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Effects of ergonomic education and exercise training program on low back pain among nurses

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Abstract
Background: Musculoskeletal disorders are a significant occupational problem among nurses. Studies suggests that the work related low back pain is the main reason for the absenteeism and early retirement in nurses. However taking precautions for preventing low back pain in nurses is important. Nurses doing a stretching and strengthening program with maintaining their correct work posture can reduce the prevalence and severity of work related musculoskeletal disorders among nurses.
Objectives: The purpose of this study is to evaluate an ergonomic education and exercise program on relieving low back pain among nurses.
Design: Pre-test post-test experimental design.
Methods: Pre-test, post-test experimental design was conducted on 30 nurses. They were divided into two groups of 15, informed concern was obtained from all individuals. Group A received educational program and exercise relevant to their occupation which include stretching and strengthening exercises. The total treatment duration was 20 minutes, thrice in a week. The group B is a control allocated to do active exercise and posture correction.
Results: The 20 week ergonomic education program and exercise training is effective to reduce low back pain among nurses.

Keywords: Ergonomic education, exercise training program, low back pain among nurses

Introduction
Work related musculoskeletal disorder is a wide range of inflammatory and degenerative diseases and disorders that result in pain and functional impairment arise when an individual is exposed to work conditions. These are becoming a major health problem encountered by professional In many industrialized countries, WMSDs has rankng the second highest occupational disease after occupational mental diseases. Because of the different work characteristics, working hours and conditions, multiple parts of WMSDs are also different. Nowadays concerns about the risk of WMSDs have been increasing in the educated world.
Review of literature shows that Nurses in general, relative to other occupational groups, have a high prevalence of WMSDs that will decrease productivity at work due to sick leave, absenteeism and early retirement. A number of intrinsic and extrinsic factors have been implicated in the etiology of WMSDs [1] Silverstein *et al*. [2] reported repetitious movement, awkward postures, and high force levels are the primary risk factors that have been associated with WMSDs in general. Nurses routine activities include prolonged standing, heavy psycho emotional burden from the nurse-patient relation, working in awkward postures and physical requirement are making nursing professional work is more stressful and also put them into high risk for WMSDs.
Review of literatures shows that low back pain is the major occupational disease reported in nurses and it may distort the nurses' performance regarding their daily life activities and hinder their interpersonal relations, result in various psychological problems and affect the quality of life adversely [3]. A major characteristic of LBP, is that it can be prevented completely if the necessary precautions are taken. It is stated in the literature that LBP is not related to what duty is done but how it is done. In this context, sitting in a proper and controlled way, lifting legs correctly and well-balanced, exercising to strengthen low back and stomach muscles, applying principles of body mechanics correctly, abstaining from activities that presses low back area, taking breaks during occupational duties that require sitting or bending forward for a long time

are important precautions [4]. Maintaining a well-balanced emotional and physical life through not gaining excessive weight, not smoking, following healthy diet and exercise habits are also effective in protection of low back health [5]. There is a large volume of literature that claims that implementation of employee fitness program can reduce the prevalence and severity of WMSDs among Nurses by doing a specially designed stretching and strengthening exercise program with maintaining their correct work posture.

Majority of studies focus on the prevalence and incidence of the WMSDs there is very little evidence to the benefit of using systematic exercise routines in resolving the physical ailments caused by the WMSDs among Nurses.

Hence this study aims at the effect of an ergonomic education and exercise program on work related low back pain among nurses

Materials and Method

1. Stop watch
2. Couch

Procedure

Group 1: A. Experimental Group: Fifteen subjects randomly selected to participate in the educational program shall form the experimental group.

After taking the base line values on the outcome tools they will be initiated into the intervention phase. The participants will then enter the ergonomic education and exercise program. The multifaceted intervention comprised of two aspects:

1. Ergonomic training on how to improve their posture while treating the patients including an occupational health lecture, approximately 45 min long, introducing musculoskeletal pathogenesis, high-risk groups, and basic ergonomic principles, as well as emphasizing taking breaks and doing exercises while in the hospital
2. Doing exercises relevant to their occupation (a specially designed stretching and strengthening exercise program).The training will take 20 minutes, three sessions per week.

