EFFECTS OF A HEALTHY UNIT GUIDANCE (HUG) PROGRAM ON WORK ENVIRONMENTS AND HEALTH OUTCOMES AMONG NURSING PERSONNEL

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ผลของโปรแกรมการให้คำแนะนำการจัดหน่วยที่ทำงานน่าอยู่ต่อสิ่งแวดล้อมการทำงานและสุขภาพของบุคลากรพยาบาล

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วิทยานิพนธ์นี้เป็นส่วนหนึ่งของการศึกษาตามหลักสูตรปริญญาสาธารณสุขศาสตรดุษฎีบัณฑิต
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Field of Study	Public Health
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วันเพ็ญ ทรงคำ: ผลของโปรแกรมการให้คำแนะนำการจัดหน่วยที่ทำงานน่าอยู่ต่อสิ่งแวดล้อมการทำงานและสุขภาพของบุคลากรพยาบาล (EFFECTS OF A HEALTHY UNIT GUIDANCE (HUG) PROGRAM ON WORK ENVIRONMENTS AND HEALTH OUTCOMES AMONG NURSING PERSONNEL) อ. ที่ปรึกษาวิทยานิพนธ์หลัก: ผศ. ดร. วัฒน์สิทธิ์ ศิริวงศ์, อ. ที่ปรึกษาวิทยานิพนธ์ร่วม: ศ.ดร. มาร์ค เกรกอรี รอบสัน, 140 หน้า.

บุคลากรพยาบาลเป็นกลุ่มที่มีความเสี่ยงสูงต่อการสัมผัสปัจจัยเสี่ยงทางด้านการยศาสตร์ นำไปสู่การเกิดอาการผิดปกติของกล้ามเนื้อและกระดูกที่เกี่ยวเนื่องกับการทำงาน การป้องกันปัญหา สุขภาพ ดังกล่าวจำเป็นต้องจัดโปรแกรมการยศาสตร์แบบมีส่วนร่วมที่มีประสิทธิภาพ การศึกษาครั้งนี้เป็นการศึกษาแบบกึ่งทดลอง มีวัตถุประสงค์เพื่อประเมินผลของโปรแกรมการให้คำแนะนำการจัดหน่วยที่ทำงานน่าอยู่ (Healthy Unit Guidance: HUG) ต่อสิ่งแวดล้อมการทำงานและสุขภาพของบุคลากรพยาบาล ซึ่งถือเป็นโปรแกรมการยศาสตร์แบบมีส่วนร่วมประเภทหนึ่งที่ผู้วิจัยสร้างขึ้นเพื่อให้เหมาะกับการนำมาใช้กับกลุ่มบุคลากร ดังกล่าว โปรแกรมการจัดหน่วยที่ทำงานน่าอยู่ประกอบด้วยการอบรมเชิงปฏิบัติแบบมีส่วนร่วมจำนวน 3 ครั้ง ได้แก่ การจัดตั้งกลุ่มสนับสนุน การเพิ่มพูนความสามารถของกลุ่มอาสาสมัคร และการประเมินผลสำเร็จของการปรับปรุงสภาพการทำงาน ทำการศึกษาในโรงพยาบาลระดับตติยภูมิจำนวนสองแห่งระหว่างเดือนพฤษภาคม พ .ศ. 2553 ถึงเดือนมิถุนายน พ.ศ. 2554 กลุ่มตัวอย่างประกอบด้วยบุคลากรพยาบาลจำนวน 90 คน แบ่งออกเป็นกลุ่มทดลองที่มาจากโรงพยาบาลที่คัดเลือกแบบเจาะจง จำนวน 45 คน และกลุ่มควบคุมจากที่มาจากโรงพยาบาลอีกแห่งหนึ่ง จำนวน 45 คน รวบรวมข้อมูลโดยใช้แบบสอบถาม ประเมิน ก่อนและหลังจัดโปรแกรม 3 เดือน และ 6 เดือน วิเคราะห์ข้อมูลเพื่อเปรียบเทียบผลต่างของคะแนนสิ่งแวดล้อมการทำงานและสุขภาพของสองกลุ่มโดยใช้สถิติ t-test การวิเคราะห์ความแปรปรวนแบบวัดซ้ำ และสถิติ Mann-Whiney U

