

Bridging the Gap: Exploring Ergonomic knowledge and Practices for Preventing Work-Related Musculoskeletal Disorders among Nurses in Riyadh City

Reham Salman Alanazi ¹ Asmaa Saber Ghaly ² Safia Belal ³

1. *Reham Salman Alanazi - Nurse Educator*
 - *Second Health Cluster in Riyadh Saudi Arabia*
 - *email: rehamssaa@gmail.com*
 - *ORCID ID: 0009-0005-9268-0422*
2. *Asmaa Saber Ghaly, Assistant Professor*
 - *Obstetrics and Gynecology Nursing Department, Faculty of Nursing, Alexandria University, Egypt*
 - *Department of Nursing, College of Applied Medical Sciences, King Faisal University, Al Ahsa, Saudi Arabia.*
 - *Emails: asmaaghaly2012@gmail.com*
 - *Orchid No: <https://orcid.org/0000-0002-0680-6633>*
3. *Safia Belal, Assistant Professor*
 - *Department of Nursing, College of Applied Medical Sciences, King Faisal University, Al Ahsa, Saudi Arabia.*
 - *Emails: salsoudany@kfu.edu.sa - sofy3131@gmail.com*
 - *Orchid No: <https://orcid.org/0000-0001-9822-9214>*

ABSTRACT

Background: Ergonomic knowledge and proper workplace practices are essential for nursing professionals to prevent work-related musculoskeletal disorders (MSDs) and enhance patient care. However, the level of ergonomics awareness and adherence to safe practices among nurses in Saudi Arabia remains underexplored. **Objective:** This study evaluates the knowledge and practical application of ergonomics among nursing staff in a Health Cluster in Riyadh City, identifying key factors influencing their ergonomic behaviors. **Methods:** A cross-sectional survey was conducted among 402 nurses using a structured questionnaire assessing demographic factors, ergonomic knowledge, and workplace practices. **Data analysis** was performed using SPSS software, incorporating descriptive statistics, chi-square tests, and regression modeling to determine associations between variables. **Results:** The findings indicated that while 60.2% of nurses demonstrated a moderate level of ergonomics knowledge, only 31.6% exhibited a strong understanding. Regarding ergonomic practices, 42.3% of participants reported excellent adherence, whereas 23.5% displayed only fair practice levels. Factors such as years of experience and department type significantly influenced both knowledge and practice scores. The study also revealed gaps in training, with a need for enhanced education on proper ergonomic techniques. **Conclusion:** Despite moderate levels of ergonomic awareness, there remains room for improvement in practical implementation among nurses. The study highlights the necessity of targeted training programs and institutional policies to promote ergonomic safety in healthcare settings.

Keywords: Ergonomics - Health cluster - musculoskeletal disorders- - Nursing staff - Saudia Arabia

1. Background

Work-related musculoskeletal disorders (MSDs) are the predominant kind of injuries and illnesses that transpire in the workplace in the United States. They constitute 33% of all injuries and illnesses reported to the Bureau of Labor Statistics by employers. While ergonomics practitioners play a crucial role in recommending strategies to prevent or handle musculoskeletal disorders (MSDs), there is limited comprehension of their actual methodology in providing these ideas (Maria *et al.*, 2017 and Dąbek *et al.* 2019). Understanding the practical and experiential decision-making techniques used by ergonomists can reveal the complex nature of their remedies for musculoskeletal disorders (MSDs). Moreover, it can help evaluate the congruence or deviation of real-world activities from the ergonomics curriculum. The main aim of this study was to enhance our comprehension of the decision-making techniques utilized by ergonomics practitioners, with a specific focus on lower back disorders (LBDs), which are the most prevalent and onerous musculoskeletal disorders (MSDs) (Zhang *et al.*, 2024).

Ergonomics is the methodical process of creating a workspace to reduce the probability of employees being exposed to potential work-related injuries (Zakerian *et al.*, 2013). Moreover, efficient workplace designs have the potential to reduce weariness and relieve general pain resulting from physical exertion and stress on the bodies of healthcare professionals (Saremi *et al.*, 2019). Hospital ergonomics seeks to optimize human performance and improve patient health by prioritizing safety (Hijam *et al.*, 2020), efficiency, and comfort in healthcare facilities, thereby minimizing injuries and increasing general well-being. In the majority of industrialized nations, economic growth has been significantly driven by advancements in science and technology throughout the previous century (Warnakulasuriya *et al.*, 2016).

The occupational safety and health of nurses is a complex area of study that focuses on ensuring the safety, well-being (Abdollahi *et al.*, 2020), and welfare of individuals in the workplace (Gilchrist and Pokorná, 2021). Nursing is widely recognized as a career characterized by a high prevalence of workplace-related injuries and illnesses (Westergren and Lindberg, 2022). The healthcare staff faces a notable health risk that is associated with ergonomics, as they are required to manually handle patients (Mailutha *et al.*, 2020), which involves the application of force to pull, push, or raise them (Shah *et al.*, 2022).

In the 21st century, the economy has been compelled to enhance healthcare services due to globalization and the need for high-quality treatment (Sasangohar *et al.*, 2020). As a result, efficient and resourceful nursing staff have become the organization's most significant asset for achieving success (Muthukrishnan and Maqbool Ahmad, 2021). Nevertheless (Barnard *et al.*, 2021), hospitals have historically prioritized the safety requirements of patients over those of their nurses (Carayon *et al.*, 2021). The intricate nature of delivering patient care in a contemporary hospital setting necessitates a reevaluation of this safety approach (Gilchrist and Pokorná, 2021), as the interaction among components associated with the patient, nurse, and physical surroundings presents a perilous ergonomic risk to everyone involved (Barnard *et al.*, 2021). Ergonomics is the field of study that focuses on designing tasks to be suitable for workers, rather than forcing the laborer's body to conform to the work (Muthukrishnan and Maqbool Ahmad, 2021). Modifying activities, workstations, apparatuses, and equipment to accommodate the worker can effectively mitigate the physical strain on the worker's body and mitigate the risk of several potentially severe and debilitating occupational illnesses (Abdollahi *et al.*, 2020).

