ORIGINAL ARTICLE

# AN INSIGHT INTO THE WORK ERGONOMICS OF RADIOLOGY DEPARTMENT AT A TERTIARY CARE SETUP IN PAKISTAN

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## ABSTRACT

**BACKGROUND:** Radiologists experience various health issues due to their working environment and the relative sedentary life style. Their postural habits and the radiation protection measures are an additional hazard to their skeletal system. The objective of this study was to see the incidence of back and neck pain among radiology workforce in our setup, and to assess their knowledge regarding work ergonomics. **METHODS:** This cross-sectional survey was performed in the Department of Radiology, Liaquat National Hospital and Medical College during January to June 2023. Radiologists and radiology technicians were registered into this study. A proforma based on 24 questions was used to inquire the basic health hazards faced by the participants and their knowledge regarding ergonomics. This proforma was formulated using references from various studies and a pilot check was performed. **RESULTS:** 326 Radiologists and radiology technicians responded to the survey. Mean age of respondents were 37.41 – 10.91 years. The majority of respondents (31.9%) were aged 20-30 years. 27.3% were aged 31-40 years, 28.8% were 41-50 years, and 10.7% were 51-60 years. Most of these were practicing radiologists (45.7%). 19.9% were radiographers, 23.3% were trainees, and 11% were technologists. Majority (39.3%) having 2 to 5 years of experience in the field. 26.4% reported experiencing back pain only. 11.7% reported neck pain only. 18.7% suffered from both neck and back pain. Most of the participants 61.7% experienced multiple episodes of spine symptoms and 50.9% had consulted a doctor for their symptoms. The participants reported that 23.6% did no physical activity. 67.9% did occasional activity. Regarding the knowledge of the participants regarding the hazards associated with prolonged sitting and wearing lead aprons 27% were aware of spine hazards from prolonged sitting and 20.2% knew about spine hazards from heavy lead aprons. We found significant association of back pain with age (p=0.036), profession (p=0.000), Duration of practice including training year (p=0.009) and perform physical activity (p=0.013 while significant association was also found for neck pain with age group(p=0.014), Duration of Practice including training year(p=0.014), Hours per day do wear lead apron(p=0.012). **CONCLUSION:** According to the survey findings, participants were suffering from several health issues due to their work environment and significantly underinformed about work ergonomics specifically during the early years of training. The hospital should develop adequate measures to reduce the hazards associated with unfavorable work ergonomics,whilst spreading awareness amongst the radiology related workforce.
**Keywords:** Spine, Ergonomics, Knowledge, Radiologists, Lead aprons, Intervention. Measures should also be taken by National radiological society.

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## Introduction

Radiologists play a vital role in diagnosing and treating medical conditions by analyzing complex medical imaging studies.[1,4] However, the taxing nature of their work, including long hours of image review and prolonged sitting, can negatively impact their spine health and overall wellbeing.[1,2,4] Therefore, prioritizing proper spine ergonomics has become imperative for radiologists and healthcare institutions.

Spine ergonomics involves maintaining optimal spinal alignment and adopting ergonomic practices to reduce the risk of developing chronic pain, musculoskeletal injuries, and other occupational hazards from the physical demands of the job.[1,3-5] Radiologists often face unique ergonomic challenges related to spine health, such as the use of heavy lead apparel and extensive sitting requirements.[1-5] Lead gowns are essential for radiation protection but their weight can strain the spine. Radiologists should employ proper lifting methods when donning and removing lead gowns to avoid back injury.[4,5] Seeking assistance or using mechanical aids like hoists or hooks can also help.

Lead aprons can further add to spinal load, especially during lengthy procedures.[1,2,4,6] Options like lead aprons with integrated weight distribution systems or padded shoulder straps can help disperse weight more evenly across the back and shoulders. Ensuring lead apparel fits appropriately and offers adequate postural support is key.[1] Frequent awkward postures while seated at imaging workstations or when performing procedures can also contribute to spinal issues.[1,3,4] Optimal ergo-nomic practices like proper chair adjustments, use of lumbar cushions, and regular posture changes are important. Facilities should provide ergonomically designed furniture and equipment to enable healthy spine alignment.[4,5]