ผลการศึกษาพบว่า สิ่งแวดล้อมการทำงานด้านกายภาพในกลุ่มทดลอง ลดลงอย่างมีนัยสำคัญทางสถิติในช่วง 3 เดือนหลังได้รับโปรแกรม เมื่อเปรียบเทียบกับกลุ่มควบคุม ($p < .01$) แต่ไม่พบการลดลงอย่างมีนัยสำคัญทางสถิติในช่วง 6 เดือนหลังได้รับโปรแกรม สำหรับสิ่งแวดล้อมการทำงานด้านจิตสังคม พบว่า มีเพียงอิทธิพลต่องานและแรงสนับสนุนทางสังคมของหัวหน้างานเท่านั้นที่เพิ่มขึ้นอย่างมีนัยสำคัญทางสถิติเมื่อเปรียบเทียบกับกลุ่มควบคุม ($p < .01$) ส่วนผลต่อสุขภาพ พบว่าความชุกของการเกิดอาการผิดปกติของกล้ามเนื้อและกระดูกในช่วง 7 วันและ 3 เดือนที่ผ่านมาในกลุ่มทดลอง ไม่ลดลงหลังได้รับโปรแกรม ในกลุ่มทดลองไม่มีรายงานเกี่ยวกับการขาดงานเนื่องจากอาการผิดปกติของกล้ามเนื้อและกระดูก แต่พบการขาดงาน ในลักษณะดังกล่าวจำนวน 2 วันในกลุ่มควบคุม สำหรับระดับความสามารถในการทำงาน พบว่ามีการเพิ่มขึ้นเล็กน้อยในกลุ่มทดลอง เมื่อประเมินในช่วง 3 เดือนและ 6 เดือนหลังได้รับโปรแกรม ส่วนในกลุ่มควบคุมพบว่า ในช่วง 3 เดือนแรกของการประเมินระดับความสามารถในการทำงานไม่มีการเปลี่ยนแปลง มีเพียงช่วง 6 เดือนหลังเท่านั้นที่พบว่าระดับความสามารถในการทำงานเพิ่มขึ้นเล็กน้อย โดยสรุปแล้ว ผลการศึกษาชี้ให้เห็นว่า โปรแกรมการจัดหน่วยที่ทำงานน่าอยู่ช่วยลดปัจจัยเสี่ยงของสิ่งแวดล้อม ด้านกายภาพ และช่วยเพิ่มปัจจัยสนับสนุนของสิ่งแวดล้อมด้านจิตสังคม อย่างไรก็ตามผลของโปรแกรมต่อสุขภาพของบุคลากรพยาบาล ที่ชัดเจนนั้น ควรทำการประเมินในช่วงระยะเวลาที่ยาวนานขึ้นหลังการได้รับโปรแกรม

สาขาวิชา สาธารณสุขศาสตร์ ลายมือชื่อนิสิต.....

ปีการศึกษา 2554 ลายมือชื่อ อ.ที่ปรึกษาวิทยานิพนธ์หลัก.....

ลายมือชื่อ อ.ที่ปรึกษาวิทยานิพนธ์ร่วม .....

5179207253 : MAJOR PUBLIC HEALTH
KEYWORDS : HUG PROGRAM / PARTICIPATORY ERGONOMIC / WORK ENVIRONMENT / HEALTH OUTCOME / NURSING PERSONNEL

WANPEN SONGKHAM: EFFECTS OF A HEALTHY UNIT GUIDANCE (HUG) PROGRAM ON WORK ENVIRONMENTS AND HEALTH OUTCOMES AMONG NURSING PERSONNEL. ADVISOR: ASST. PROF. WATTASIT SIRIWONG, Ph.D., CO-ADVISOR: PROF. MARK GREGORY ROBSON, Ph.D., 140 pp.