The occupational safety and health of nurses is a complex area of study that focuses on ensuring the safety, well-being (Abdollahi *et al.*, 2020), and welfare of individuals in the

workplace (Gilchrist and Pokorná, 2021). Nursing is widely recognized as a career characterized by a high prevalence of workplace-related injuries and illnesses (Westergren and Lindberg, 2022). The healthcare staff faces a notable health risk that is associated with ergonomics, as they are required to manually handle patients (Mailutha *et al.*, 2020), which involves the application of force to pull, push, or raise them (Shah *et al.*, 2022). This research aims to demonstrate the scope of ergonomics and determine that a considerable fraction of the participants exhibit a moderate level of understanding and a favorable disposition towards ergonomics within the professional setting. Nevertheless, the use of ergonomic measures in the working environment may not be prevalent. This study possesses the capacity to ascertain numerous risk factors by examining a range of sociodemographic data, this study will enrich the literature with reports that may improve the level of nursing care by enhancing the ergonomics among them in different healthcare sectors (Gilchrist and Pokorná, 2021). As well, this study can also illustrate the main challenges that may face nurses in ergonomics practices when we assess the level of practice for such certain disorders and the main factors affecting their perfect practices, it will shed light on the importance of making courses and sessions for nurses to know more about ergonomics and how to implement.

1.1. Aim of the Study

This research study aims to assess the Ergonomics Knowledge and practices among nursing Staff in the Health Cluster in Riyadh region, Saudi Arabia.

1.5 Specific Objectives

1. To identify the nurses' Ergonomics level of Knowledge in Health Cluster.
2. To assess nurses' Ergonomics Practices in Health Cluster
3. To determine the association between nurses' knowledge and ergonomics practice in the health cluster.

3. Research Methodology

3.1 Study Design

The research employed a quantitative descriptive, cross-sectional study design, which is an observational research methodology that analyzes data from a population at a certain moment in time to evaluate the exposures and outcomes of the research participants simultaneously. Cross-sectional studies present numerous advantages, such as their efficiency in terms of time and cost, ability to accommodate large sample numbers, capacity to measure prevalence, and capacity to generate hypotheses (Mohammad *et al.*, 2019).

3.2 Population and Sampling

. The study took place in the health cluster of Riyadh region, Saudi Arabia. The survey encompasses the entire population of nurses employed in the Health Cluster located in Riyadh with the following inclusion criteria; nurses of both genders, from all nationalities, nurses who have not participated in a similar study before, nurses who are working in the Health cluster in Riyadh, nurses who have direct patient care responsibilities, and nurses agreed to participate in the study. Exclusion criteria include nurses who are absent during conducting this study and nurses who are unwilling to participate in the study.

This study employed stratified random sampling and convenience sampling techniques, to ensure the representation of a diverse range of nurses working in healthcare settings within the Health Cluster. The population was stratified according to many factors, including the healthcare environment and the working areas (categorized as inpatient or outpatient). A representative

sample of nurses was selected from each stratum through the utilization of a random number generator or a comparable appropriate methodology. To augment stratified random sampling and expand the sample size, convenience sampling was employed. This approach involves choosing persons who are easily reachable and willing to take part in the study, considering factors such as convenient places and willingness to engage. Utilizing convenience sampling will enhance the representativeness of the sample. (Majid, U. 2018).).

The sample size was calculated using the G*Power Program. The Health Cluster in Saudi Arabia employs a total of 3000 nurses. Based on the G*Power program's statistical sample size calculation, the study required a sample size of 500 at a 95% confidence level. An additional 10% was allocated for the pilot project, resulting in a total sample size of at least 312. The student researcher ensured that the sample's confidence level remained at about 98% and the margin of error remained at 0.05%. The total sample size was 402 nurses.

3.3 Data Collection Instruments and Procedures

A standardized questionnaire was used with closed-ended questions for assessing the level and degree of ergonomics among nurses who participated in this study with measurements relating to their agreement. The data was collected with the aid of nurses in each area by distributing the questionnaires for 6 weeks. Data were collected through the utilization of online surveys administered using Microsoft Forms. To ensure optimal data integrity, participants received explicit instructions on how to accurately complete the questionnaires. The data-gathering process required a duration of one to two months, with each participant being allocated 30 minutes. The sections of the questionnaire are as follows:

Section One: Socio-demographic Characteristics:

This section collects basic demographic information such as gender, age, years of experience, nationality, marital status, inpatient, out-patient units and working areas includes (ICU, CCU, OR, ER, Hemodialysis, Surgical ward, medical ward, Primary care). These socio-demographic characteristics provide context and help analyze the survey responses.

Section Two: Ergonomics Knowledge Assessment:

There are ten items which describe ergonomics knowledge in general and assess the level of ergonomics among these nurses and the knowledge and practice as reported by ALHazim et al. (2022) study. *The Scoring*; The questionnaire utilizes Likert scale responses, with participants rating their agreement with each statement on a scale from strongly disagree (1) to strongly agree (5), The questionnaire is comprehensive and covers various dimensions (Attia *et al.*, 2023).

Total Score Interpretation: 1-4 points: Poor Knowledge - This score indicates a very limited understanding of ergonomics principles. It might suggest the need for additional education and resources. 5-7 points: Fair Knowledge - This score suggests a basic understanding of ergonomics but might not translate to consistent application in practice. 8-10 points: Good Knowledge - This score indicates a solid understanding of ergonomics principles. Individuals with this score are likely to be able to identify and address ergonomic risks in the workplace.

Section Three: Ergonomics Practices Assessment:

Ten questions will be used to assess the ergonomics practices among nurses with answers, each question is rated on a scale of 1 (Never) to 5 (Always). Scores for all questions are added together. Maximum score = 100 points. A higher score reflects more consistent use of ergonomic practices in the workplace. *The Scoring*; The questionnaire utilizes Likert scale responses, with participants rating their agreement with each statement on a scale from never (1) to always (5),

The questionnaire is comprehensive and covers various dimensions. *Total Score Interpretation*; From (40-50) are excellent Ergonomic Practices, this score indicates the nurse consistently uses ergonomic practices in most situations. From (31-39) are good Ergonomic Practices, while the nurse frequently uses ergonomic practices but may have room for improvement in some areas. From (21-30) are fair Ergonomic Practices, while the nurse uses ergonomic practices somewhat often, but there are likely situations where they could be implemented more consistently. From 11-20 poor ergonomic practices, while the nurse infrequently uses ergonomic practices and may be at higher risk for work-related musculoskeletal disorders (MSDs). From **(10-10)** are Very Poor Ergonomic Practices, while the nurse rarely or never uses ergonomic practices and is likely at high risk for MSDs.

3.4 Validity and Reliability

Validity refers to a questionnaire's correctness and appropriateness in assessing what it claims to measure. It guarantees that the questionnaire includes the required constructs or variables (Cohen *et al.*, 2017). A valid and reliable questionnaire is essential for delivering accurate and useful data for study or evaluation. A pilot sample of the questionnaire was provided to 5-10% of participants to assess the questionnaire's validity and reliability. The validity was done by 4-5 experts in the field and was made accordingly to investigate and validate the tool items in addition to readapt and arrange the validity of questionnaire items to the study aim, population, and setting. The study finding's reliability was measured by evaluating the internal consistency for the questionnaire items using alpha Cronbach, the results must be more than 0.7 to refer to total good reliability for the survey items.

