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A STUDY TO ASSESS THE EFFECT OF PLANNED TEACHING ON KNOWLEDGE AND PRACTICE REGARDING BODY ERGONOMICS IN THE PREVENTION OF OCCUPATIONAL INJURIES AMONG BUS WORKERS IN SELECTED BUS DEPOTS OF NAVI MUMBAI

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ABSTRACT

Background: Musculoskeletal disorders (MSDs) are highly prevalent worldwide, affecting over 100 million people and accounting for 42–58% of all work-related illnesses. They cause long-term pain, disability, and reduced productivity. Ergonomic interventions help minimize risks across high-risk sectors such as construction, healthcare, transportation, and office work by reducing workplace hazards. Bus drivers face risks from prolonged sitting, repetitive hand–foot movements, and exposure to air and noise pollution, while conductors are vulnerable due to prolonged standing, vibration, and continuous passenger interaction. Awareness and application of ergonomic principles in workstation setup can significantly prevent discomfort and enhance productivity. The researcher chose to study this topic to improve knowledge about body ergonomics and the prevention of occupational injuries among the bus workers. This information is to be given in the local bus depots. An individual will get information by planned teaching in the form of a lecture come discussion, and demonstration of exercises to prevent musculoskeletal disorders and improve the ergonomic practices of bus workers.

Aim: The Knowledge and Practice regarding Body Ergonomics in the prevention of occupational injuries should improve after planned teaching

Objectives: 1. To assess the knowledge and practice of bus workers regarding body ergonomics before and after planned teaching. 2. To determine the association of knowledge and practice scores with selected demographic variables.

Material and Methods: One-group pre-test-post-test design. 60 bus workers selected from the selected bus depot of Navi Mumbai. Non-probability convenience sampling technique was used. Data collection included the use of planned teaching, a structured questionnaire for knowledge, an observation checklist for exercises, and an inventory checklist for the observed practices.

Analysis: The findings regarding pre- and post-test knowledge of bus workers reveal that in the pre-test, none of them had excellent knowledge, which drastically improved after planned teaching. Comparison between pre-test and post-test knowledge scores (t=,40.69), Practice of stretching exercised on day-0^{th} and day-7^{th} (t=12.01), pre-and post-test practice scores of bus conductors (t=14.82), and of bus conductors (t= 9.19) which was greater than the tabulated value therefore, there was a significant difference in the knowledge and practices of the bus workers. Correlation between knowledge and practice (r=-0.084) indicates no significant relationship between knowledge and practices of bus workers. The association between post-test knowledge scores and their selected demographic variables showed that age (t = -0.79), occupation (t = 0.19), and education (t = 1.25) were not statistically significant, as the t-values were less than the tabulated value. Therefore, there was no significant association between knowledge and the selected demographic variables.

Conclusion: Knowledge and Practice depicted marked improvement after planned teaching. Regular stretching exercises and continuous observation of preventive measures are also important for reducing the incidence and preventing occupational injuries.

Implications: The planned teaching regarding Body Ergonomics in the prevention of occupational injuries can be taken in the nursing Service to help nursing personnel working in hospitals and communities to plan health education for patients admitted with complaints of any occupational injury. Additionally, it provides a foundation for developing teaching programs aimed at creating awareness among nursing staff about body ergonomics and the prevention of occupational injuries. Nursing supervisors can also utilize the study's insights to organize sessions on stretching exercises, which help prevent ergonomic disorders among staff nurses.

From the perspective of nursing education, the study serves as a guideline for using planned teaching as an effective method to disseminate information. It also offers an opportunity to impart knowledge to

others**.** In nursing research, the research methodology, tools, and findings can be added to the nursing literature, which can provide insight to future nurse researchers, can be used as reference material for students, and even the same study can be replicated on a larger population.
Keywords: Planned teaching, Knowledge, Body Ergonomics, Occupational Injuries.