Incorporating regular exercise into their daily routines is vital for radiologists to counteract the adverse effects of extensive sitting required in their work.[1,4,6] Exercise helps strengthen core muscles, improve flexibility, and maintain overall musculoskeletal health. Investing in supportive seating is also critical given the long hour s radiologists spend sitting.[4,6,7] Chairs with adjustable lumbar support and cushioning can help minimize spinal strain. Adjustable armrests can also reduce shoulder and upper back tension.[1]

Frequent movement and stretching breaks are essential to alleviate the strain of prolonged sitting.[1-5] Radiologists should be encouraged to take breaks and perform stretches for the neck, shoulders, back, hips and core muscles.[4,5] These can relieve tension, improve circulation, and provide spinal support.[1,2,4-7]

Additional accessories like lumbar rolls or pillows can give extra low back support while seated. Footrests can also improve leg and lower back posture.[4]

Optimizing workstation layout is another key aspect.[1,3] Adjusting chair height, desk height and monitor position to maintain neutral spine alignment is important. Positioning frequently used items within easy reach can minimize twisting or reaching.

Providing training and education on spine ergonomics to radiologists and staff is recommended.[1,4-8] Emphasizing good posture, breaks, and ergonomic strategies can help prevent musculoskeletal problems.[1,4]

It is vital to consult with occupational health experts or ergonomic specialists who can provide personalized recommendations adapted to individual needs and workplace conditions.[1,4,5,7] They can evaluate the unique ergonomic challenges in radiology settings and suggest tailored solutions to optimize spine health for radiologists and staff.

In summary, spine ergonomics is critically important for radiologists to maintain spinal health and overall wellbeing. By taking proactive measures, applying ergonomic principles, and seeking professional guidance, radiologists can enhance their comfort, longevity, and patient care.[1-8] Making exercise part of their daily routine is also essential to counteract the adverse effects of extensive sitting. Exercise can strengthen core muscles, improve flexibility, and support overall musculoskeletal health.

Work ergonomics although having a significant impact on human health is rarely discussed in our setup. Hence we conducted this study to to see the incidence of back and neck pain among radiology workforce in our setup, and to assess their knowledge regarding work ergonomics.

## Material and Methods

This descriptive cross-sectional survey was performed in Department of Radiology, Liaquat National Hospital

and Medical College during January to June 2023. The study was first reviewed by the Hospital Ethics Committee and then the study was commenced upon receiving formal approval from chairperson of Ethical Committee (App#:0900-2023-LNH-ERC). Radiologists and radiology technicians from Liaquat national hospital and few other related setups were registered into this study after their written informed consent. Participants aged 18 years and above of any gender, willing to participate were included in the study. The sample size was calculated through Sample Size Calculator by Wan NorArifin(Available at https://wnarifin.github.io/ssc/ss1prop.html) by taking prevalence of lower back pain=45% Ref (Kawthalkar AS, Sequeira RA, Arya S, Baheti AD. Non-radiation occupational hazards and health issues faced by radiologists A cross-sectional study of Indian radiologists. Indian journal of radiology and imaging. 2019 Jan;29(01):61-6.), margin of error=5%.The total calculated sample size was 381 patients.

The method of convenience sampling was used to enlist study participants. A proforma based on 24 questions was used to inquire the basic health hazards faced by the participants and their knowledge regarding ergonomics. This proforma was formulated using references from various studies and a pilot check was performed. The first section was demographics comprising of five question investigating age, gender, education and underwent imaging test in past. The secondpart of questionnaire assessed the various problems faced by the participants and the measures taken by them. The third part of the performa assessed the basic knowledge of the participants regarding ergonomics. The study questionnaire is attached as a supplementary file. SPSS version 21 was used to input the data for statistical analysis. Percentage and frequency were used to describe categorical variables. The chi-square test was used to compare participant answers between those who had never undergone imaging and those who had. P-values of 0.05 or less were considered statistically significant.