3.5 Ethical Considerations

Ethical Approval was obtained with grant number (KFU-REC-2024-MAR-ETHICS2149) from the ethics and research committee at the faculty of King Faisal University. Permission was obtained from Eastern Province hospitals in Saudi Arabia University. The consent form was supplied with comprehensive information regarding the study's objectives, methodologies, prospective advantages and disadvantages, and the voluntary nature of their engagement before their participation. A pilot study of 10% was collected and excluded from the total samples. All participants have the right to be anonymous and all their data must be kept confidential and secret, they have all rights to withdraw from the study or questionnaires.

3.6 Data Management

Following the principle of confidentiality, appropriate measures were taken to ensure the protection of participant information. The data-gathering technique excluded personal identifiers, such as names and contact information. Instead, unique participant numbers were employed. Only the study team has access to the key that links participant identifiers to their personal information. The data were stored safely and would only be accessible to individuals who have been granted authorization by the study team. Per institutional norms, data was disposed of once it had been retained for the specified duration. Concerning Anonymity: The study ensured that participants' identities remained anonymous, and no personal identifiers were incorporated into the data collection process. To ensure the preservation of anonymity, each participant was allocated distinct codes. The study team took measures to maintain the integrity of participant information concerning the research data.

3.7 Data Analysis

The questionnaire's data analysis was performed using SPSS version 21. Initially, it was important to input the participants' responses into an SPSS dataset, ensuring the assignment of suitable labels and variable types. The calculation of descriptive statistics allowed for the provision of a comprehensive summary of the characteristics of the respondents. This included the determination of frequencies and percentages for categorical variables, such as gender, age, and years of experience. To evaluate the consistency of the questionnaire's scales, reliability analysis was conducted using measurements such as Cronbach's alpha. Chi-square tests were commonly employed in statistical analysis to investigate relationships between categorical variables, whilst t-tests or ANOVA were utilized to analyze variations among groups based on demographic factors and Likert scale items. The utilization of correlation analysis enabled the examination of associations between variables, whereas regression analysis facilitated the identification of predictive relationships.

4. Results

Table 1: Study Participants Profile (n=402)

Variables	Responses	Count	%
Department	ICU	20	5.0
	ER	86	21.4
	Outpatient Department	72	17.9
	Coordinators	87	21.6
	OR	33	8.2
	Surgical ward	18	4.5
	Home Health Care ¹	13	3.2
	CCU	18	4.5
	Medical ward	10	2.5
	Haemodialysis	13	3.2
	NICU	11	2.7
	Medical Rehabilitation	21	5.2
Experiences	6-10 years	142	35.3
	1-5 years	98	24.4
	11-15 years	88	21.9
	15-20 years	51	12.7
	More than 20 years	23	5.7
Age in years	31-35 years	165	41.0
	25-30 years	103	25.6
	36-40 years	93	23.1
	41-45 years	24	6.0
	More than 45 years	17	4.2
Marital Status	Single	159	39.6
	Married	220	54.7
	Divorced	19	4.7
	Widow	4	1.0
Education	Intermediate	65	16.2

	Bachelor of Science	263	65.4
	Master	68	16.9
	PhD	6	1.5
Nationality	Saudi	374	93.0
	Non-Saudi	28	7.0
Gender	Female	227	56.5
	Male	175	43.5

Table (1) illustrates the study participants' demographic characteristics and job-related data. The majority of the nurses studied were Saudi nationals. More than one-quarter of the nurses studied (n=165) were aged 31 to 35. About 21.4% worked in the Emergency Department, and 21.6% worked as coordinators. Nearly 35.3% of nurses studied had work experience of 6-10 years. More than half (54.7%) were married, 65.4% had a bachelor's degree, and 56.5% were female.

Table 2 Nurses' Ergonomics level of knowledge (N = 402)

	Ergonomics knowledge statements	Correct Response out of 402		95%. CI
		Count	%	
1	The main goal of ergonomics	48	11.9	9.0-14.8
2	Diabetes is a common musculoskeletal disorder (MSD) associated with poor ergonomics in nursing	260	64.7	60.4-69.0
3	The recommended posture for lifting a heavy object from the floor	238	59.2	54.8-63.6
4	Identify the benefit of using adjustable workstations for nurses	294	73.1	69.1-77.1
	Working with cold hands is NOT a good practice for preventing repetitive strain injuries (rsis)?	110	27.4	23.44-31.44
6	Standing for long periods is always bad for your back, regardless of posture.	374	93.0	90.7-95.3
7	Proper ergonomics can help to reduce fatigue and improve job satisfaction among nurses.	389	96.8	95.2-98.4
8	Wrist rests is an ergonomic tool they are designed to protect wrists	244	60.7	56.3-65.1
9	Anti-fatigue mats is an ergonomic tool they are designed to protect the Knees	372	92.5	90.1 - 94.9
10	Anti-fatigue mats Adjustable chairs is an ergonomic tool they are designed to protect Back	335	83.3	80.0-86.6
Overall level of ergonomic knowledge:				
	• Poor Knowledge	33	8.2	5.7-10.7
	• Fair Knowledge	242	60.2	55.8-64.6
	• Good Knowledge	127	31.6	27.4-35.8

	Mean Ergonomics knowledge score (mean $\pm$ SD) Range	6.6 $\pm$ 1.5 2-10
--	---	-----------------------

Table (2) shows the level of Ergonomic knowledge among the study nurses (n=402). The mean (SD) of the Ergonomic knowledge score was 6.6 $\pm$ 1.5. Most of the nurses studied (60.2%) had fair knowledge regarding ergonomics. Most responded correctly regarding the harm of standing for long periods (93%), proper ergonomics reduce fatigue (96.8%), and correct definition of Anti-fatigue materials (92.5%).