Group 2: Control Group

15 subjects will be randomly assigned to the control group. These subjects will do free active exercise and posture correction. The time schedule for the control group will be 20 minutes and it will be twice per week.

Fig 1: Hamstring Stretch

Fig 2: seated rotation

Fig 3: Bridging

Fig 4: Abdominal strengthenin

Fig 5: spinal stretch

Fig 6: spinal extension

Fig 7: knee-to-chest

Fig 8: planks

Fig 9: Partial curl ups

Statistical Analysis
Demographic profile

Table 1: Age distribution

Group	Mean	SD	Minimum	Maximum
Experimental	36.27	4.13	28	42
Control	35.87	3.5	29	41

Age	Experimental Group		Control Group	
	Frequency	Percentage	Frequency	Percentage
25 - 35 yrs	5	33.3%	5	33.3%
36 - 45 yrs	10	66.7%	10	66.7%
Total	15	100.0%	15	100.0%

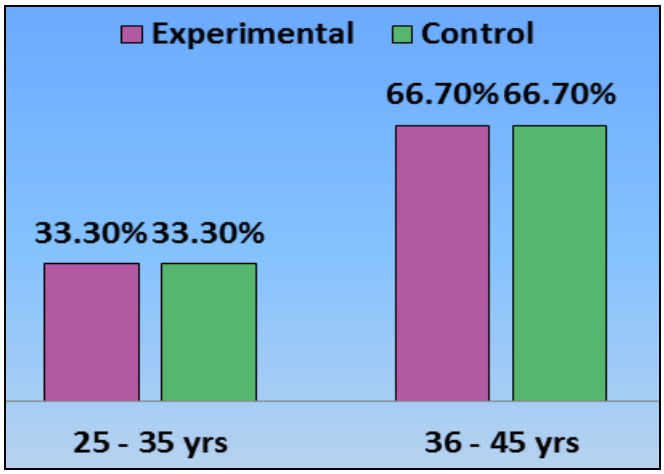

Fig 10: Age distribution

Table 2: Height distribution

Group	Mean	SD	Minimum	Maximum
Experimental	161.2	6.67	147	170
Control	161.4	6.16	149	172

Height (cm)	Experimental Group		Control Group	
	Frequency	Percentage	Frequency	Percentage
145 - 160 cm	7	46.7%	8	53.3%
161 - 175 cm	8	53.3%	7	46.7%
Total	15	100.0%	15	100.0%

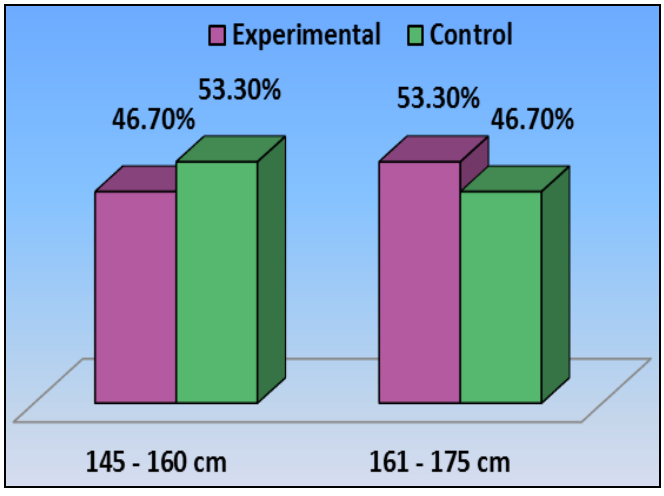

Fig 11: Height distribution

Table 3: Weight distribution

Group	Mean	SD	Minimum	Maximum
Experimental	61.4	5.27	50	70
Control	65.67	4.68	58	70
Weight (kg)	**Experimental Group**		**Control Group**	
	Frequency	**Percentage**	**Frequency**	**Percentage**
50 - 60 kg	6	40%	3	20%
61 - 70 kg	9	60%	12	80%
Total	15	100.0%	15	100.0%