## Results

Mean age of respondents were 37.41 – 10.91 years. The majority of respondents (31.9%) were aged 20-30 years. 27.3% were aged 31-40 years, 28.8% were 41-50 years, and 10.7% were 51-60 years and 1.2% were aged above 60 years with 54.3% males and 45.7% females. Most of these were practicing radiologists (45.7%). 19.9% were radiographers, 23.3% were trainees, and 11% were technologists. Majority (39.3%) having 2 to 5 years of experience in the field. 26.4% reported experiencing back pain only. 11.7% reported neck pain only. 18.7% suffered from both neck and back pain. Most of the participants 61.7% experienced multiple episodes of spine symptoms and 50.9% had consulted a doctor for their symptoms. The severity of the symptoms can be considered tolerable as 50.9% participants did not take leaves and only 41.7% reported using local analgesics for their symptoms. 31.9% reported using physiotherapy. Most of the participants (40.2%) reported that they wore a lead apron for less than 3 hours per day. 27.9% wore it for 3-6 hours daily. The participants reported that 23.6% did no physical activity. 67.9% did occasional activity. 20% exercised up to 3 days per week. Only 12.1% exercised over 3 days per week. Type of physical activity included brisk walking 24.5%, 30.1% did jogging/running, 11.6% did aerobic exercise, 11.6% did weight training, 8.8% did other activities. Regarding the knowledge of the participants regarding the hazards associated with prolonged sitting and wearing lead aprons 27% were aware of spine hazards from prolonged sitting and 20.2% knew about spine hazards from heavy lead aprons as presented in (Tab.1).

Among 326 participants, 39 (12%) reported with carpal tunnel syndrome, 76 (23.3%) with elbow pain and 54 (16.6) with tenosynovitis while 69 (21.2) took intravenous medication and 104 (31.9) took physiotherapy for symptoms treatment as presented in (Fig.1) and (Fig.2). (Fig.3) to (Fig.6) compares back pain and neck pain with respect to the knowledge of the participants regarding the hazards associated with prolonged sitting and wearing lead aprons.

We found significant association of back pain with age (p=0.036), profession (p=0.000), duration of practice including training year (p=0.009) and perform physical activity (p=0.013 while significant association was also found for neck pain with age group (p=0.014), duration of practice including training year (p=0.014), hours per day do wear lead apron (p=0.012) and type of physical activity done other than work routine (p=0.019) as presented In (Tab.2) and (Tab.3).

| | n (%) |
|---|---|
| Age (years); mean± Std. Dev | 37.41±10.91 |
| **Age Groups** | |
| 20-30 years | 104(31.9) |
| 31-40 years | 89(27.3) |
| 41-50 years | 94(28.8) |
| 51-60 years | 35(10.7) |
| >60 years | 4(1.2) |
| **Gender** | |
| Male | 177(54.3) |
| Female | 149(45.7) |
| **Profession** | |
| Radiologist (practicing) | 149(45.7) |
| Radiographer | 65(19.9) |
| Trainee | 76(23.3) |
| Technologist | 36(11) |
| **Duration of practice including training year** | |
| <2 years | 76(23.3) |
| 2-5 years | 128(39.3) |
| 5-10 years | 76(23.3) |
| >10 years | 46(14.1) |
| Daily Working Hours; mean± Std. Dev | 9.21±3.00 |
| Average sitting hours per day; mean± Std. Dev | 6.19±2.11 |
| Work related Stress; mean± Std. Dev | 3.20±1.78 |
| Back pain | 86(26.4) |
| Neck pain | 38(11.7) |
| Back and neck pain | 61(18.7) |
| **Episodes of symptoms** | |
| Single | 125(38.3) |
| Multiple | 201(61.7) |
| **Consulted any doctor for symptoms** | |
| Yes | 166(50.9) |
| No | 160(49.1) |
| **Ever applied for leave due to symptoms** | |
| Yes | 160(49.1) |
| No | 166(50.9) |
| **Hours per day do wear lead apron** | |
| <3 hours | 131(40.2) |
| 3-6 hours | 91(27.9) |
| 6-8 hours | 64(19.6) |
| >8 hours | 40(12.3) |
| **Medicine taken for the relief of symptoms** | |
| None | 64(19.6) |
| NSAIDS | 24(7.4) |
| Muscle relaxant | 124(38) |
| Analgesics | 80(24.5) |
| all of above | 34(10.4) |
| **Ever get any imaging done for symptoms** | |
| Yes | 236(73.4) |
| No | 90(27.6) |
| **How long did the symptoms lasted** | |
| <2 weeks | 165(50.6) |
| >2 weeks | 88(27) |
| other | 73(22.4) |
| **Perform physical activity** | |
| Yes | 249(76.4) |
| No | 77(23.6) |
| **Frequency of physical activity (n=249)** | |
| Occasionally | 169(67.9) |
| <3 days per week | 50 (20) |
| >3 days per week | 30(12.1) |
| **Duration of physical activity (n=249)** | |
| 30 mint | 101(40.6) |
| 1 hour | 77(30.9) |
| >1 hour | 67(26.9) |
| None | 4(1.6) |
| **Type of physical activity done other than work routine** | |
| Brisk walking | 61(24.5) |
| Jogging and running | 75(30.1) |
| Swimming | 33(13.3) |
| Aerobic exercise | 29(11.6) |
| Weight training | 29(11.6) |
| Other | 22(8.8) |
| **Feel pain while doing physical activity** | |
| Yes | 95(38.2) |
| No | 126(50.6) |
| Sometimes | 28(11.2) |
| **Knowledge about spine hazards due to prolonged sitting** | |
| Yes | 88(27) |
| No | 188(57.7) |
| Sometimes | 50(15.3) |
| **Knowledge about spine hazards due to wearing heavy lead gowns** | |
| Yes | 66(20.2) |
| No | 214(65.6) |
| Sometimes | 46(14.1) |