Nursing personnel are at a high risk of exposure to ergonomic risk factors, lead to development of work-related musculoskeletal disorders (WMSDs). Effective participatory ergonomic intervention is beneficial and has indicated that can prevent musculoskeletal disorders. The purpose of this quasi-experimental study was to evaluate effects of the Healthy Unit Guidance (HUG) program, a tailored participatory ergonomics intervention, on work environments and health outcomes among nursing personnel. The HUG program consisted of a multifaceted training with three workshops include establish management support, participant's capacity strengthening, and evaluation work improvement achievement. The study was conducted at two tertiary care hospitals during May 2010 to June 2011. Of a total 90 participants, nursing personnel from the selected hospital were assigned in an intervention group (n=45), with those from another hospital used as a control group (n=45). Data collection was carried out by self-reported questionnaire at baseline, 3 months and 6 months after the completion of the intervention. Comparison of work environments and health outcomes scores between the two groups were analyzed using t-test, repeated measure analysis of variance as well as Mann-Whiney U test.

The results showed that physical work environment among the intervention group was significantly decreased compared with the control group at 3 months ($p < .01$), while there was not significantly decreased at 6 months after the HUG intervention was done. Considering psychosocial work environment, only influence of work and social support from supervisor had significantly increased when compared with the control group ($p < .01$). For health outcomes, prevalence rate of musculoskeletal symptoms in the last 7-day and 3-month among the intervention and the control groups at post-intervention were not decreased compared to pre-intervention measurement. There was no day of sick leave reported by the intervention group but the control group had 2-day sick leave due to musculoskeletal problems. Work ability among the intervention group revealed slightly increased at 3 months and 6 months, while the control group showed not change at 3 months and slightly increased after completed intervention at 6 months. In conclusion, the finding suggested that the HUG program can contribute to reduce the risk factors of physical work environment and improve promotion factors of psychosocial work environment. While obvious effect on health outcomes should be investigated in a long-term period after intervention.

Field of Study: Public Health ..... Student's Signature .....

Academic Year: 2011 ..... Advisor's Signature .....

Co-advisor's Signature .....

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Finally, I am grateful to my family for their entirely care and love. The usefulness of this thesis, I dedicate to my parents and all the teachers who have taught me since my childhood.

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CHAPTER I
INTRODUCTION

1.1 Theoretical Background

Work-related musculoskeletal disorders (WMSDs) are a significant concern for the nursing workforce. A number of studies worldwide for the past decades documented that nursing personnel were encountered with musculoskeletal problems (Ando *et al*., 2000; Trinkoff *et al*., 2002; Eriksen, 2003; Smith *et al*., 2003; Smith *et al.*, 2004; Alexopoulos, Burdorf, and Kalokerinou, 2006; Lorusso, Bruno, and Abbate, 2007; Kantiya, 2009; Tongpoon, 2009) often resulting in pain, sickness-related absenteeism (Sheikhzadeh *et al*, 2009), and disability leaves (Nelson, Fragala, and Menzel, 2003; de Castro, 2006).

The U.S. National Institute for Occupational Safety and Health [NIOSH] (2004) indicates that WMSD cases are more severe than the average nonfatal injury or illness case. In 2007, MSDs accounted for 29 percent of all workplace injuries requiring time away from work and involved a median of 9 days compared with 7 days for all nonfatal injury and illness cases (U.S. Bureau of Labor Statistics, 2009). The overall cost of such disorders related to patient care is estimated at over $25 million per year with substantial additional unmeasured costs (Veterans Health Administration, 2005). Parallel to the UK, It is now generally acknowledged that MSDs have the potential to lead to long and serious disability of the employee, and impose heavy costs on employers and on society. The estimate economic costs to individuals, industries and society are also excessive, £5.7 billion per year (Buckel, 2005).

Nursing personnel are an essential part of clinical services. Not only do they have primary responsibility for a significant proportion of patient care in most healthcare settings, but also be the backbone of health systems (World Health Organization, 2002). As a result, the impact of MSDs is not only most notably evident in the workers‘ health and compensation cost (Lei *et al.*, 2005) but also diminishes quality of care and health system performance (WHO, 2002). The more data

reflecting the burden of MSDs in pain, disability, and cost emphasize the need for finding effective solutions to prevent and control musculoskeletal disorders hazards and problems in the hospital setting. Besides, the most important reason for prevention of MSD is the humanitarian one – MSDs are preventable conditions (Morse, 2004).