INTRODUCTION:

Ergonomics is the process of designing or arranging workplaces, products, and systems to fit the people who use them. Ergonomics applies to the design of anything that involves people, workspaces, sports and leisure, health, and safety. Ergonomics is the design of work tasks to best suit the capabilities of workers. It can help reduce or eliminate work-related musculoskeletal disorders (WMSDs) and other injuries and improve safety. Ergonomics programs provide guidelines for reducing workplace risk factors, which can lead to reduced workplace injuries.
Musculoskeletal disorders (MSDs) can affect the body's muscles, joints, tendons, ligaments, bones, and nerves. Most work-related musculoskeletal disorders (WMSDs) develop over time and are caused either by the work itself or by the employees' working environment. They can also result from accidents, e.g., fractures and dislocations. Health problems range from discomfort, minor aches, and pains to more serious medical conditions that require time off work and even medical treatment. In more chronic cases, treatment and recovery are often unsatisfactory - the result could be permanent disability and loss of employment.
Many problems can be prevented or greatly reduced by complying with existing safety and health laws and following guidance on good practice. This includes assessing work tasks, implementing preventive measures, and ensuring these measures remain effective.
Though the bus driver's job looks sedentary, they have to sit for prolonged periods while they are driving, and there are continuous hand and foot movements for operating the bus; also, they are exposed to environmental pollution, such as air and noise pollution, putting them at risk of occupational hazards. On the other hand, even the conductor's work is stressful due to prolonged standing, exposure to vibrations, and continuous work like talking to the passengers and providing them with the tickets, hence they are also exposed to the risk of occupational Hazards.
Work-related musculoskeletal disorders (WMSDs) develop in the musculoskeletal system over a prolonged period and may limit activities in the professional environment or non-professional activities. The prolonged sitting or standing posture during long-distance driving and the whole-body vibration from poorly maintained vehicles increase the vulnerability of professional drivers and conductors to developing MSDs.
Research Question: What is the effect of planned teaching on the knowledge and practice regarding body ergonomics in the prevention of occupational injuries among bus workers?
Objective: 1. To assess the knowledge and practice of bus workers regarding body ergonomics before and after planned
teaching. 2. To determine the association of knowledge and practice scores with selected demographic variables.

MATERIALS AND METHODS:

A pre-experimental one-group pre-test post-test design was used for the study. 60 bus workers were selected from the bus depots of Navi Mumbai using a non-probability convenience sampling technique. Knowledge about body ergonomics and the prevention of occupational injuries was assessed by a structured questionnaire, steps of stretching exercises were assessed using an observation checklist, and practices were assessed using an Inventory checklist. Planned teaching on body ergonomics and the prevention of occupational injuries was given to the bus workers, along with a Demonstration of stretching exercises. Post-test on knowledge was taken by a structured questionnaire, and post-intervention practices were observed using an inventory checklist and an observation checklist. **Participants:** The Target population comprised bus workers who were present at the time of data collection, understood, read, and were able to write English, Marathi, or Hindi, and were willing to participate. Those who were not willing to participate were excluded. Planned teaching involved: a lecture cum discussion using PowerPoint slides and a flip chart, and a demonstration of exercises. On the 7th day, the post-test was administered, and exercises were observed, followed by the observation of on-the-job practices.
Ethical considerations: The study was conducted as part of a larger research project approved by the Ethical Committee for Research at Leelabai Thackersey College of Nursing, S.N.D.T. Women's University. Before data collection, participants were provided with an information sheet, and their informed consent was obtained after explaining the steps involved in the process.
Quantitative Data Analysis: Data was analysed by section I, demographic variables included age, gender, weight, height, occupation, educational status, years of experience, monthly income, shift timings, diet, any poor health habits, any medical illness, heath problems experienced, any alternate therapy practiced, previous ergonomic training attended, and any history of injuries at the workplace among the bus workers.
Section II data about knowledge regarding body ergonomics and prevention of occupational injuries were analysed under 9 subheadings:
1. Purposes and importance of body ergonomics. 2. Ergonomic principles and their application. 3. Risk factors for occupational injuries. 4. Effects of poor ergonomic practices. 5. Correct ergonomic practices. 6. Prevention of

