

## A SYSTEMATIC REVIEW OF INTERVENTION TO REDUCE MUSCULOSKELETAL DISORDERS: HAND AND ARM DISORDERS

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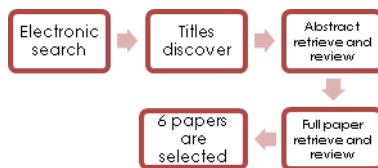
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### Graphical abstract



### Abstract

Despite with countless number of incidence related to musculoskeletal disorders among workers, there are lot of studies that come out with interventions in order to reduce musculoskeletal disorders. Musculoskeletal disorders continue to give a large impact and challenge towards employer and employee in many different sectors. This article had reviewed the literature that related to intervention to reduce musculoskeletal disorders of the hand and arm. 5 databases were reviewed to identify studies related to intervention to reduce musculoskeletal disorders of the hand and arm among workers. In order to identify and classify research studies, specific keywords (ergonomic, musculoskeletal disorder, hand and arm disorders, occupation, injury, intervention and prevention) were identified and used in a systematic search to guide the discovery of relevant studies. Included studies were reviewed and interventions were assessed. As overall, 312 titles were discovered during the search and only 6 studies that were related to hand and arm disorders and met inclusion criteria. Within these 6 studies, this review identified ergonomic interventions in terms of training, program and workstation redesign. The positive outcomes after the implementation of these interventions, there were significant reduction related to hand and arm disorders among workers. As conclusion, interventions that had been implemented in these 6 studies and significant reduction of musculoskeletal disorders, there is need to do further research in order to propose ergonomic designs for the workers in workplace.

Keywords: Interventions; ergonomic; musculoskeletal disorders; hand and arm; literature review

### Abstrak

Walaupun banyak kemalangan berkaitan dengan gangguan rangka otot dalam kalangan pekerja, terdapat banyak kajian dengan kaedah yang dapat mengurangkan gangguan rangka otot. Gangguan rangka otot ini terus memberikan satu impak besar dan cabaran terhadap majikan dan pekerja dalam pelbagai sector. Artikel ini telah mengkaji semula kajian berkaitan dengan kaedah mengurangkan gangguan otot berkaitan dengan otot tangan dan lengan. 5 pangkalan data telah dikaji semula untuk mengenalpasti kajian berkaitan dengan kaedah mengurangkan gangguan otot tangan dan lengan dalam kalangan pekerja. Bagi mengenalpasti kajian, kata kunci (ergonomic, gangguan otot, gangguan tangan dan lengan, kecederaan, kaedah dan pencegahan) dikenalpasti dengan menggunakan kajian sistematik. Secara keseluruhannya, 312 tajuk ditemui dan hanya 6 kajian yang berkaitan dengan gangguan tangan dan lengan yang memenuhi criteria. 6 kajian ini dikenalpasti berkaitan dengan ergonomic dalam merancang dan mereka bentuk semula stesen kerja. Hasil positing selepas pelaksanaan kaedah ini, terdapat pengurangan signifikan berkaitan dengan gangguan rangka otot dalam kalangan pekerja. Kesimpulannya, kaedah yang dilaksanakan dalam 6 kajian ini, terdapat pengurangan signifikan terhadap gangguan rangka otot dan penelitian perlu

dilakukan supaya dapat mencadangkan rekabentuk yang ergonomik untuk pekerja di tempat kerja.

*Kata kunci:* Kaedah; ergonomic; gangguan rangka otot; tangan dan lengan; tinjauan kajian

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## 1.0 INTRODUCTION

Malaysia is one of the rapidly industrializing countries in Asia region but it is also faced challenges of risk of musculoskeletal disorders (MSDs). This is due to lack of attention on safety awareness in workplace [1]. MSD consist of minor physical disabilities. This term is used to describe a variety of conditions that affect the muscle, bones and joints. The severity of MSD can be varied and the pain and discomfort may interfere with person's daily activities. Besides, MSDs are extremely common and the risk may increase with age [2].

