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Effects of Ergonomics Training on Mechanical Performance in Nursing Students

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Abstract:

Although many training interventions have been used, the prevalence of work-related musculoskeletal disorders has risen significantly recent years. Early training intervention is an important key to prevent musculoskeletal disorders while lifting, lowering, pulling and transferring during work among nursing students. A training course, including anatomic knowledge, basic biomechanical principles and nursing clinical practice, was designed and carried out among the nursing students while learning fundamental nursing using a randomized controlled trial. Compared with control group, the scores of intervention group in the two evaluations were evidently higher at the end of practice and six-month follow-up. But they were obviously lower in six-month follow-up assessment than the marks at the end of training. The results showed that the training intervention distinctly ameliorated the mechanical properties of the body in the skill practice among the nursing students in a short time, but the effect wears off as time passed. The study suggested that nursing professionals should emphasize and repeat training interventions to achieve the long-term effects of musculoskeletal disorders.

Keywords*: Education, Early intervention, Musculoskeletal pain, Nursing, Randomized Controlled.*

I. INTRODUCTION

Being a major cause of occupational morbidity, work-related musculoskeletal disorders (WMSDs) also are a main public health problem among registered nurses (RNs) [1,2]. Musculoskeletal disorders (MSDs) are closely related to disability in hospital care givers. Among risk factors cause MSDs, the physical factors were highly associated with the symptoms of work-related MSDs in nursing [3]. Physical risk factors for MSDs included carrying or moving loads, moving and handling people and repetitive movements [4]. Frequent bending and working in static positions played a major role in the physical strain of nursing staff [5].

ISSN: 0011-9342
Issue: 11 | Pages: 676 - 684

Researchers are working on training programs to lower the prevalence of MSDs. Training including intervention on ergonomic plays a vital role in lessening MSDs to workers in health care [6]. Studies supported that multifaceted ergonomic intervention reduced the load on the back, injury risk and symptom score in nurses [7, 8]. But there were different opinions about the effect of training or mechanical aides [9]. A single intervention is not enough to reduce the symptoms of MSDs in the long term and its effectiveness was influenced by many factors [5]. The interaction between ergonomic intervention and the threats among MSDs appears to be intricate and comprehensive.

The experience of nursing students plays a pivotal role in enabling excellence in nursing care and is very import to prevent work related MSDs, least of all nursing students never engaged in nursing skill practice. It is important for health care to utilize the tenet of great human mechanics during their task to prevent and manage musculoskeletal conditions [7, 10]. Although training program was used to prevent the MSDs in nursing education, there was a gap between training and practice [11].

The present study is aimed to evaluate the effectiveness of training intervention on work performance and discover the factors which may affect the performance within nursing students.

II. METHODOLOGY

2.1 Design and Setting

The research was regarded as a randomized controlled trial. The objects of research were students enlisted from a nursing school. The modified Body Mechanics Evaluation Checklist (BMEC) [12] was used for human mechanics scoring. The points for activities of lifting, releasing, pulling and moving were respectively estimated and contrasted at two point-in-time, such as the bottom of the grooming and six-month arrangement. Fig.1 demonstrated the design and embodiment of the interposition via the training program.

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Issue: 11 | Pages: 676 - 684

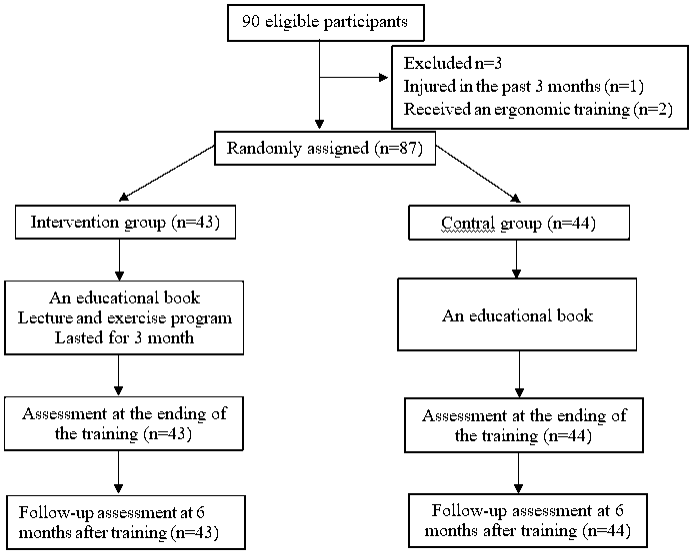

Fig 1: Flow diagram of the study of ergonomic intervention program for nursing students