ergonomic disorders. 7. Stretching exercises to reduce muscle tension. 8. Common ergonomic-related injuries and adjustments for bus drivers. 9. Common ergonomic-related injuries and adjustments for bus conductors.
The questionnaire consisted of a total of 30 questions divided into 3 parts. Part 1 consisted of 25 questions common to both the bus conductors and bus drivers. Part 2 consisted of 5 questions for the bus drivers only, and Part 3 consisted of 5 questions for the bus conductors only.

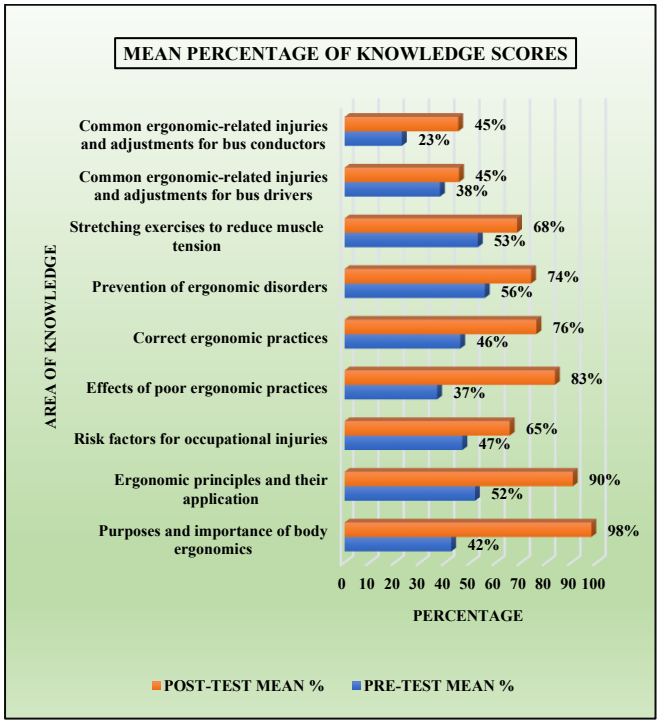

Fig. 1: Distribution of bus workers according mean percentile of overall knowledge score regarding body ergonomics and prevention of occupational injuries.

RESULTS

The above presented graph illustrates the mean percentage of knowledge scores before and after the planned teaching. Overall, there was a marked improvement in the knowledge across all areas, demonstrating the effectiveness of the planned teaching intervention. The highest post-test gains were observed in the area of purposes and importance of body ergonomics, i.e., from 42% to 98%. Whereas the area of common ergonomic-related injuries in bus drivers showed lesser improvement, i.e., from 38% to 45%.
Overall, the findings indicate that the planned teaching program was effective in significantly enhancing the bus workers' knowledge regarding ergonomics and the prevention of occupational injuries.

Table 1: COMPARISION OF LEVEL OF OVERALL KNOWLEDGE OF BUS WORKERS BEFORE AND AFTER PLANNED TEACHING

Sr. No.	Area of knowledge	M	SD	R	SED	t-test		Significance
						Cal value	Critical value	
1.	Pre-test	13.13	3.08	0.73	0.27	40.69	0.05= 2 0.01=2.662	Significant at the 0.01 level of significance
2.	Post-test	24.25	2.01					

While comparing the means of pretest and post-test knowledge scores of bus workers regarding body ergonomics and prevention of occupational injuries, it was found that the mean of the pretest was 13.13, while for the post-test, it was 24.25. The standard deviations were 3.08 for the pre-test and 2.01 for the post-test, with a total sample size of 60 participants. The calculated “t” value was 40.69, which was found to be greater than the critical value of t (2.662) for degrees of freedom 59 at a 0.01 significance level; therefore, the null hypothesis is rejected and the alternate hypothesis is accepted, suggesting a significant difference between the pre-test and post-test knowledge scores regarding body ergonomics and prevention of occupational injuries. Hence, planned teaching provided by the researcher was found to be effective in improving the knowledge of bus workers at selected bus depots.