Table 3 Nurses' Ergonomics Practices (N = 402)

	Ergonomics Practices Questions (Correct Response)	Always out of 402	Mean $\pm$ SD	95%. CI
1	I use proper lifting techniques when moving patients or equipment.	172(42.8)	3.56 $\pm$ 1.5	38.4-47.2
2	I adjust my workstation (chair, keyboard) to maintain good posture throughout my shift.	191(47.5)	3.74 $\pm$ 1.4	43.0-52.0
3	I take short breaks to stretch and move around every 1-2 hours.	172(42.8)	3.49 $\pm$ 1.5	38.4-47.2
4	I wear comfortable shoes with good arch support during my shift.	201(50.0)	3.84 $\pm$ 1.4	45.5-54.5
5	I avoid awkward postures like reaching or twisting my body to access supplies.	177(44.0)	3.66 $\pm$ 1.4	39.6-48.4
6	I use ergonomic tools like stethoscopes with lightweight headsets.	166(41.3)	3.49 $\pm$ 1.5	36.9-45.7
7	I report any discomfort or pain I experience while working to a supervisor.	159(39.6)	3.50 $\pm$ 1.5	35.2-44.0
8	I actively seek out information and resources on ergonomics in the workplace.	177(44.0)	3.65 $\pm$ 1.4	39.6-48.4
9	I remind my colleagues about the importance of practicing good ergonomics.	185(46.0)	3.68 $\pm$ 1.4	41.5-50.5
10	I feel confident in my ability to identify and address ergonomic risks in my work environment.	181(45.0)	3.71 $\pm$ 1.4	40.5-49.5
Overall level of Ergonomics Practices :				
	• Excellent Ergonomic Practices	175	42.3%	37.9-46.7
	• Good Ergonomic Practice	71	17.7%	14.3-21.1
	• Fair Ergonomic Practices	94	23.5	19.7-27.3
	• Poor Ergonomic Practices	48	11.9%	9.0-14.8
	• Very Poor Ergonomic Practices	14	3.5%	1.9-55.1
	Mean Ergonomics Practices score (mean $\pm$ SD) Range	36.3 $\pm$ 13.1 10-50		

Table (3) shows the level of Ergonomic practice among the study nurses (n=402). The mean (SD) of the Ergonomic knowledge score was 36.3 $\pm$ 13.1. Most of the nurses studied (42.3%) had excellent ergonomic practices. Half of them responded correctly regarding using comfortable shoes during their shift (50 %) with a mean (SD) of 3.84 $\pm$ 1.4, adjusting their workstations (47.5

%) with a mean (SD) of 3.74 ± 1.4 , and remaining their colleagues about good ergonomics (92.5%) with a mean (SD) of 3.68 ± 1.4 .

Figure (1) illustrates the association between nurses' agronomic knowledge and practices (N = 402). A highly significant relationship existed between nurses' agronomic knowledge and practices ($p < 0.001$) with a small effect size ($\eta = 0.42$).

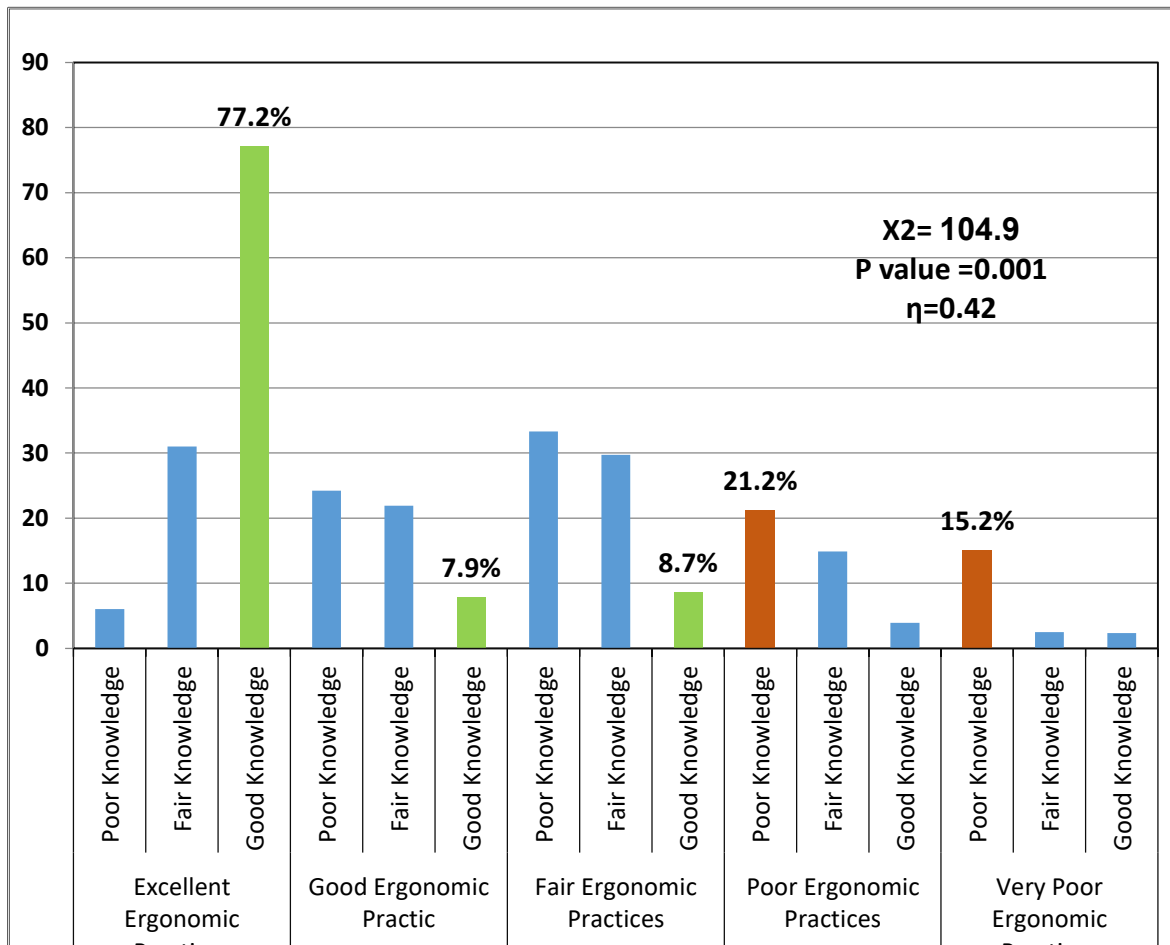


Fig. 1: Chi -square test explain the association between agronomic knowledge and Nurses' Ergonomics Practices (N = 402)

Table 4 : Association between agronomic knowledge and Nurses' Ergonomics Practices

Agronomic knowledge Ergonomics Practices	Count	Poor Knowledge	Fair Knowledge	Good Knowledge	p-value
	%				
Excellent Ergonomic Practices	Count	2	75	98	0.001
	%	6.1	31.0	77.2	
Good Ergonomic Practice	Count	8	53	10	0.001
	%	24.2	21.9	7.9	

Fair Ergonomic Practices	Count	11	72	11	0.001
	%	33.3	29.8	8.7	
Poor Ergonomic Practices	Count	7	36	5	0.001
	%	21.2	14.9	3.9	
Very Poor Ergonomic Practices	Count	5	6	3	0.001
	%	15.2	2.5	2.4	
Total	Count	33	242	127	0.001
	%	8.2	60.2	31.6	

Pearson Chi-Square : $X^2=104.9$

Directional Measures = $\eta=0.42$

Table (4) presents the association between nurses' ergonomic knowledge and practices. There is a highly significant relationship ($p<0.001$) between the three levels of ergonomic knowledge (poor, fair, and good) and the five levels of ergonomic practice (excellent, good, fair, poor, and very poor) with a small effect size ($\eta=0.42$).