| | n (%) |
|---|---|
| **Domain** | |
| Diagnostic | 201(61.7) |
| Intervention | 125(38.3) |
| **Personal satisfaction level** | |
| Good | 12(3.7) |
| Average | 132(40.5) |
| Below average | 110(33.7) |
| Poor | 72(22.1) |
| **Work related stress** | |
| Yes | 318(97.5) |
| No | 8(2.5) |
| **Suffer from mental stress** | |
| Yes | 308(97.5) |
| No | 8(2.5) |
| **Cause of increased stress in work environment** | |
| Work overload | 16(4.9) |
| Inadequate income | 8(2.5) |
| Administrative responsibilities | 8(2.5) |
| Improper workplace atmosphere and workplace relationships | 294(90.2) |

**Table 1:** Descriptive statistics for study population (n=326)

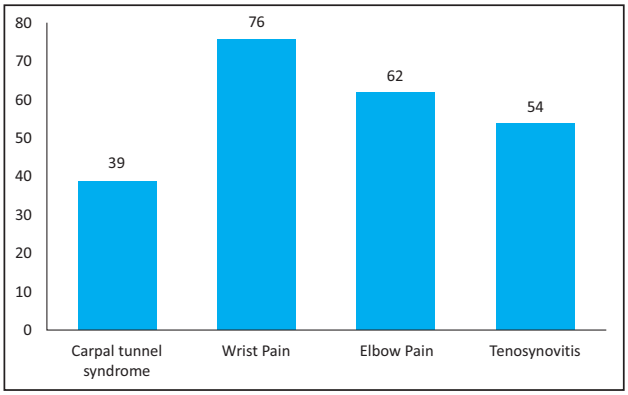


**Figure 1**

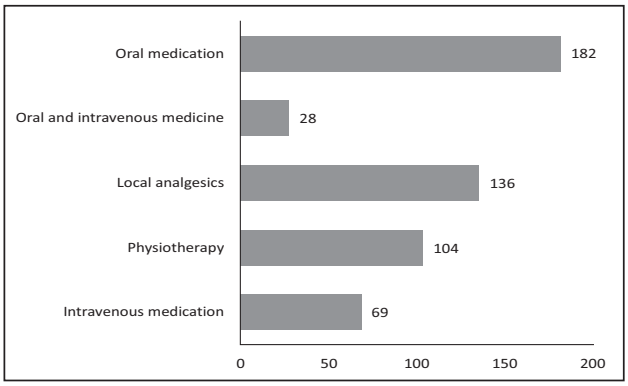


**Figure 2**

| | Back Pain | | p-value |
|---|---|---|---|
| | Yes | No | |
| **Age Groups** | | | |
| 20-30 years | 35(40.7) | 69(28.8) | |
| 31-40 years | 25(29.1) | 64(26.7) | |
| 41-50 years | 15(17.4) | 79(32.9) | 0.036 |
| 51-60 years | 9(10.5) | 26(10.8) | |
| >60 years | 2(2.3) | 2(0.8) | |
| **Gender** | | | |
| Male | 48(55.8) | 129(53.8) | 0.742 |
| Female | 38(44.2) | 111(46.3) | |
| **Profession** | | | |
| Radiologist (practicing) | 56(65.1) | 93(38.8) | |
| Radiographer | 8(9.3) | 57(23.8) | 0.000 |
| Trainee | 6(7) | 70(29.2) | |
| Technologist | 16(18.6) | 20(8.3) | |
| **Duration of Practice including training year** | | | |
| <2 years | 24(27.9) | 52(21.7) | |
| 2-5 years | 26(30.2) | 102(42.5) | 0.009 |
| 5-10 years | 16(18.6) | 60(25) | |
| >10 years | 20(23.3) | 26(10.8) | |
| **Hours per day do wear Lead Apron** | | | |
| <3 hours | 35(40.7) | 96(40) | |
| 3-6 hours | 26(30.2) | 65(27.1) | 0.819 |
| 6-8 hours | 14(16.3) | 50(20.8) | |
| >8 hours | 11(12.8) | 29(12.1) | |
| **Perform Physical activity** | | | |
| Yes | 74(86) | 175(72.9) | 0.013 |
| No | 12(14) | 65(27.1) | |
| **Type of physical activity done other than work routine** | | | |
| Brisk walking | 23(31.1) | 38(21.7) | |
| Jogging and running | 19(25.7) | 56(32) | |
| Swimming | 13(17.6) | 20(11.4) | |
| Aerobic exercise | 5(6.8) | 24(13.7) | 0.085 |
| Weight training | 5(6.8) | 24(13.7) | |
| Other | 9(12.2) | 13(7.4) | |
| **Domain** | | | |
| Diagnostic | 56(65.1) | 145(60.4) | 0.442 |
| Intervention | 30(34.9) | 95(39.6) | |