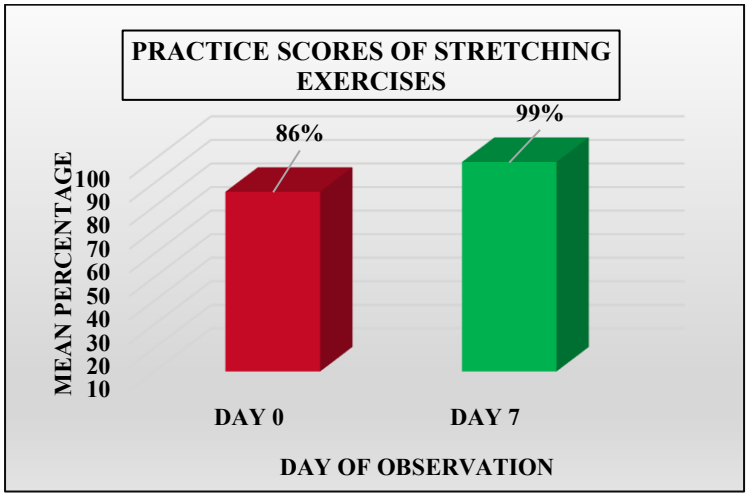

Fig. 2: Comparison of mean percentile practice scores regarding stretching exercises of bus workers.

The above given graph highlights the mean percentage of practice scores of the bus workers regarding stretching exercises on day 0th (Before demonstration) and day 7th (After demonstration). There is a slight improvement in the practice scores from 86% on day 0th to 99% on day 7^{th,} indicating that the bus workers' exercise practices were improved after the planned teaching and demonstration.

Table 2: COMPARISON OF LEVEL OF PRACTICE OF BUS WORKERS WITH REGARD TO STRETCHING EXERCISES ON DAY 0th AND DAY 7th

Sr. No.	Area of Practice	M	SD	R	SED	t-test		Significance
						Cal value	Critical value	
1.	Day 0th	48.28	5.22	0.49	0.59	12.01	0.05= 2 0.01=2.662	Significant at the 0.01 level of significance
2.	Day 7th	55.38	2.00					

While comparing the level of practice of bus workers concerning stretching exercises on day 0th (Before demonstration) and day 7th (After demonstration), it showed that the mean score increased from 48.28 (SD=5.22) on day 0 to 55.38 (SD=2.00) on day 7. The calculated t-value was 12.01, which exceeds the critical value t (2.662) at the 0.01 level of significance at degrees of freedom 59, indicating a statistically significant difference in the pre- and post-demonstration scores. Hence, it can be inferred that the planned teaching and demonstration were effective in improving the practice of stretching exercises among the bus workers.

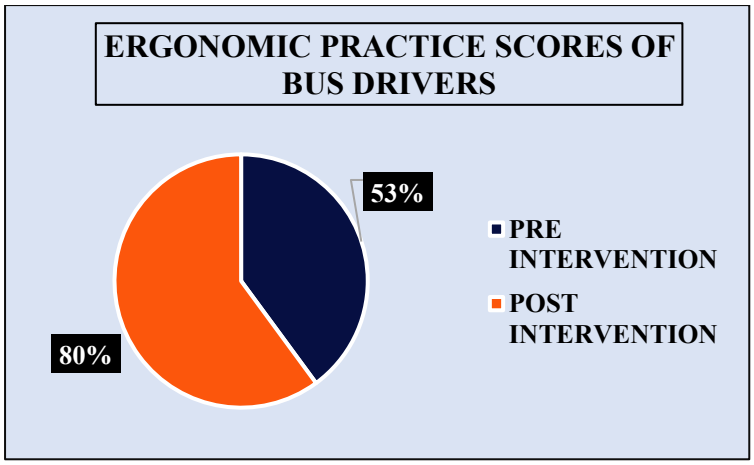

Fig. 3: Comparison of the mean percentage of ergonomic practice scores of bus drivers