2.2 Participants

The undergraduate nursing students, who were going to have the course of fundamental nursing after learning anatomy and physiology, were invited to take part in the research by the program leader. Participator were not part-time nursing students with 18 to 23 years old, and who fit in the following categories were included: 1) study in the nursing college for more than 3 months; 2) not participated in an ergonomic or similar program before this training; 3) No musculoskeletal injuries in the past three months; 4) willing to participate in the study.

The sample size was calculated using open source software OpenEpi, Version 3, http://www.openepi.com/. Based on the two-sided confidence level=95, power of 80%, and percent of LBP 31% [13], a sample of 82 participates was selected for this study. Among the 98 nursing students, 8 students refused to take part in, 1 volunteer was wounded 2 months before the program began, and 2 participates had been trained in human engineering. The sample size was 87 students considering the dropping-out in this study.

A random allocation sequence was generated in software SPSS by a teaching assistant. The serial numbers of participants were given according to their student ID. After random numbers between 0 and 1 were generated, the participators were allocated to the intervention group (n=43) at random if the number is below 0.5 or control group (n=44) if the number is above 0.5.

The nursing students in intervention group received intervention courses, involving a weekly seminars and exercise solutions which lasted 3 months under supervision, apart from a book in education having been supported to the control group. The 30-minute lecture contains human musculoskeletal anatomy, basic principles of biomechanics, MSDs hazard, and biomechanics of nursing sports, etc. Campaign involves classic mechanical technical abilities to decrease musculoskeletal pressure when lifting, lowering, pulling and transferring objects.

ISSN: 0011-9342
Issue: 11 | Pages: 676 - 684

2.3 Outcome Measurement

The whole joining nursing undergraduates were given a practical testing at the two point-in-time mentioned above via BMEC by three overseers who were blind to the interventions and groups in Clinic Skills Centre. The average score given by each student's last three mentors is used for the assessment.

The questionnaire (appendix) is designed to assess 20 norms connected with human mechanics, which includes lifting (6 items), lowering (6 items), pulling (4 items) and transferring (4 items) of pieces in the operative surroundings. Besides, the evaluation of instrument can be scored 20. The instrument primarily assesses bending of hips and knee, the position of the object against the body and the bending or rotation of the trunk, which exhibited high reliability and validity in the preceding studies [14].

2.4 Analysis of Data

The data were analysed by the software SPSS version 21.0. The results were demonstrated by mean and standard deviation (mean±SD). The manifestation of the two groups were displayed and analyzed via an independent t-test. Comparison of the various activities marks from two groups mentioned were a paired t-test between post-intervention and six-month follow-up. The P value was statistically significant at $\alpha < 0.05$, for analysed by statistics.

III. DATA ANALYSIS

The marks of the two groups at the end of the programme and six-month after the treatment are showed as follows. The consequences were compared between the 2 groups, and the different points in time of both groups will be made a comparison.

3.1 Baseline Data

There were 87 nursing students joining in this study and none student dropping-outs in either group. The students' age ranges from 18 to 23, with an average age of 19.94±0.87 years. Furthermore, the intervention group composed of 43 undergraduates in nursing, which includes 37 girls and 6 boys. While the control group contained 44 ones with 37 girls and 7 boys. The common traits of the participator are demonstrated in TABLE I. The outcome reveals that no obvious difference appears in baseline characteristic between the two groups.