**Table 2:** Association of back pain

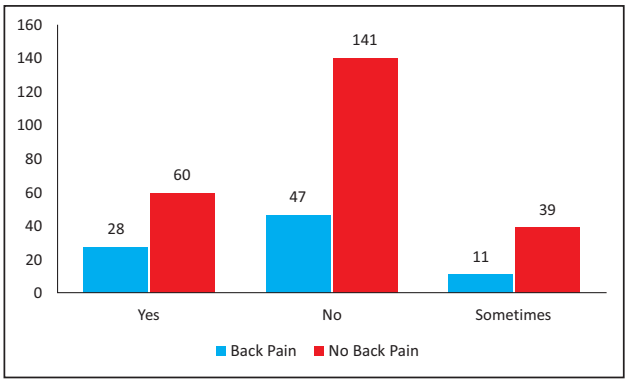


**Figure 3:** Frequency of back pain with knowledge about spine hazards due to prolonged sitting

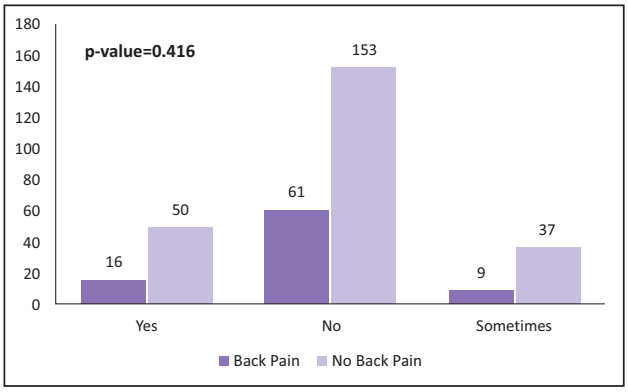


**Figure 4:** Frequency of back pain with knowledge about spine hazards due to wearing heavy lead gowns

| | Back Pain | | p-value |
|---|---|---|---|
| | Yes | No | |
| **Age Groups** | | | |
| 20-30 years | 16(42.1) | 88(30.6) | |
| 31-40 years | 13(34.2) | 76(26.4) | |
| 41-50 years | 3(7.9) | 91(31.6) | 0.014* |
| 51-60 years | 5(13.2) | 30(10.4) | |
| >60 years | 1(2.6) | 3(1) | |
| **Gender** | | | |
| Male | 15(39.5) | 162(56.3) | 0.051 |
| Female | 23(60.5) | 126(43.8) | |
| **Profession** | | | |
| Radiologist (practicing) | 21(55.3) | 128(44.4) | |
| Radiographer | 3(7.9) | 62(21.5) | 0.201 |
| Trainee | 9(23.7) | 67(23.3) | |
| Technologist | 5(13.2) | 31(10.8) | |
| **Duration of practice including training year** | | | |
| <2 years | 12(31.6) | 64(22.2) | 0.014* |
| 2-5 years | 6(15.6) | 122(42.4) | |
| 5-10 years | 11(28.9) | 65(22.6) | |
| >10 years | 9(23.7) | 37(12.8) | |
| **Hours per day do wear lead apron** | | | |
| <3 hours | 24(63.2) | 107(37.2) | |
| 3-6 hours | 6(15.8) | 85(29.5) | 0.012* |
| 6-8 hours | 3(7.9) | 61(21.2) | |
| >8 hours | 5(13.2) | 35(12.2) | |
| **Perform physical activity** | | | |
| Yes | 26(68.4) | 223(77.4) | 0.219 |
| No | 12(31.6) | 65(22.6) | |
| **Type of physical activity done other than work routine** | | | |
| Brisk walking | 3(11.5) | 58(26) | |
| Jogging and running | 11(42.3) | 64(28.7) | |
| Swimming | 1(3.8) | 32(14.3) | |