The chart presents a comparison of ergonomic practice scores among the bus drivers pre- and post-planned teaching intervention. The pre-intervention score was 53% which increased to 80% post-intervention, indicating a substantial improvement.

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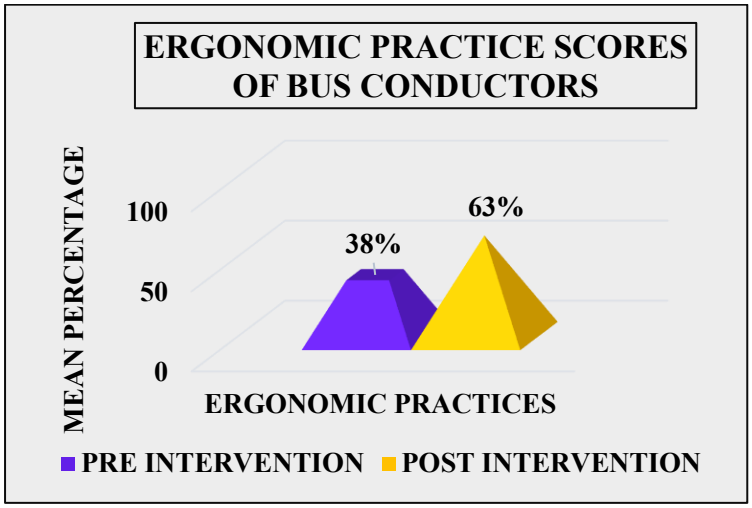

Fig. 4: Comparison of the mean percentage of ergonomic practice scores of bus conductors

The chart presents a comparison of ergonomic practice scores among the bus conductors pre- and post-planned teaching intervention. The pre-intervention score was 38% which increased to 63% post-intervention, indicating a moderate improvement in the practice scores.
Both Fig.3 and Fig. 4 highlight the effectiveness of planned teaching in enhancing ergonomic awareness and promoting safe work practices among bus drivers and conductors, thereby contributing to the prevention of occupational injuries.

Table 3: COMPARISON OF LEVEL OF ERGONOMIC PRACTICE OF BUS DRIVERS AND CONDUCTORS BEFORE AND AFTER PLANNED TEACHING

Sr. No.	Area of Practice	M	SD	R	SED	t-test		Significance
						Cal value	Critical value	
Ergonomic Practices of Bus Drivers								
1.	Pre-test	6.4	1.47	0.587	0.218	14.82	0.05= 2 0.01=2.662	Significant at the 0.01 level of significance
2.	Post-test	9.63	0.88					
Ergonomic Practices of Bus Conductors								
1.	Pre-test	5.36	1.44	0.426	0.373	9.19	0.05= 2 0.01=2.662	Significant at the 0.01 level of significance
2.	Post-test	8.8	2.18					

The findings presented in the table demonstrate a significant improvement in ergonomic practices among both bus drivers and conductors following the planned teaching intervention. For bus drivers, the mean practice score increased from 6.4 ± 1.4 in the pre-test to 9.63 ± 0.88 in the post-test. The calculated t-value of 14.82 exceeds the critical value at both 0.05 and 0.01 levels of significance, indicating that the improvement is statistically significant at the 0.01 level. Similarly, for bus conductors, the mean score improved from 5.36 ± 1.44 in the pre-test to 8.8 ± 2.18 in the post-test. The calculated t-value of 9.19 also exceeds the critical value, confirming statistical significance at the 0.01 level. These results clearly suggest that the planned teaching intervention was highly effective in enhancing ergonomic practices among bus workers.