Table (5) Multiple logistic regression model for ergonomic knowledge and socio-demographic variables as factors associated with overall Nurses' Ergonomics Practices

Variables	Unadjusted				Adjusted			
	Sig.	OR	[95.0% C.I. for OR]		Sig.	OR	[95.0% C.I. for OR]	
			Lower	Upper			Lower	Upper
Knowledge								
• Poor Knowledge	R							
• Good knowledge	0.000	4.39	2.86	6.74	0.000	5.06	3.13	8.17
Gender								
• Female	R							
• Male	0.015	1.35	1.89	2.02	0.050	1.59	1.99	2.57
– Age in years								
– 31-35 years	R							
– 25-30 years	0.000	0.32	0.19	0.54	0.012	0.42	0.21	0.83
– 36-40 years	0.018	0.53	0.31	0.90	0.056	0.50	0.25	1.02
– 41-45 years	0.368	0.66	0.27	1.62	0.434	0.63	0.20	2.00
– More than 45 years	0.347	1.86	0.51	6.77	0.156	3.36	0.63	17.89
Nationality								
• Saudi	R							

• Non Saudi	0.728	1.15	0.52	2.57	0.556	1.34	0.50	3.60
Marital status								
• Single	R							
• Married	0.269	1.27	0.83	1.93	0.362	0.76	0.42	1.37
• Divorced	0.626	0.79	0.30	2.05	0.147	0.43	0.14	1.35
• Widow	0.735	0.71	0.10	5.17	0.115	0.14	0.01	1.62
Education								
• Intermediate	R							
• Bachelor of Science	0.055	1.71	0.99	2.95	0.129	1.64	0.87	3.09
• Postgraduate	0.029	2.15	1.08	4.27	0.015	2.70	1.21	6.04
Experiences								
• 1-5 years	R							
• 6-10 years	0.000	0.32	0.19	0.54	0.007	1.55	1.29	2.06
• 11-15 years	0.156	0.66	0.38	1.17	0.995	1.00	0.50	2.00
• 15-20 years	0.607	0.84	0.42	1.66	0.662	1.23	0.49	3.10
• More than 20 years	0.164	0.53	0.21	1.30	0.514	0.64	0.17	2.42

* Statistically significant at ≤ 0.05

Table (5) indicates multiple logistic regression models for ergonomic knowledge and socio-demographic variables associated with overall nurses' ergonomics practices. A positive significant association exists between nurses' knowledge and practice regarding ergonomics (OR=4.39, $P<0.001$). Also, significant positive associations were detected between gender and nurse practice (OR=1.35, $P=0.015$). This suggests that nurses with higher knowledge levels are approximately 4.39 times more likely to engage in the desired practice than those with lower knowledge levels. Nurses aged 25-30 years and 36-40 years old had a weak positive association with ergonomic practice had OR=0.32, $P<0.001$, and OR=0.53, $P=0.018$. At the same time, no significant associations were detected between nationality and ergonomic practice (OR=1.15, $P=0.728$) and married, divorced, or widow marital status (OR=1.27, $P=0.269$, OR=0.79, $P=0.626$, and OR=0.71, $P=0.735$ respectively). Our finding was that nurses with a bachelor's degree were 1.71 times more likely to engage in ergonomic practices than those without a bachelor's degree. With a positive relationship, it is not statistically significant at the 5% level (OR =1.71, $p=0.055$). Also, nurses with postgraduate degrees are 2.15 times more likely to engage in ergonomic practices than those without a postgraduate degree. The p-value of 0.029 is below the 0.05 threshold, indicating statistical significance (OR =2.15, $p=0.029$). Regarding experience years, nurses with 6-10 years of experience are 0.32 times as likely to engage in ergonomic practices compared to those with less experience with a statistically significant relationship (OR=0.32, $p=0.000$). Nurses with 11-15 years of experience are 0.66 times as likely to engage in ergonomic practices compared to those with less experience, with not statistically significant (OR=0.66.

$p=0.156$). Also, nurses with 15-20 years of experience are 0.84 times as likely to engage in ergonomic practices as those with less experience. This indicates a slight negative association but suggests they are more likely to engage in ergonomic practices than the previous groups with no statistically significant ($OR=0.84$, $p=0.607$). Nurses with more than 20 years of experience are 0.53 times as likely to engage in ergonomic practices as those with less experience, indicating a notable negative association. The p -value of 0.164 is also above the significance threshold, indicating that this relationship is not statistically significant ($OR=0.53$, $p=0.164$).

5. Discussion:

Ergonomics is crucial in nursing practice. It combines efficiency, worker health, and service quality. Nurses should understand the importance of ergonomic techniques and the consequences of not implementing them. Health encompasses mental, emotional, and physical well-being in healthcare settings (Hochhauser and Liberman, 2024). Working in a different hospital department with 12x36 shifts requires manual labor and limited assistance. Understanding ergonomics and how to use equipment can help nurses meet user needs and prevent accidents and injuries. Ergonomics is a crucial area of study in nursing work (Sousa *et al.*, 2023). Professional nurses understand the importance of fitting work environments into human characteristics. They consider ergonomic principles for patients and themselves, ensuring their long-term well-being. Negligence by an organization in implementing ergonomic standards suggests a lack of concern for worker safety (Nilsen *et al.*, 2020). Ergonomists are integrating principles of ergonomics into the operating room, sterile processing department, and environmental services in hospitals. Work in the hospital environment is tailored toward helping staff have better physical safety and addressing mental stress and job satisfaction. (Che Huei *et al.*, 2020; Majchrowicz *et al.*, 2022)

Our study findings reported that most nurses were Saudi nationals, young, married, had enough working experience with a bachelor's degree, and females working in different hospital specialties. Concerning the level of Ergonomic knowledge among the study nurses, most of the nurses studied had a fair knowledge of ergonomics. The majority of them knew the harm of standing for long periods, that proper ergonomics reduce fatigue and correctly defined Anti-fatigue materials. Also, the level of ergonomic practice among the study nurses was high. The mean score of the Ergonomic knowledge score was satisfactory. Most of the nurses who studied had excellent ergonomic practices. Half responded correctly regarding using comfortable shoes during their shift and adjusting their workstations, and the remaining colleagues responded correctly about good ergonomics. Our study found a highly positive association between nurses' ergonomic knowledge and practices.