The most common form of occupational disease in many of today's industrialized nations which is MSD, WHO [3] recommended that organizations combine ergonomics improvements such as workstation redesign, or the introduction of new tools equipment or job rotation with health promotion activities aimed at reduce risk of MSD. Currently, however, there appears to be little evidence of this in practice [4], with consultants focusing almost entirely in the physical aspects of the work environment, tending to neglect the more "psychological" aspects of the interaction between the worker and their work environment.

Ergonomic risk factors are the aspects of a job or task that impose a biomechanical stress on worker. Ergonomic risk factors are the synergistic elements of MSDs hazards. The following ergonomic risk factors are most likely to cause or contribute to MSDs such as force, vibration, repetition, contact stress, awkward postures, extremes postures, extreme temperatures and static postures [1]. MSDs such as neck, shoulder, arm and low-back pains and discomfort are commonly seen in many workplaces [5].

In the last few years, there have been a number of systematic reviews of the literature regarding prevention of musculoskeletal disorders or their consequences (disability) as well as a number of newly published papers [6]. The current review aims to update the knowledge base for reducing musculoskeletal disorders specifically on hand and arm disorders for working populations.

## 2.0 METHODOLOGY

In order to identify and classify research studies on work related to arm musculoskeletal disorders, specific keywords were identified and used in a systematic search to guide the discovery of relevant studies and data Electronic database including ELCOSH, PubMed, ScienceDirect, Google Scholar and OSH-ROM. Journals and abstracts were printed and reviewed. Following keywords and combination of these words were searched: ergonomic, musculoskeletal disorder, hand and arm disorders, occupation, injury, intervention and prevention. Printed materials including industry magazines and professional journals were also searched [7].

### 2.1 Definition Of Terms Used In The Review

**Ergonomic.** International Ergonomics Association stated that scientific discipline to design and optimize human wellbeing while interacting with industrial product [2].

**Musculoskeletal disorder.** Consist of minor physical disabilities. This term is used to describe a variety of conditions that affect the muscle, bones and joints. The severity of MSD can be varied and the pain and discomfort may interfere with person's daily activities [2].

**Intervention.** A planned program or strategy aimed at preventing and/or reducing the incidence/prevalence of MSDs, including programs focusing on education of workplace staff and/or programs focusing on administrative organizational. Criteria for considering studies for this review [8]:

**Type of study.** To identify the intervention in reducing hand and arm musculoskeletal disorders, a randomized controlled trial (RCT) is considered the study design of choice. However, other experimental studies, such as quasi-RCT and non-RCT, such as observational studies and action research also included in this literature review due to limited number of RCT's study [8].

**Type of participant.** In this literature review, populations were comprised of workers in any sectors with different exposure and environment during working [8].

**Type of interventions.** The types of intervention included both primary and secondary prevention [8].

**Type of outcomes.** The outcomes of interest were musculoskeletal disorders and related to hand and arm [8].

### 3.0 SELECTIONS OF INTERVENTION STUDIES

As overall, 312 titles were discovered during the search, and only 6 studies that were related to arm musculoskeletal disorders and met selection criteria. The chance-adjusted between-reviewer agreement on the included studies was good ( $\kappa=0.71$ ) [9].

#### 3.1 Descriptions Of Intervention Studies

Appendix 1 showed the summary of 6 intervention studies that related in reducing hand and arm musculoskeletal disorders, which were initiated and

conducted in different places globally, Texas, North German, Malaysia, United States, California and Finland.

#### 3.2 Characteristics Of Study Populations

The program was conducted at a large academic medical center, the Johns Hopkins Hospital and University's Homewood campus in Baltimore, Maryland with ranging 17,000 to 22,000 employees per year from 1992 until 1998 [10]. A study done by Meinert [11], it consisted of five respondents that were mainly working with computer at work. In total, respondents for a study by Norashikin *et al.* [12], 43 respondents in the experimental group and 55 in the control group which were office workers from 6 different units in Universiti Teknologi Malaysia (UTM).