Table 4: CORRELATION BETWEEN KNOWLEDGE AND SELECTED ERGONOMIC PRACTICES

Sr.no.	Correlation parameters	M	N	r		Level of significance
				Cal value	Critical value	
1.	Knowledge	24.25	60	-0.084	0.05= 0.15 0.01= 0.212	Not significant at the 0.05 level of significance
2.	Practice	9.21				

The above table data shows the correlation between the mean post-test knowledge and practice scores of the bus workers. The mean knowledge score was 24.25, and the practice score was 9.21, with a total sample size of 60. The calculated correlation coefficient (“r” value) was 0.084, while the critical values were 0.15 at a 0.05 level of significance and 0.212 at a 0.01 level of significance. Hence, the calculated value is lower than both critical values. Therefore, the null hypothesis is accepted at a 0.05 level of significance. Hence, it indicates that there is no

significant relationship between the knowledge and practices of bus workers regarding body ergonomics and prevention of occupational injuries.

Table 5: COMPARISON OF KNOWLEDGE OF THE BUS WORKERS REGARDING BODY ERGONOMICS AND PREVENTION OF OCCUPATIONAL INJURIES AFTER PLANNED TEACHING WITH REGARD TO THEIR DEMOGRAPHIC VARIABLES.

Sr no	Demographic variable	N	M	SD	df	SDD	SED	t-value		Significance
								Cal	Critical	
1.	**Age**									Not significant at the 0.05 level
	Up to 40 years	29	24.03	2.07	58	2.01	0.52	-0.79	0.05= 2 0.01=2.662	
	>40 years	31	24.45	1.96						
2.	**Occupation**									Not significant at the 0.05 level
	Drivers	30	24.3	2.03	58	2.03	0.52	0.19	0.05= 2 0.01=2.662	
	Conductors	30	24.2	2.02						
3.	**Education**									Not significant at the 0.05 level
	SSC	29	24.58	2.07	58	2.00	0.51	1.25	0.05= 2 0.01=2.662	
	>SSC	31	23.93	1.93						

Age- While comparing the means of post-test knowledge of bus workers according to their age, it was found that the mean score of knowledge of bus workers with an age up to 40 years was 24.03, whereas the mean score of bus workers with an age of more than 40 years the mean score was 24.45. The calculated t-value was -0.79, and the critical value was 2.662 at a 0.01 level of significance and 2 at a 0.05 level of significance. Since the calculated value was less than the critical value, there was no significant association of knowledge with the age of bus workers.

Occupation- While comparing the means of post-test knowledge of bus workers according to their occupation, it was found that the mean score of knowledge of bus drivers was 24.3, whereas for bus conductors, the mean score was 24.2. The calculated t-value was 0.19, and the critical value was 2.662 at a 0.01 level of significance and 2 at a 0.05 level of significance. Since the calculated value was less than the critical value, there was no significant association of knowledge with the occupation of bus workers.

Education- While comparing the means of post-test knowledge of bus workers according to their education, it was found that the mean score of knowledge of bus workers educated till SSC was 24.58, whereas the mean score of bus workers educated more than SSC was 23.93. The calculated t-value was 1.25, and the critical value was 2.662 at the 0.01 level of significance and 2 at the 0.05 level of significance. Since the calculated value was less than the critical value, there was no significant association of knowledge with the education of bus workers.

Hence, while comparing the means of post-test knowledge scores of bus workers according to the selected demographic variables, it was found that there was no significant association of knowledge with age, occupation, or education of the bus workers.

Table 6: COMPARISON OF PRACTICE SCORES OF THE BUS WORKERS REGARDING ERGONOMIC PRACTICES FOR PREVENTION OF OCCUPATIONAL INJURIES AFTER PLANNED TEACHING WITH REGARD TO THEIR DEMOGRAPHIC VARIABLES.