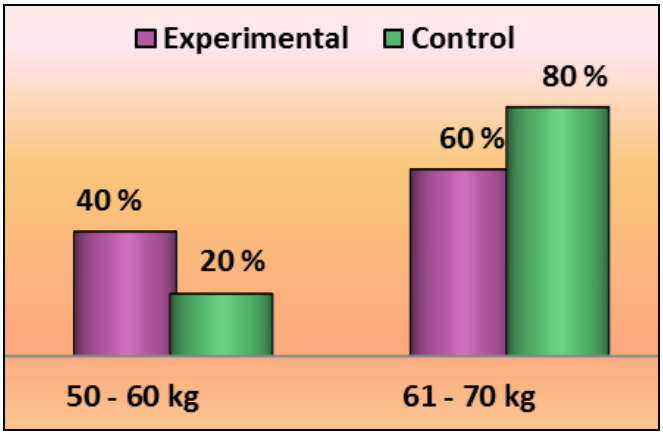

Fig 11: Weight distribution

Statistical analysis of disability index using t-tests

Table 4: Comparison of Pre-test Post-test disability index in Experimental and Control Groups

Group	Pre-test mean	SD	Post-test mean	SD
Experimental	42.67	4.7	18.93	3.1
Control	41.33	4.94	38.27	5.6

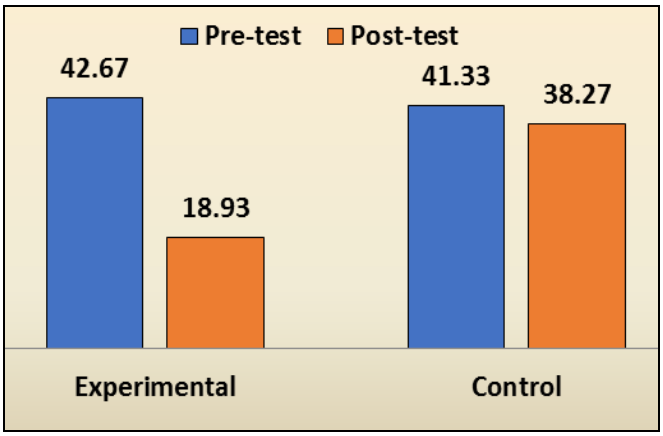

Fig 12: Comparison of Pre-test Post-test disability index in Experimental and Control Groups

Table 5: Mean, S.D. and t-value to compare Pre-test & Post-test Oswestry Disability Index in Experimental Group

Test	Mean	SD	Mean change	n	*t*	*df*	*table value*	*p-value*
Pre-test	42.67	4.7	23.74	15	31.54	14	2.15	$p < 0.05$
Post-test	18.93	3.1						

The mean column displays the mean pre-test and post-test disability index scores among individuals in the experimental group. SD is the standard deviations of the scores in pre & post respectively. Mean change 23.74 is the difference between pre-test and post-test (42.67&18.93). Since the *t-value*, 31.54is greater than the *table value* 2.15, $p < 0.05$, there is a significant difference existing between the pre-test and post-test disability index scores among individuals in the experimental group. The disability index has significantly reduced in the post test. This proves the effect of strengthening and stretching exercise on disability.

Table 6: Mean, S.D. and t-value to compare Pre-test Post-test Oswestry Disability Index In Control Group

Test	Mean	SD	Mean change	n	*t*	*df*	*table value*	*p-value*
Pre-test	41.33	4.94	3.06	15	5.6	14	2.15	$p < 0.05$
Post-test	38.27	5.6						

The mean column displays the mean pre-test and post-test disability index scores among individuals in the control group. SD is the standard deviations of the scores in pre & post respectively. Mean change 3.06 is the difference between pre-test and post-test (41.33&38.27). Since the *t-value*, 5.6 is greater than the *table value* 2.15, $p < 0.05$, there is a significant difference existing between the pre-test and post-test disability index scores among individuals in the control group. This shows the effect of pre-exercises.