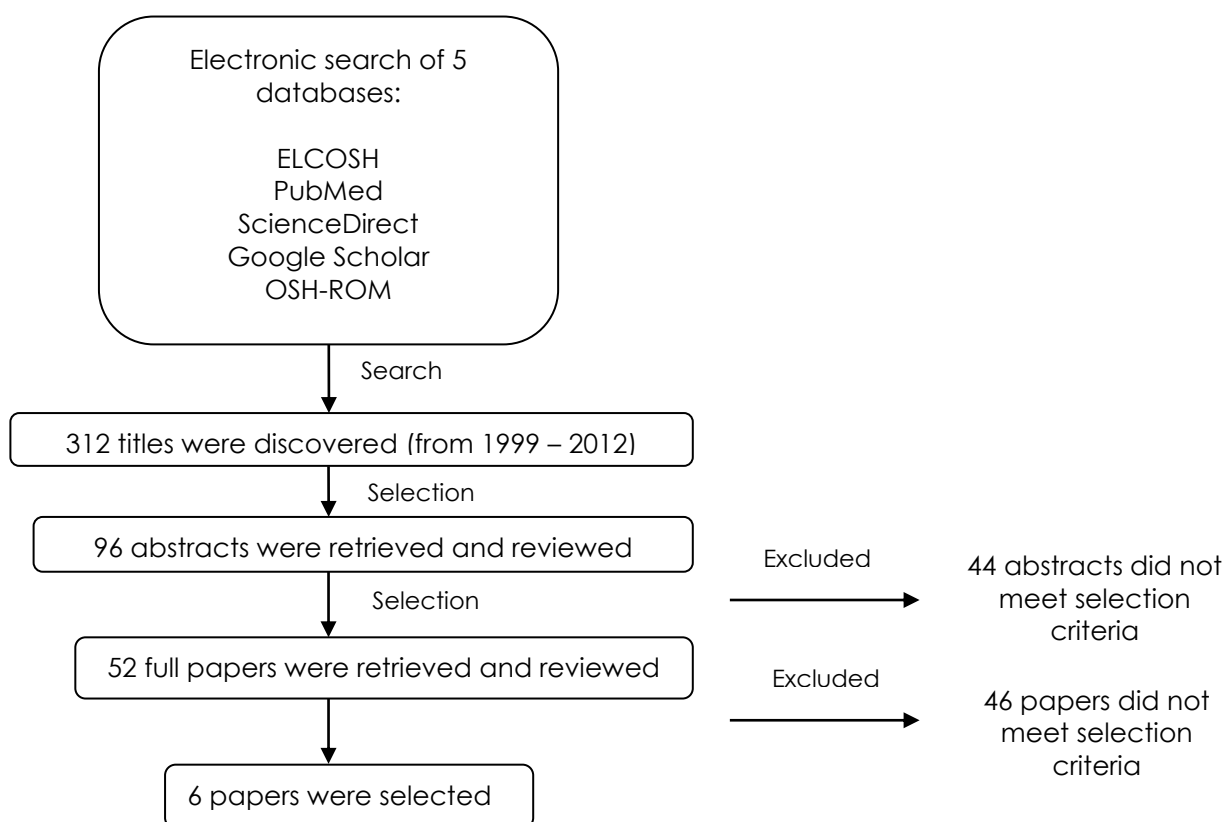


Figure 1: Overview of literature search and review [8]

Respondents in the research done by Dainoff *et al.* [13] consisted 1 group of 28 female data entry operators and for a study by Faucet *et al.* [14] consisted of 108 manufacturer's workers. Lastly, subjects that participated in this study were 20 newspaper employees [15].

All studies except one study gave information about gender and age. Four studies included males and females and only one study included only females as respondents [13]. The ages of participants ranged from 20 to 66 years old.

Randomized controlled trial of sampling was carried out when selecting participants in two studies [12, 15] while voluntary participation was carried out in this study [13].