TABLE I. Baseline characteristics of the intervention and control groups

Characteristics	Control group (n=44)	Intervention group (n=43)	*P* value
	Mean ± SD	Mean ± SD	
Age (years)	19.95±0.65	19.93±1.06	0.90
Height (cm)	163.77±7.08	162.60±6.81	0.44
Weight (kg)	53.07±8.15	54.07±6.92	0.54

ISSN: 0011-9342
Issue: 11 | Pages: 676 - 684

BMI (kg/m2)	19.72±2.14	20.42±1.99	0.12

Note. SD, standard deviation; BMI, bone mass index (kg/m2).

3.2 Results of Comparison between Groups of Intervention and Control

In the distribution of all marks at the end of the training evaluation (TABLE II), 82% students in the control group scored 15 or below, whereas 90% in the intervention group got 15 points or above. Nevertheless, as to the six-month follow-up evaluation, the whole control group achieved scores less than 15, contrasted to 84% of the intervention group. As to the two evaluations, the intervention group achieved evidently more perfect marks in statistics ($P < 0.05$).

TABLE II. Analysis of difference between nursing students on nursing skill performance scores

Task		Scores (Mean ± SD)	
		Control group(n=44)	Intervention group(n=43)
The end of the training	Lifting(6 items)	4.08±0.58	4.98±0.56*
	Lowering(6 items)	3.99±0.55	4.95±.053*
	Pulling(4 items)	2.64±0.36	3.21±0.42*
	Transferring(4 items)	3.07±0.50	3.58±0.29*
	Total	13.50±1.53	16.72±1.32*
6 month after training	Lifting(6 items)	3.68±0.44	3.85±0.45
	Lowering(6 items)	3.56±0.62	3.71±0.70
	Pulling(4 items)	2.37±0.41	2.75±0.37*
	Transferring(4 items)	2.48±0.33	3.40±0.41*
	Total	12.36±1.17	13.69±1.29*

Note. The intervention group received ergonomic instruction; the control group did not. The highest total scores were 20 points.

*Significant difference between intervention group and control group, $P < 0.05$.

The intervention group's average marks were more prefect than the marks belonging to control group in the evaluations above during the events of lifting and lowering. Significant differences exist between groups of intervention and control after training, but the difference was not distinct at the 6 months follow-up.

During both time points of evaluation, with respect to pulling and transferring items, intervention group achieved more perfect marks than control group.

3.3 Comparison Results of Various Activities within Groups of Intervention and Control

As to the two point-in-time intervention, the average marks of acts of lifting, lowering, pulling and transferring in the two groups at 6 months follow-up the training were distinctly

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Issue: 11 | Pages: 676 - 684

lower than that at the end of the research (Fig. 2).