Our study found a positive association between nurses' knowledge and ergonomic practices, with higher knowledge levels being 4.39 times more likely to engage in ergonomic practices. Nurses aged 25-30 and 36-40 had weak positive associations with ergonomic practice. No significant associations were found between nationality and marital status. Nurses with bachelor's degrees were 1.71 times more likely to engage in ergonomic practices than those without degrees. Postgraduate degrees were 2.15 times more likely than those without a degree. Experience years also had a significant relationship, with nurses with 6-10 years of experience being 0.32 times more likely to engage in ergonomic practices. Nurses with over 20 years of experience were 0.53 times more likely to engage in ergonomic practices.

Our finding is in line with a study conducted in Oman that assessed the ergonomic awareness of 200 staff nurses, finding that while there was a fair degree of ergonomic knowledge (mean score of 3.2 out of 5), many reported discomforts, particularly in the lower back and neck regions.

(Attia *et al.*, 2023) Researchers in another study found that nurses' understanding and use of ergonomics improved after participating in a training session. The training, which lasted for a few months, covered the theory and practice of ergonomics, with the former focusing on the principles and the latter on safe patient handling procedures. After completing the training, nurses' knowledge and safety behaviors improved significantly, and this improvement was maintained over time, according to follow-up evaluations. To increase workplace safety and decrease occurrences of musculoskeletal injuries, this research highlights the significance of ongoing education and hands-on training for nurses in improving their ergonomic practices. (Hamid *et al.*, 2022)

Several studies show that nurses, the largest group of healthcare workers, experience the highest number of work-related injuries and illnesses. The stressful nature of nursing units negatively affects nurses' health and leads to high turnover rates. (Al Muharraq *et al.*, 2024; Attia *et al.*, 2023; Hamid *et al.*, 2022) Nurse fatigue impacts employee performance and poses a risk to patients. Creating favorable working conditions and implementing ergonomic practices can improve nurses' quality of life, enhance safety and health, foster a positive work culture, create an attractive workplace, improve patient service, and provide economic benefits to companies. Nurses' knowledge of ergonomics is crucial in realizing these benefits. (Al-Dossary *et al.*, 2022) Another study by Al Muharraq *et al.* (2024) on the ergonomic knowledge of 150 nurses in Riyadh found that although most understood the importance of ergonomics in their work, very few put these ideas into practice. According to the study, seventy percent of nurses experienced musculoskeletal pain associated with their lack of hands-on experience with ergonomic practices. According to the survey, comprehensive training programs focusing on ergonomic principles are critically needed to improve nurses' well-being and decrease injury rates (Al Muharraq *et al.*). The study found that ergonomic interventions in Saudi Arabian hospitals significantly reduced musculoskeletal disorders among nurses, improved health outcomes, enhanced productivity, and recommended institutional support for ergonomic training. (Al-Dossary *et al.*, 2022)

Our findings, congruent with a study involving 273 healthcare workers, including nurses, found that while participants demonstrated fair knowledge (average score of 2.6) and good attitudes towards ergonomics, actual ergonomic practices were often poorly implemented. The research indicated that being Saudi, female, and having lower academic qualifications were associated with poorer ergonomic knowledge and practices. This highlights a gap between knowledge and practical application, suggesting a need for improved training and implementation of ergonomic principles in daily nursing activities to prevent musculoskeletal disorders (MSDs). (AlHazim *et al.*, 2022) This satisfactory level of knowledge and practice toward work ergonomics may be related to their increased years of experience. This finding, similar to a study, indicated that both student nurses and first-year nurses displayed weak knowledge of ergonomic principles, with no significant difference in their levels of awareness. This suggests that educational preparedness does not immediately translate into practical knowledge once they enter the workforce. The findings highlighted a need for enhanced ergonomics training during nursing education to better equip new nurses with the necessary skills to manage ergonomic risks effectively in their roles. (Hochhauser *et al.*, 2024)

Healthcare safety and patient care are closely linked to nursing work conditions. Nurses face frequent injuries due to musculoskeletal demands. Regulations for workers' compensation and ergonomics are needed but not fully adopted. Including ergonomics education is crucial. (Du *et al.*, 2021; Ou *et al.*, 2021) Studies show a link between nurses' ergonomics skills and

musculoskeletal disorders, with students often lacking knowledge. Neglecting ergonomics in healthcare is a significant issue, as it can improve patient outcomes, corporate financing, and patient health. (Al Muharraq *et al.*, 2024; Attia *et al.*, 2023) Studies reveal that many nursing professionals lack an understanding of ergonomics principles and their importance in improving workplace health and safety. This lack of understanding is linked to health conditions, as there is a scarcity of courses and continuous education on ergonomics in healthcare and nursing education. Only a small percentage of healthcare facilities offer training on back injury prevention, and limited experience can hinder clinical practice. Research shows that many nurses are unaware of the importance of ergonomics, do not receive training on ergonomic handling, and suffer from pain in body parts. Health sector development programs and academic reforms should be combined to address this. (Albanesi *et al.*, 2022; Al Muharraq *et al.*, 2024; Attia *et al.*, 2023)

Research suggests ergonomic nursing education is crucial for reducing nurse back injuries, particularly in specific cultures. However, there is a lack of comparison groups, case studies, equipment evaluations, and evidence of adequate intervention trials, even when focusing on nursing education. (Krishnan *et al.*, 2021) The study highlights the importance of ergonomics training for nurses, highlighting the negative impact of inadequate patient handling in veterans with back injuries. It suggests that nursing-oriented interventions are effective, while manual handling education programs may not be effective. (Aleid *et al.*, 2021; Cheraghi *et al.*, 2023) More studies are required to compare nurses' theoretical knowledge of ergonomics with practical application, finding a significant gap between knowledge and application. Most emergency nurses relied on opinion interviews and observation methods for assessing ergonomic risks. Standardized tools, such as acronyms and checklists, were found to improve patient and staff safety, but these tools need to be customized and tested in different healthcare settings. (Albanesi *et al.*, 2022; Krishnan *et al.*, 2021)

Barriers to implementing ergonomic practices in nursing include inadequate funding, lack of training, busy schedules, cultural resistance, time pressure, and lack of medical specialists. Organizational factors, poor leadership commitment, and communication issues hinder successful implementation. Successful ergonomic work requires active listening, continuous communication, and a complete workflow and patient-handling process overhaul. (Cheraghi *et al.*, 2023) There are significant repercussions for failing to apply proper ergonomics. With more than 35,000 cases of musculoskeletal injuries, nurses rank higher than any other healthcare worker. Because of this, nurses experience chronic agony, despair, and burnout, which ultimately leads many to quit the field. People are less likely to apply for jobs in unhealthy workplaces. Workers' compensation costs and public perception are both negatively impacted by injury rates that are too high. We must take swift and decisive action. (Aleid *et al.*, 2021; Cheraghi *et al.*, 2023) The high physical exertion nurses require makes them susceptible to musculoskeletal illnesses (MSDs). (Dale *et al.*, 2017) One common injury that nurses have on the job is chronic low back pain, which can have a significant impact on their emotional and mental well-being. Problems with self-esteem, sadness, anxiety, and sensitivity to others are all brought on by MSDs. There is a correlation between cognitive and emotional symptoms and changes in how personnel perceive and respond to pain. Reduced performance is a direct outcome of the fact that more than 65 percent of nurses are still dealing with pain and disability caused by MSDs. According to empirical research, nurses may need specific interventions again to function at their highest level. Expenditure rises as a result of staff dysfunction's economic impact. (Zhang *et al.*, 2020) The limitation of our study included limited generalizability, as the survey conducted in one hospital

or region may not apply to other healthcare settings. Surveys conducted in a single setting may suffer from selection bias, mainly if the sample is not representative of the larger population—lack of ability to make causal relationships or observe changes over time.