### 3.3 Inclusive/Exclusive Criteria

Bernacki *et al.* [10] screened that there was no improvement during ergonomic surveys and job analysis in their workstation, employees already diagnosed with an upper extremity repetitive trauma disorder and surgeries for repetitive trauma disorders before. Meinert [11] selected that all subjects were mainly working with computers at the work with different kind of visual aid. The criteria were people who worked with computers, at least 3 hours per day, in either permanent and contract employment and did not have any previous illness and/or injuries that may contributed to MSDs [12]. Dainoff *et al.* [13] selected respondents based on volunteers who were permanent employees of CSC working in data conversion. Faucet *et al.* [14] screened to ensure respondents did not have a diagnosed upper extremity musculoskeletal disorder and excluded if they have symptoms worse than a moderate level (pain, numbness, stiffness of the upper extremity, neck or shoulders). Besides, all respondents had received company's basic training program about work station ergonomics and WRMSDs. Lastly, the selection criteria included the prerequisite that the respondents had musculoskeletal pain in the forearms, at least 30 days during the past 12 months and they worked at least 4 hour per day with VDU [15].

### 3.4 Study Outcomes

All six studies found a reduction in self-reported musculoskeletal pain and discomfort after the intervention. The body sites for decreased pain were different for each study: upper extremity part [10], arm, neck, back, and shoulder [1], neck, right and left shoulder, right and left upper limbs (upper arm, elbow, lower arms, wrist and fingers [12], neck, shoulder, forearm/arm back and legs [13], muscle tension on forearms/hand [14] and lastly, neck, shoulder and arm [15].

## 4.0 DISCUSSION

This literature review sought to answer the prime question: "how far prevention interventions for workers have an improved effect on musculoskeletal disorders and pains during working?". As overall, the findings were explained in details for the symptoms and pain that related to musculoskeletal disorders. For example, the study done by Norashikin *et al.* [12] stated that there were 9 categories of musculoskeletal disorders which were neck, right and left shoulder, upper and lower back, right and left upper limbs (upper arm, elbow, lower arm, wrist and fingers).

### 4.1 Interventions

Bernacki *et al.* [10] has conducted several intervention program among employees in order to reduce UEWMsDs by using a standardized protocol, ergonomic survey, medical assessment and non-operative therapy, using electrodiagnostic studies, and job analysis. Standardized protocol stated that each employee presented complaints that possibly associated with UEWMsD that were medically evaluated and survey was performed for all employees that presenting with significant UEWMsDs. Besides, medical assessment and non-operative therapy focused on employees with potential UEWMsDs were scheduled for evaluation by a physiatrist or orthopedic surgeon to obtain a definitive diagnosis and job analysis, employees were provided with medical restrictions with the opportunity to have modifications to the work environment, including personnel to help the employee to engage in productive work without injury [10].

Research done by Meinert [11] for web-based office ergonomic interventions, there was "IfADo Ergonomic Vision" website for pre- test and post-test experiment that presented information and a guidance tool in a simple way to for individual ergonomic adjustments of computer workstations. Next, ergonomic training had been given to respondents that consisted of lectures on office ergonomics, understanding the relationship between office ergonomics and MSDs's development, improvement and adjustments of workstation and stretching exercise [12]. The intervention was categorized into 3 parts: workstation redesign. A complete redesign of each workstation was carried out in order to provide an optimum ergonomic workplace. Components that included were advance ergonomic chairs, motorized adjustable workstations, advanced adjustable keyboards, adjustable copyholders, adjustable footrests and monitor support surfaces. Ergonomic training/coaching. Participants were given with knowledge of ergonomics principles along with specific instruction relating to the particular pieces of ergonomic equipment and corrective lens, an

optometric examination to consider the visual function of the participant with respect to the particular visual demands of the workplace [13]. For a test of two training interventions were Muscle Learning Therapy (MLT) by using surface electromyography (sEMG) feedback to decrease muscle tension during complex work tasks and adult learning and cognitive behavioral techniques as second intervention that was applied in small group discussion to advance the worker's capabilities for symptom and stress management and problem-solving [14]. Lastly, two different intervention models implemented among newspaper employees for VDU work (E = redesign measures for environment only and ET = redesign measures for both the environment and work techniques). Environment improvements focused on office layout and ergonomics of VDU workstations in both groups [15].