| Aerobic exercise | 1(3.8) | 28(12.6) | 0.019* |
| Weight training | 4(15.4) | 25(11.2) | |
| Other | 6(23.1) | 16(7.2) | |
| **Domain** | | | |
| Diagnostic | 20(52.6) | 181(62.8) | 0.223 |
| Intervention | 18(47.4) | 107(37.2) | |

**Table 3:** Association of neck pain

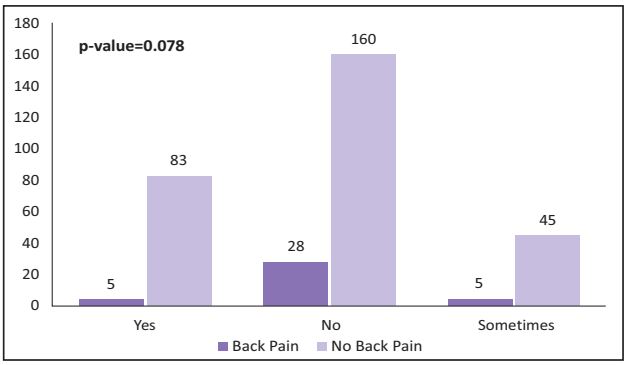


**Figure 5:** Frequency of neck pain with knowledge about spine hazards due to prolonged sitting

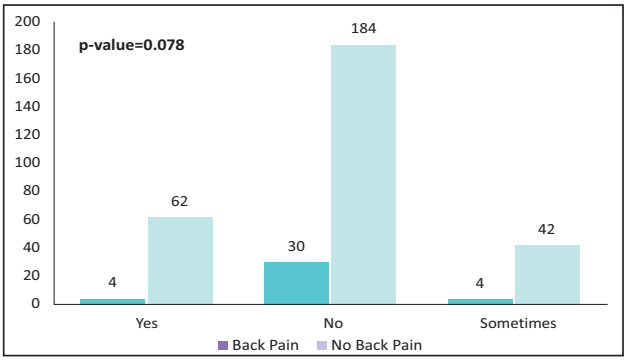


**Figure 6:** Frequency of neck pain with knowledge about spine hazards due to wearing heavy lead gowns

## Discussion

Proper spine health and ergonomics are critical occupational health concerns for radiologists that require greater attention. Radiologists frequently have to sit or stand for prolonged periods to interpret medical images, often assuming awkward static postures as they view monitors or maneuver equipment.[1,2] They also conduct intricate imaging procedures that can involverepetitive motions. Without proper ergonomic awareness and practices, radiologists face high risks for developing spinal problems, musculoskeletal disorders and repetitive strain injuries over time.[3,4] Unfortunately, research reveals a troubling lack of education and focus on work-related ergonomics within radiology training programs and clinical settings. In our study Mean age of respondents were 37.41 – 10.91 years. 54.3% males and 45.7% females. Major participants of the study were practicing radiologists (45.7%). 19.9% were radiographers, 23.3% were trainees, and 11% were technologists. Majority (39.3%) having 2 to 5 years of experience.

