon a couch that is above the level of the examiner’s arm. The finding of the low back as most common WRMDs is not surprising as by convection in our part of the world sonographer do scanning while sitting which demands repeated forward bending, twisting or side bending of the trunk while doing examination. As most participants of the current study were employed at university hospital where hydraulic adjustable examination table are available, consequently prevalence of shoulder pain is very less in contrast to the study of D. E. Basseyy. The perpetuating factor for back ache is trunk twist independent of the body and held in static position for long time while performing scanning in busy setup. This static position reduces blood supply however muscles do not get fatigued if only 10-15% of muscle force is applied during static position. This is impractical while scanning obese patients or doing lengthy examination. Among all participants of current study 49 were employed at tertiary care University Hospital, among these 46 reported WRMDs. This finding once again signifies the work load and lengthy examination as most patients at tertiary care needs conclusive results after scanning. These contrasting results for common site of the WRMDs can best explain by various ergonomic factors, arrangement of the work station and posture of the examiner. Contrary to the common belief that in general population low back ache is more prevalent among female; the distribution of the low back ache as WRMDs in this study was insignificant with respect to gender. However the result of this study showed neck ache is more prevalent among female sonographer when compared to male sonographer as shown in graph. The perpetu-

ating factor may be the flexion, extension and protraction of the neck. The apparent cause may be the use of inappropriate position of the monitor and habit of sharing examination images with the patients. The monitor should ideally be positioned so as that examiner can look at the top of the screen. If examiner is in habit of sharing examination images with the patient than auxiliary monitor should be use. The problem has been partially resolved, new ultrasound systems are now equipped with articulated monitor that can be move into a number of different positions. University Hospital(s) are generally equipped with latest operator friendly machine, conducive environment and good working station, yet among 49 participants’ employed at tertiary care University Hospital, 46 reported WRMDs. This reflect that work load also play significant role in the development/progression of WRMDs. As working conditions at different places varies significantly we analyzed data to identify predictor variable for WRMDs at our set up. The age does not correlate to the severity of WRMDs. However experience of the sonologist, duration of WRMDs, performing scanning of both abdomen and Obs/ Gynae examination and working at more than one place are significant predictors for the severity of WRMDs. Most of the sonographer reported that itis sufficiently severe necessitating frequent rescheduling of the work assignment yet affecting routine daily life adversely. No relief in severity of WRMDs reported even by those Sonographers doing some routine physical activity. The pain was annoying enough to affect routine daily life of 56% (n=62) sonologist necessitating frequent rescheduling of routine work; The 38 (34.86%) participants of current study having WRMDs were using self-prescribed NSAID regularly while 14(14.84%) were taking hot fomentation and massage as a remedy for their symptoms’. Although it is strongly suggested that those having WRMDs should consult with experienced health care provider²⁴, even in that case management has poor outcome as the person has to go back to the same environment that initiated the process²⁵.

CONCLUSION

The prevalence of WRMDs and its severity is significantly high among Sonographers of the Sindh province of Pakistan.

RECOMMENDATIONS

The pathogenesis of WRMDs is multifactorial and therefore needs to be addressed appropriately. The preventive measure against WRMDs should be part of

the curriculum. The work station should always be adjustable and must be adjusted appropriately to comfortable position by the operator, to minimize the risk of WRMDs and those affected should be provided best possible care.

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