## 5.0 CONCLUSION

In conclusion, this literature review found varies of interventions to reduce musculoskeletal disorders especially on arm and hand's part. These six studies found a reduction in self-reported musculoskeletal pain and discomfort after the intervention. The effect of the interventions (whether positive, negative or none) were influenced by sample size, sampling technique, type of interventions and length of time examined (short or long term study). Therefore, there is need to do further research in order to propose ergonomic designs as to reduce musculoskeletal disorders of the hand and arm in employment.

## Acknowledgements

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## Appendix

## Appendix 1 Summary of Intervention Studies

Topic/author	Population	Intervention	Outcome
<b>An ergonomic program designed to reduce the incidence of upper extremity work related musculoskeletal disorders [10].</b>	Employee at Johns Hopkins Hospital and the associated Schools of Medicine, Hygiene, and Public Health as well as the Schools of Engineering and Arts and Sciences on the University's Homewood campus in Baltimore, Maryland.	Early diagnosis and treatment of potential upper extremity work related musculoskeletal disorders (UEWMSDs).  Ergonomic assessment and abatement and correction of work areas.	The rate of UEWMSDs per 1000 workers decreased by 80% over the 7-years period.  The number of surgeries for repetitive trauma disorders decreased.  Clear inverse relationship between the number of ergonomic surveys or job analyses performed and the presentations for repetitive trauma disorders.
<b>Web-based office ergonomic intervention on work-related complaints [11].</b>	5 subjects (First experiment) 24 subjects (Second experiment)	A website. (Presenting information and a guidance tool for ergonomic individual adjustments of computer workstations).	96% of the employees adapted their workplaces.  Self-reported musculoskeletal disorders and headache symptoms decreased significantly after the intervention.
<b>Ergonomic Training Reduces Musculoskeletal Disorders among Office Workers: Result from the 6-Month Follow-Up [12].</b>	43 respondents (intervention group) 55 respondents (control group).	Ergonomic training.  Workstation adjustment.	A significant improvement in workstation habits.  The largest reduction of musculoskeletal disorders was in the neck region.  Significant differences were found at the follow-up time point in the neck, right shoulder, right and left upper limbs, lower back and right and left lower limbs.  No significant difference was found for the days and episodes of sick leave or the psychological well-being among workers after the intervention.
<b>The effect of an ergonomic intervention on musculoskeletal, psychosocial and visual strain of VDT Data entry work: the united states Part of international study [13].</b>	29 females' data entry employee. Permanent employees of Cincinnati Service Center (CSC) working Data Conversion.	Corrective lenses.  Workstation redesign.  Training	Statistically significant reduction in physical signs, subjective reports of intensity and frequency of musculoskeletal pain and subject reports of visual problems.



			Electromyography (EMG) decreased after intervention.
<b>A test of two training interventions to prevent work-related musculoskeletal disorders of the upper extremity [14].</b>	Manufacturer's worker: 32 participant (MLT group) 37 participant (EDUC group) 39 participant (control group)	Muscle Learning Therapy (MLT)  Educational (EDUC)	Significant differences of symptom outcome (pain, stiffness, numbness) at 6 weeks of intervention, increasing severity (control group), decline modestly (EDUC group) and little change (MLT group).  MLT group was consistently effective in reducing muscle tension and partially effective for the forearms.
<b>Ergonomic intervention on neck, shoulder and arm symptoms of newspaper employees in work with visual display units (15).</b>	20 newspaper employees.	2 different intervention models :  E=redesign measures for the environment only.  ET=redesign measures for both the environment and work techniques.	Intervention measure before and after 7-month:  Statistically significant difference between 2 groups in shoulder flexion, muscular activity of right trapezius and right extensor carpi radialis.  Reduction of pain symptoms in neck, shoulders and elbows were greater in ET group than E group.