Multiple studies highlight the high prevalence of spine symptoms and suboptimal ergonomic practices among radiologists across specialties. A survey by Cornelis et al. found that while most interventional radiologists reported frequent spinal pain, only 38% had received any formal training on occupational ergonomics.[2] As seen in our study 26.4% reported experiencing back pain only, with 11.7% reported neck pain only about 18.7% suffered from both neck and back pain. In our study most of the participants 61.7% experienced multiple episodes of spine symptoms and 50.9% had consulted a doctor for their symptoms. The study by Cornelis et al stressed the need for continuous ergonomics education beginning in residency to improve awareness and prevent work-related injuries. Benjamin and Meisinger called for implementing structured ergonomics protocols and training in interventional radiology programs, noting the lack of formal curricula currently.[1]

Other analyses reaffirm poor ergonomic awareness and its adverse impacts. Davis et al. found interventional radiologists had a high rate of neck, back and hip pain attributable to substandard ergonomics.[5] Most of the participants in our study did not have enough knowledge regarding ergonomics due to prolonged sitting 57.7 %, 27% had adequate knowledge and 15.3% were unsure. 65.6% were unaware of spine hazards due to wearing heavy lead gowns, 20.2% knew the hazards. Mohan and Mohan emphasized the need to prioritize work environment modifications and ergonomics training for radiologists starting from residency itself.[6] Multiple studies have identified musculoskeletal disorders as a leading cause of disability, lost work time and early retirement among radiologists.[3,7]

Specific ergonomic risk factors relevant to radiologists work include prolonged sitting or standing, bending and twisting to view images, repetitive wrist and finger motions, static postures during procedures, and improperly configured equipment and workstations.[4,8,9]

These factors can contribute to frequent neck, shoulder, back, wrist and hand pain. Musculoskeletal issues can also negatively impact radiologists and diagnostic performance, productivity, career longevity and quality of care.[2,10] Strategies to improve spine health awareness and foster ergonomic practices should target multiple levels:

Individual interventions: Education on optimal ergonomic practices, posture, work habits and exercises. This can be incorporated into training programs and continuing education.[11,12] Encouraging regular breaks, stretching, movement and strength training as part of radiologists & # 39; daily work routines.[13,14] Ensuring access to ergonomic consults and resources to optimize workstation configurations and address musculoskeletal issues early.[15]

Organizational initiatives: Developing structured protocols for reading room layout, image viewing, equipment adjustment and procedural ergo-nomics.[16] Proactive modifications of facilities and technologies to enable ergonomic work practices.[17] Promoting a culture focused on radiologist health, not just productivity.Offering regular ergonomic training for radiology trainees and staff.[18,19]

Equipment and process changes: Adjustable chairs, standing desks and workstation accessories to accommodate varied users and tasks.[20] Optimal positioning of displays and interactive viewing screens.[21] Voice recognition and dictation software to reduce repetitive motions.[22] Standardizing optimal patient positioning for procedures.[23] With a multifaceted focus on education, protocols, environment design, technology and culture, ergonomic awareness and spinal health can be improved amongst radiology professionals. This will benefit clinicians, patients and healthcare organizations alike.

However, effecting organizational and behavioral changes requires high-level support and resource investment. Radiologist health should receive as much priority as patient care quality and safety.

The over-whelming evidence reveals that lack of proper ergonomic awareness and practices is putting radiologists at significant risk both early and later in their careers. While imaging technologies and procedures may become more advanced, the human body remains vulnerable. It is incumbent upon the radiology community to confront this urgent issue through improved training, optimal work practices and proactive environmental design. With focused effort and collaboration, a culture of ergonomic mindfulness and spine health can become the norm in radiology. The careers of current and future radiologists depend on it.

## Conclusion

According to the survey findings, participants were suffering from several health issues due to their work environment and significantly underinformed about work ergonomics specifically during the early years of training. The hospital should develop adequate measures to reduce the hazards associated with an unhealthy working environment whilst spreading awareness amongst the radiology related workforce.

**Conflict of interest:** None

**Source of funding:** None

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