Sr no	Demographic variable	N	M	SD	df	SDD	SED	t-value		Significance
								Cal	Critical	
1.	**Age**									Not significant at the 0.05 level
	Up to 40 years	29	9.27	1.79	58	1.72	0.44	0.25	0.05= 2 0.01=2.662	
	>40 years	31	9.16	1.65						
2.	**Occupation**									Not significant at the 0.05 level
	Drivers	30	9.63	0.88	58	1.67	0.43	1.93	0.05= 2 0.01=2.662	
	Conductors	30	8.8	2.18						
3.	**Education**									Not significant at the 0.05 level
	SSC	29	9.03	1.40	58	1.71	0.44	-0.79	0.05= 2 0.01=2.662	
	>SSC	31	9.38	1.96						

Age- While comparing the means of the post-test practice of bus workers according to their age, it was found that the mean practice score of bus workers with an age up to 40 years was 9.27, whereas the mean score of bus workers with an age of more than 40 years was 9.16. The calculated t-value was 0.25, and the critical value was 2.662 at a 0.01 level of significance and 2 at a 0.05 level of significance. Since the calculated value was less than the critical value, there was no significant association of practice with the age of bus workers.

Occupation- While comparing the means of the post-test practice of bus workers according to their occupation, it was found that the mean practice score of bus drivers was 9.63, whereas for bus conductors, the mean score was 8.8. The calculated t-value was 1.93, and the critical value was 2.662 at a 0.01 level of significance and 2 at a 0.05 level of significance. Since the calculated value was less than the critical value, there was no significant association of practice with the occupation of bus workers.

Education- While comparing the means of the post-test practice of bus workers according to their education, it was found that the mean practice score of bus workers educated till SSC was 9.03, whereas that of bus workers educated more than SSC was 9.38. The calculated t-value was -0.79, and the critical value was 2.662 at the 0.01 level of significance and 2 at the 0.05 level of significance. Since the calculated value was less than the critical value, there was no significant association of practice with the education of bus workers.

Hence, while comparing the means of post-test practice scores of bus workers according to the selected demographic variables, it was found that there was no significant association of ergonomic practices with age, occupation, and education of the bus workers.

Therefore, it showed that age, occupation, and education did not influence knowledge and practices.

DISCUSSION:

According to Hijam et al. (2020). Quasi-experimental research was conducted on "Effectiveness of ergonomic training program on knowledge, self-efficacy, and practice on prevention of work-related low back pain among staff nurses in Harayana. The findings of the study showed that there was a significant difference between the pre-test and post-test knowledge scores t-test value was 12.01. Also, there was a significant difference in the mean post-test knowledge (p=0.001) and practice (p=0.001) scores of staff nurses in the experimental and comparison groups. Thus, the study showed that ergonomic training was effective in improving the knowledge, self-efficacy, and practice for the prevention of low back pain among staff nurses.

According to Fatima et al. (2024), "Musculoskeletal Disorders Among the United Arab Emirates Healthcare Professionals: Ergonomics Knowledge and Practice Study." The study was conducted among 380 healthcare professionals, including doctors and nurses. The study findings revealed that the prevalence of musculoskeletal disorders was 90.4%. The knowledge and practice scores were 61.8% and 36.3% respectively. They found that there was a significant association between inadequate ergonomic knowledge and practice and the presence of musculoskeletal disorders.

CONCLUSION:

The study revealed that planned teaching significantly improved the knowledge and practice scores of bus workers, demonstrating its effectiveness in promoting body ergonomics and preventing occupational injuries. However, no correlation was found between knowledge and practice, nor between these variables and factors such as age, occupation, or education. The findings suggest that structured training programs are valuable in enhancing awareness and practices related to ergonomics and injury prevention among bus workers. Additionally, incorporating regular stretching exercises and consistent monitoring of preventive practices is essential in reducing the occurrence of occupational injuries.

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