Limitations

The limitation of our study included limited generalizability, as the survey conducted in one region may not apply to other healthcare settings. Surveys conducted in a single setting may suffer from selection bias, mainly if the sample is not representative of the larger population—lack of ability to make causal relationships or observe changes over time.

Conclusion and Recommendations

It has been found that while participants demonstrated fair knowledge (average score of 2.6) and good attitudes towards ergonomics, actual ergonomic practices were often poorly implemented. The research indicated that being Saudi, female, and having lower academic qualifications were associated with poorer ergonomic knowledge and practices. Barriers to implementing ergonomic practices in nursing include inadequate funding, lack of training, busy schedules, cultural resistance, time pressure, and lack of medical specialists. Organizational factors, poor leadership commitment, and communication issues hinder successful implementation. Successful ergonomic work requires active listening, continuous communication, and a complete workflow and patient-handling process overhaul. Ergonomics to nurses' practices and knowledge is essential to be assessed and implemented among nurses to enhance their knowledge to some musculoskeletal disorders. More studies need to be conducted on larger sample size and in other areas to get full and diverse assessment of practices and nurses' knowledge about ergonomics.

Conflicts of interest

The authors declare no conflicts of interest or any competing interests.

Authors contributions

A.S.G offered the idea and design of the study. R.S.A prepared and submitted the IRB dossier; validated the study questionnaire; S.B, and R.S.A., analyzed the data; and drafted the manuscript. A.S.G and R.S.A examined the literature and wrote the study proposal. R.S.A and S.B supervised data collection. A.S.G and S.B reviewed the manuscript and supervised the entire projects. All authors have critically reviewed and approved the final draft and reviewed the content for similar index of the manuscript.

Data availability

The datasets analyzed during the current study are available from the corresponding author on reasonable request.

References

- Abdollahi, T., Pedram Razi, S., Pahlevan, D., Yekaninejad, M. S., Amaniyan, S., Leibold Sieloff, C., & Vaismoradi, M. (2020). Effect of an ergonomics educational program on musculoskeletal disorders in nursing staff working in the operating room: A quasi-randomized controlled clinical trial. *International Journal of Environmental Research and Public Health*, 17(19), 7333. <https://doi.org/10.3390/ijerph17197333>
- Al-Dossary, R. N. (2022). The effects of nursing work environment on patient safety in Saudi Arabian hospitals. *Frontiers in Medicine*, 9, 872091. <https://doi.org/10.3389/fmed.2022.872091>
- Al Muharraq, E.H., Abdali, F., Alfazan, A. et al. Exploring the perception of safety culture among nurses in Saudi Arabia. *BMC Nurs* 23, 412 (2024). <https://doi.org/10.1186/s12912-024-02077-7>
- Albanesi, B., Piredda, M., Bravi, M., Bressi, F., Gualandi, R., Marchetti, A., Facchinetti, G., Ianni, A., Cordella, F., Zollo, L., & De Marinis, M. G. (2022). Interventions to prevent and reduce work-related musculoskeletal injuries and pain among healthcare professionals: A comprehensive systematic review of the literature. *Journal of Safety Research*, 82, 124–143. <https://doi.org/10.1016/j.jsr.2022.08.002>
- Aleid, A. A., Eid Elshnawie, H. A., & Ammar, A. (2021). Assessing the work activities related to musculoskeletal disorder among critical care nurses. *Critical Care Research and Practice*, 2021, 8896806. <https://doi.org/10.1155/2021/8896806>
- ALHazim, S. S., Al-Otaibi, S. T., & Herzallah, N. H. (2022). Knowledge, attitudes, and practices regarding ergonomic hazards among healthcare workers in a Saudi government hospital. *Journal of Multidisciplinary Healthcare*, 15, 1771–1778. <https://doi.org/10.2147/JMDH.S371361> Dove Press
- Attia, R. M., Shaheen, W. A., Al Harrasi, N. S., & Al Toubi, A. K. (2023). Relationship between ergonomic awareness and work-related musculoskeletal disorders among staff nurses in Oman: An observational study. *Oman Medical Journal*, 38(4), e531. <https://doi.org/10.5001/omj.2023.92>
- Barnard, E., Sheaffer, K., Hampton, S., Measel, M. L., Farag, A., Shaw, C., & Measel, M. (2021). Ergonomics and work-related musculoskeletal disorders: Characteristics among female interventionists. *Cureus*, 13(9), e18226. <https://doi.org/10.7759/cureus.18226>
- Carayon, P., Wust, K., Hose, B. Z., & Salwei, M. E. (2021). Human factors and ergonomics in health care. In G. Salvendy (Ed.), *Handbook of Human Factors and Ergonomics* (5th ed., pp. 1417–1437). Wiley. <https://doi.org/10.1002/9781119636113.ch53> University of Minnesota Experts
- Cheraghi, R., Ebrahimi, H., Kheibar, N., & Sahebiagh, M. H. (2023). Reasons for resistance to change in nursing: An integrative review. *BMC Nursing*, 22, 310. <https://doi.org/10.1186/s12912-023-01460-0>
- Dąbek, J., Piotrkowicz, J., Korzeń, D., & Gąsior, Z. (2019). Knowledge and use of ergonomic principles in physicians and nurses with low back pain. *Health Problems of Civilization*, 13(3), 217–224. <https://doi.org/10.5114/hpc.2019.81342> agro.icm.edu.pl/2 ResearchGate+2 PMC+2
- Dale, A. M., Jaegers, L., Welch, L., Barnidge, E., Weaver, N., & Evanoff, B. A. (2017). Facilitators and barriers to the adoption of ergonomic solutions in construction.