So we have seen that there is significant reduction in disability index among the individuals in experimental group as well as in control group.

Now let us find whether there was homogeneity among disability index scores in the pre-test between experimental and control groups and hence prove the effect of strengthening and stretching exercise by comparing the post-test disability index scores between experimental and control groups.

Table 7: Mean, S.D. and t-value to compare the pre-test Oswestry Disability Index scores between Experimental and Control Groups using t-test

Group	Pre-test Mean	S.D.	Difference in mean	*n*	*t*	*df*	*table value*	*p-value*
Experimental	42.67	4.7	1.33	30	0.757	28	2.05	$p = 0.46$
Control	41.33	4.94						

The Mean column in the t test table displays the mean pre-test disability index scores in experimental and control group respectively. The standard deviation column displays the standard deviation of the scores in two groups. The difference (1.33) shows the difference between mean in two groups (42.67&41.33).Since the *t-value*0.757, is less than the *table value* 2.05,*p-value*> 0.05, there is no significant difference in pre-test disability index scores between the experimental and the control groups. So we can consider the groups as homogenous in the baseline level.

Table 8: Mean, S.D. and t-value to compare the post-test Oswestry Disability Index scores between Experimental and Control Groups using t-test

Group	Mean	S.D.	Difference in mean	*n*	*t*	*df*	*table value*	*p-value*
Experimental	18.93	3.1	19.34	30	11.69	28	2.05	$p < 0.05$
Control	38.27	5.6						

The Mean column in the t test table displays the mean post-test disability index scores in experimental and control group respectively. The standard deviation column displays the standard deviation of the scores in two groups. The difference (19.34) shows the difference between post-test mean in two groups (18.93&38.27).Since the *t-value*11.69, is greater than

the *table value* 2.05, *p-value*< 0.05, there is a significant difference in post-test disability index scores between the experimental and the control groups. The disability index in the experimental group is significantly low.
Hence strengthening and stretching exercise has significant high effect as compared with pre-exercises.

Statistical analysis of pain using t-test

Table 9: Comparison of Pre-test Post-test pain in Experimental and Control Groups

Group	Pre-test mean	SD	Post-test mean	SD
Experimental	6.87	0.74	4.13	0.92
Control	6.4	0.98	5.73	0.96

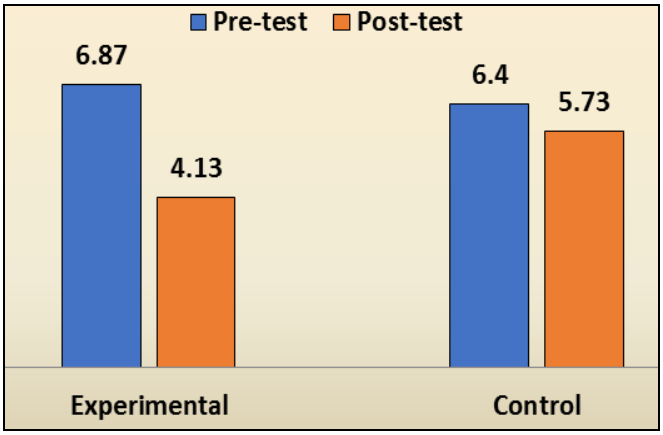

Fig 13: Comparison of Pre-test Post-test pain in Experimental and Control Groups

Table 10: Mean, S.D. and t-value to compare the pre-test Oswestry Disability Index scores between Experimental and Control Groups using t-test

Group	Pre-test Mean	S.D.	Difference in mean	*n*	*t*	*df*	*table value*	*p-value*
Experimental	42.67	4.7	1.33	30	0.757	28	2.05	*p = 0.46*
Control	41.33	4.94						

The Mean column in the t test table displays the mean pre-test disability index scores in experimental and control group respectively. The standard deviation column displays the standard deviation of the scores in two groups. The difference (1.33) shows the difference between mean in two groups (42.67&41.33).Since the *t-value*0.757, is less than the *table value* 2.05,*p-value*> 0.05, there is no significant difference in pre-test disability index scores between the experimental and the control groups. So we can consider the groups as homogenous in the baseline level.