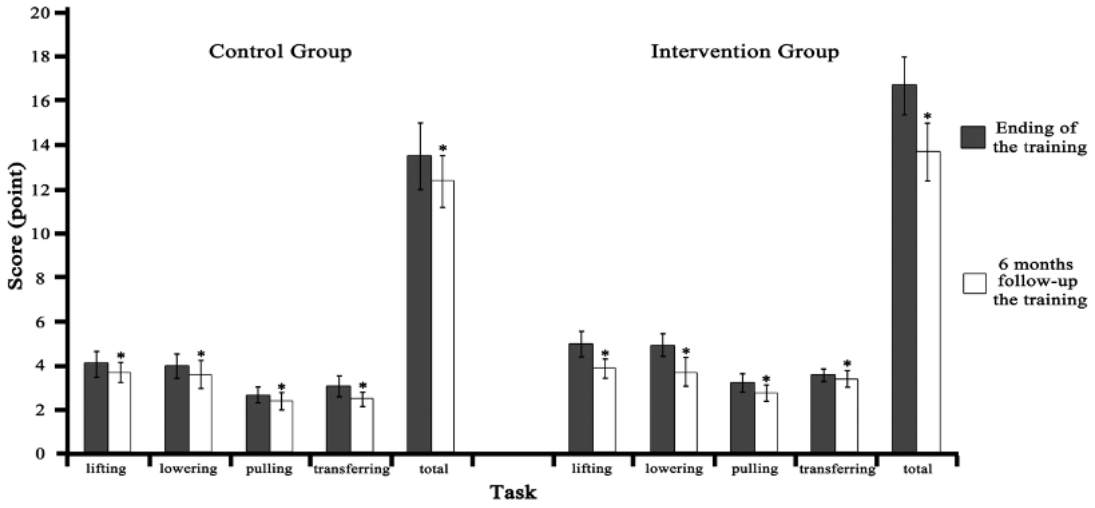

Fig 2: Effect of intervention compared within both groups

Note. * Significant difference between post intervention and six-month following up, $p < 0.05$.

IV. DISCUSSION

MSDs are related with work, and treated as a main cause of severe ache and handicap in the healthcare divisions. Many studies have reported the relationship between ergonomic factors and musculoskeletal symptoms [15, 16]. These studies will contribute to future development of the ergonomic intervention in nursing. In this study, the physical mechanics performance of nursing students receiving ergonomic training was obviously better than that of whom had none training after the program. The meaning can be seen that the ergonomic intervention has made the manifestation of the nursing undergraduates better in terms of human mechanics. Thus, beginning with ergonomic education to the nursing education is a valuable recommendation.

In this study, after 6 months of training, the performance of all nursing students decreased significantly, with only visible differences in the activities of pulling and transferring of the 2 groups. The results are similar to the report of McCauley [12], which reveals that though the usage of physical mechanical techniques is beneficial for the following nurses' practices after training, however, the effectiveness will gradually weaken with the passage of time. Maybe, this is one of the origins for why MSDs has a high percentage of qualified nurses. It follows that it is a perennial challenge.

Human behaviour in daily life is controlled by habit [17], and repetition of behaviour is acquired for the success of the habit formation. The outcome in this research also demonstrated that the performance in nursing students had declined after the training. Habituation plays a key role in changing health behaviour which must be performed both repeatedly over a long period of time. Therefore, emphasizing and repeating ergonomic interventions via the nursing student's

ISSN: 0011-9342
Issue: 11 | Pages: 676 - 684

stage and even after they are qualified is necessary.

Physical work environment influenced nurses' job satisfaction. There are gaps in policies and programs for the safety of nurses. Health care leaders should design and optimize working conditions for preventing MSDs. Educational experience of nursing students has something to do with constructing their occupational status. Ergonomic training should be initiated at an early stage to guard against and manage all kinds of musculoskeletal problems before improper postural habits develop in nursing students.

V. LIMITATIONS

There are some limitations in this study. The first, the evaluation of the study happened both after and six-month later of the training, the long-time research was not designed and organized, therefore the perennial effectiveness of the intervention after six-month are unclear. An in-depth research might have a deep perspective. The second, the participants were recruited only in one nursing college in a university. If the nursing students who take part in the study come from different nursing colleges, the results will be more meaningful. The third, the study only used quantitative methods for performance comparison during work, and the causes for the decline in exam scores will be focused on for MSDs prevention using qualitative methods in further study.

VI. CONCLUSION

This research proves that appropriate human mechanics usage during undergraduates in nursing in clinical practice can be improved, through 3 months' ergonomic intervention, containing MSDs hazard, information about the musculoskeletal anatomy of the human body and advisable usage in practice of nursing techniques. Our findings suggest, at the end of training of nursing students, that ergonomic intervention is efficient precaution for the work relevant to MSDs, but its effect receded after 6 months. In designing appropriate health-promoting interventions, our findings underscore the importance of early implementation of MSDs prevention activities and their extension throughout working life. In the light of our results, age-specific priorities in prevention activities should be reconsidered. Underlining and repeating of the ergonomic intervention is obligatory for ensuring the long-time effects. In the process of lifting, lowering, pulling and transferring, more in-depth studies are needed to monitor the changes of human mechanics.

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ISSN: 0011-9342
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