- American Journal of Industrial Medicine, 60(3), 295–305.
<https://doi.org/10.1002/ajim.22693>
- Du, J., Zhang, L., Xu, C., & Qiao, J. (2021). Relationship between the exposure to occupation-related psychosocial and physical exertion and upper body musculoskeletal diseases in hospital nurses: A systematic review and meta-analysis. *Asian Nursing Research*, 15(3), 157–167. <https://doi.org/10.1016/j.anr.2021.03.003>
- Gilchrist, A., & Pokorná, A. (2021). Prevalence of musculoskeletal low back pain among registered nurses: Results of an online survey. *Journal of Clinical Nursing*, 30(11–12), 1675–1683. <https://doi.org/10.1111/jocn.15722>
- Hamid, A. A. M. A. (2022). *Effect of Ergonomics Training Program on Nurses' Knowledge and Safety Practice* (Doctoral dissertation, Cairo University).
- Hijam, S., Deaver, U., & Sarin, J. (2020). Effectiveness of ergonomic training program on knowledge, self-efficacy and practice on prevention of work-related low back pain among staff nurses. *Indian Journal of Forensic Medicine & Toxicology*, 14(4), 551–556. <https://doi.org/10.37506/ijfmt.v14i4.11540> Env-Behav Proceedings Journal +1Medico Publication+1
- Hochhauser, M., & Liberman, E. (2024). Health status and ergonomics education: A comparison between student nurses and first-year nursing staff. *Nursing Open*, 11(7), e2239. <https://doi.org/10.1002/nop2.2239>
- Krishnan, K. S., Raju, G., & Shawkataly, O. (2021). Prevalence of work-related musculoskeletal disorders: Psychological and physical risk factors. *International Journal of Environmental Research and Public Health*, 18(17), 9361. <https://doi.org/10.3390/ijerph18179361>
- Mailutha, J. T., Mugga, J., & Kanali, C. L. (2020). Prevalence of musculoskeletal disorders among nurses in Kenya: Part 1, anthropometric data and MSDS. *International Journal of Emerging Technologies and Advanced Engineering*, 10(4), 158–163.
- Tomaszewska, K., & Majchrowicz, B. (2022). Harmful factors at the workplace of an operating nurse. *Journal of Education, Health and Sport*, 12(7), 286–300. <https://doi.org/10.12775/JEHS.2022.12.07.028APCz+1Zenodo+1>
- Majid, U. (2018). Research fundamentals: Study design, population, and sample size. *Undergraduate Research in Natural and Clinical Science and Technology Journal*, 2, 1–7. <https://doi.org/10.26685/urncst.16>
- Maria, T., Andrianna, K., Evdokia, B., & Elias, T. (2017). Work-related musculoskeletal disorders among female and male nursing personnel in Greece. *World Journal of Research and Review*, 4(1), 262859.
- Mohammad, A., Abbas, B., & Narges, H. (2019). Relationship between knowledge of ergonomics and workplace condition with musculoskeletal disorders among nurses. *International Archives of Health Sciences*, 6(3), 121–126. DOI: 10.4103/iahs.iahs_10_19
- Muthukrishnan, R., & Maqbool Ahmad, J. (2021). Ergonomic risk factors and risk exposure level of nursing tasks: Association with work-related musculoskeletal disorders in nurses. *European Journal of Physiotherapy*, 23(4), 248–253. <https://doi.org/10.1080/21679169.2020.1715473Colab+1ResearchGate> +1

- Nilsen, P., Seing, I., Ericsson, C., Birken, S. A., & Schildmeijer, K. (2020). Characteristics of successful changes in health care organizations: An interview study with physicians, registered nurses, and assistant nurses. *BMC Health Services Research*, 20, 147. <https://doi.org/10.1186/s12913-020-4999-8> BMC Health Services Research
- Ou, Y. K., Liu, Y., Chang, Y. P., & Lee, B. O. (2021). Relationship between musculoskeletal disorders and work performance of nursing staff: A comparison of hospital nursing departments. *International Journal of Environmental Research and Public Health*, 18(13), 7085. <https://doi.org/10.3390/ijerph18137085>
- Saremi, M., Fallah Madvari, R., Akhlaghi Pirposhte, E., Mohammad Hosseini, A., Laal, F., & Adineh, H. A. (2019). The relationship between knowledge of ergonomic science and occupational injuries in nurses. *Journal of Patient Safety & Quality Improvement*, 7(2), 47–51.
- Sasangohar, F., Moats, J., Mehta, R., & Peres, S. C. (2020). Disaster ergonomics: Human factors in COVID-19 pandemic emergency management. *Human Factors*, 62(7), 1061–1068. <https://doi.org/10.1177/0018720820939428> SAGE Journals
- Shah, S. Z., Rehman, S. T., Khan, A., Hussain, M. M., Ali, M., Sarwar, S., & Abid, S. (2022). Ergonomics of gastrointestinal endoscopies: Musculoskeletal injury among endoscopy physicians, nurses, and technicians. *World Journal of Gastrointestinal Endoscopy*, 14(3), 142–149. <https://doi.org/10.4253/wjge.v14.i3.142>
- Sousa, A. D., Baixinho, C. L., Presado, M. H., & Henriques, M. A. (2023). The effect of interventions on preventing musculoskeletal injuries related to nurses' work: A systematic review. *Journal of Personalized Medicine*, 13(2), 185. <https://doi.org/10.3390/jpm13020185> MDPI
- Warnakulasuriya, S. S. P., Peiris, J. R., Sivayogan, S., Sathiakumar, N., & Wickremasinghe, A. R. (2016). An intervention to change knowledge, attitudes, and practices on work ergonomics among nurses in two selected teaching hospitals in Colombo.
- Westergren, E., & Lindberg, M. (2022). Work-related musculoskeletal complaints among haemodialysis nurses: An exploratory study of the work situation from an ergonomic perspective. *Work*, 72(3), 875–884. <https://doi.org/10.3233/WOR-205241> NGDC
- Zakerian, S. A., Monazzam, M. R., Dehghan, S. F., Mohraz, M. H., Safari, H., & Asghari, M. (2013). Relationship between knowledge of ergonomics and workplace conditions with musculoskeletal disorders among nurses: A questionnaire survey. *World Applied Sciences Journal*, 24(2), 227–233.
- Zhang, T., Tian, Y., Yin, Y., Sun, W., Tang, L., Tang, R., Tian, Y., Gong, S., & Tian, S. (2024). Efficacy of an Omaha system-based remote ergonomic intervention program on self-reported work-related musculoskeletal disorders (WMSDs): A randomized controlled study. *Heliyon*, 10(2), e24514. <https://doi.org/10.1016/j.heliyon.2024.e24514>
- Zhang, Y., ElGhaziri, M., Nasuti, S., & Duffy, J. F. (2020). The comorbidity of musculoskeletal disorders and depression: Associations with working conditions among hospital nurses. *Workplace Health & Safety*, 68(7), 346–354. <https://doi.org/10.1177/2165079919897285>