Table 11: Mean, S.D. and t-value to compare the post-test Oswestry Disability Index scores between Experimental and Control Groups using t-test

Group	Mean	S.D.	Difference in mean	*n*	*t*	*df*	*table value*	*p-value*
Experimental	18.93	3.1	19.34	30	11.69	28	2.05	*p <0.05*
Control	38.27	5.6						

The Mean column in the t test table displays the mean post-test disability index scores in experimental and control group respectively. The standard deviation column displays the standard deviation of the scores in two groups. The difference (19.34) shows the difference between post-test mean in two groups (18.93&38.27).Since the *t- value*11.69, is greater than

the *table value* 2.05, *p-value*< 0.05, there is a significant difference in post-test disability index scores between the experimental and the control groups. The disability index in the experimental group is significantly low.
Hence strengthening and stretching exercise has significant high effect as compared with pre-exercises.

Statistical analysis of pain using t-tests

Table 12: Comparison of Pre-test Post-test pain in Experimental and Control Groups

Group	Pre-test mean	SD	Post-test mean	SD
Experimental	6.87	0.74	4.13	0.92
Control	6.4	0.98	5.73	0.96

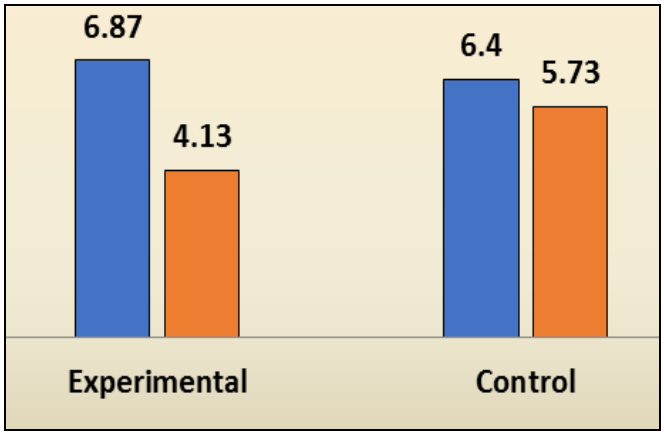

Fig 14: Comparison of Pre-test Post-test pain in Experimental and Control Groups

Table 13: Mean, S.D. and t-value to compare Pre-test & Post-test pain in Experimental Group

Test	Mean	SD	Mean change	n	*t*	*df*	*table value*	*p-value*
Pre-test	6.87	0.74	2.74	15	11.98	14	2.15	*p < 0.05*
Post-test	4.13	0.92						

The mean column displays the mean pre-test and post-test pain scores among individuals in the experimental group. SD is the standard deviations of the scores in pre & post respectively. Mean change 2.74 is the difference between pre-test and post-test (6.87&4.13). Since the *t-value*, 11.98 is greater than the *table value* 2.15, *p < 0.05*, there is a significant difference existing between the pre-test and post-test pain scores among individuals in the experimental group. The pain has significantly reduced in the post test. This proves the effect of strengthening and stretching exercise on pain.

Table 14: Mean, S.D. and t-value to compare Pre-test & Post-test pain In Control Group

Test	Mean	SD	Mean change	n	*t*	*df*	*table value*	*p-value*
Pre-test	6.4	0.98	0.67	15	5.29	14	2.15	*p < 0.05*
Post-test	5.73	0.96						

The mean column displays the mean pre-test and post-test pain scores among individuals in the control group. SD is the standard deviations of the scores in pre & post respectively. Mean change 0.67 is the difference between pre-test and post-test (6.4&5.73). Since the *t-value*, 5.29 is greater than the *table value* 2.15, *p < 0.05*, there is a significant difference existing between the pre-test and post-test pain scores among

individuals in the control group. This shows the effect of pre-exercises.

So we have seen that there is significant reduction in pain among the individuals in experimental group as well as in control group.

Now let us find whether there was homogeneity among pain scores in the pre-test between experimental and control groups and hence prove the effect of strengthening and stretching exercise by comparing the post-test pain scores between experimental and control groups.

Table 15: Mean, S.D. and t-value to compare the pre-test pain scores between Experimental and Control Groups using t-test

Group	Pre-test Mean	S.D.	Difference in mean	*n*	*t*	*df*	*table value*	*p-value*
Experimental	6.87	0.74	0.47	30	1.46	28	2.05	*p = 0.46*
Control	6.4	0.98						

The Mean column in the t test table displays the mean pre-test pain scores in experimental and control group respectively. The standard deviation column displays the standard deviation of the scores in two groups. The difference (0.47) shows the difference between mean pre-test in two groups (6.87&6.4).Since the *t-value*1.46, is less than the *table value* 2.05, *p-value*> 0.05, there is no significant difference in pre-test pain scores between the experimental and the control groups. So we can consider the groups as homogenous in the baseline level.

Table 16: Mean, S.D. and t-value to compare the post-test pain scores between Experimental and Control Groups using t-test

Group	Mean	S.D.	Difference in mean	*n*	*t*	*df*	*table value*	*p-value*
Experimental	4.13	0.92	1.6	30	4.67	28	2.05	*p <0.05*
Control	5.73	0.96						

The Mean column in the t test table displays the mean post-test pain scores in experimental and control group respectively. The standard deviation column displays the standard deviation of the scores in two groups. The difference (1.6) shows the difference between post-test mean in two groups (4.13&5.73).Since the *t-value*4.67, is greater than the *table value* 2.05, *p-value*< 0.05, there is a significant difference in post-test pain scores between the experimental and the control groups. The pain in the experimental group is significantly low.

Hence strengthening and stretching exercise has significant high effect as compared with free-exercises.

Discussion

The term musculoskeletal disorders encompass a gamut of inflammatory and degenerative conditions that affects the muscles, tendons, ligaments, joints, peripheral nerves, and supporting blood vessels with consequent ache, pain or discomfort [6, 7]. Workrelated musculoskeletal disorders (WMSDs) are defined as musculoskeletal disorders that result from a workrelated event [8]. Moreover, LBP also affects the economy of the countries adversely due to labor loss of nurses, reduction in work efficiency and other financial Costs [9]. Nurses may be forced to quit their jobs or change their work places because of LBP [10].

On statistical analysis of visual analogue scale scores,the mean pre- treatment score of experimental and control group was 6.87 and 6.4 and mean post treatment pain score of experimental and control group was 4.13 and 5.73 respectively. Which shows pain in the experimental group is significantly low.

Slade *et al*. (2006) found that trunk strengthening exercise and revealed that this exercise can alleviate pain and improve functions more effectively than aerobic and other exercise do.

On statistical analysis the mean pre-treatment ODI scores of experimental and control group were 42.67 and 41.33 and mean post-treatment ODI scores of experimental and control group was 18.93 and 38.27 respectively. This shows there is a significant difference existing between the experimental and control group. The result of study indicated a specific stretching and strengthening program reduced pain and functional improvement among nurses. As shown by the nurses in the present study were highly exposed to known risk factors for development of musculoskeletal low back pain.

Conclusion

The knowledge of ergonomics was generally poor among the nurses. Working in the same positions for long periods, lifting or transferring dependent patients and treating an excessive number of patients in one day were the most perceived job risk factors for WMSDs.

While getting help in handling heavy patients, modification of nursing procedures in order to avoid stressing an injury, and modifying patients or nurse position were the top there coping strategies.

Statistically it is observed that, the stretching and strengthening exercise leads to a significant improvement in strength and decrease low back pain of the subjects under study. Based on the performed study, it can be concluded that stretching and strengthening exercise therapy can be performed as a daily routine to improve strength and to decrease pain.

Overall, the nurses who have important duty and responsibilities for improvement and protection of health need to protect and improve their health first in order to be able to provide effective care and be more beneficial for the patients [11].

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