Considering healthcare setting, the complexity of nursing practices in patient care encompasses an assortment of variables that place nursing personnel at risk for MSDs. The interaction between factors related to the patient, nursing profession, physical environment poses dangerous ergonomic risk factors in this setting (de Castro, 2006). According to patient caring, nursing occupation exposed to ergonomics risk factors including handling of heavy loads is often involved transferring, repositioning and lifting patients, working in awkward positions and prolonged standing (Waters e*t al.*, 2006; Lorusso, Bruno, and Abbate, 2007) and working in work environment which is not well adapted (transformable beds, internal transport of patients, bad architectural structure of the ward, etc) lead to MSDs occurrence.

Various interventions have been implemented to reduce MSDs among nursing personnel (Hignett, 2003; Bos, Krol, Van Der Star, and Groothoff, 2006). These include worker education programs, physical conditioning or exercise, disability management, organizational policies and use of mechanical lifts or other patient transfer equipment. For example, based on the Occupational Safety and Health Administration (OSHA) recommendation, the American Nurses Association (ANA) has launched the Handle With Care® campaign in response to the significant number and severity of work-related back injuries and other musculoskeletal disorders among nurses. This is being done through developing partnerships and coalitions, education and training increasing use of assistive equipment and patient-handling devices, reshaping nursing education incorporate safe patient handling, and pursuing federal and state ergonomics policy by highlighting technology-oriented safe-patient handling benefits for patients and nurses (de Castro, 2006; Hughes, 2006). The successful of campaign on reducing nurses injuries have been reported in several studies (Hignett, 2001; Yassi *et al.*, 2001; Owen, Keene, and Olson, 2002; Hefti *et al*., 2003, Evanoff *et al*., 2003, Haiduven, 2003, Mutch, 2004). De Castro (2006) indicated that injuries among nursing staff have dramatically declined since incorporating patient handling

equipment and devices along with an institutional commitment to safest available methods. Additional benefits include decreased fatigue, increased job satisfaction, not working in pain, and sustainability of professional careers.

In Asian countries, however, in the absence of ergonomics regulations at national level, limited financial support, and lack of numerous ergonomists experts, practical ergonomics approaches that are built on local achievements and that focus on participatory training methods have proven useful for facilitating concrete workplace improvements in the existing conditions (Kogi *et al*., 2003; Kogi, 2006). Direct participation of workers and employers has been promoted in ergonomics training aimed at immediate solutions and continuous improvement (Kawakami and Kogi, 2005), thus, the participatory ergonomics (PE) is needed for MSDs prevention.

From a preventative perspective, PE appears to be the most effective method of applying ergonomics in the workplace (Kogi, 2006; Domanski *et al.*, 2008). It is an increasingly utilized tool to improve working conditions, productivity and product quality, without interrupting the work process (Carrivick, Lee, and Yau, 2002; Hignett, Wilson and Morris, 2005; Manothum *et al*., 2009). Moreover, it has a positive impact on musculoskeletal symptoms; therefore, it is broadly used to reduce work related musculoskeletal disorders in several workforces (National Research Council, 2001; Loisel *et al*., 2001; Carrivick, Lee, and Yau, 2002; Hignett, Wilson, and Morris, 2005; Udo *et al*., 2006; Klangsin, 2007; Rivilis *et al*., 2007; Boynton and Darragh, 2008; Driessen *et al*., 2008; Institute for Work and Health, 2008; Pehkonen *et al.*, 2009), as well as in nursing personnel (Pohjonen, Punakallio, and Louhevaara, 1998; Evanoff, Borh, and Wolf, 1999; Hignett, 2001; Kim and Lee, 2010)

The rationale behind PE is to involve the end-user in the change process so that worker becomes an advocate and an active change agent rather than a passive recipient of the process (St-Vincent, *et al*., 2006). The scope of PE intervention has been focused on multi-faceted building human-centered work environments and also practical measures in terms of improving physical and psychosocial workloads (Carrivick, Lee, and Yau, 2002; Kawakami and Kogi, 2005; Hignett, Wilson and Morris, 2005; Manothum *et al.*, 2009). Therefore, it is anticipated that whether the work environment in the hospital setting has been improved, the consequence of better improving will affect positively on nursing personnel health outcomes,

particular on musculoskeletal health, sick leave, and work ability (Pohjonen, Punakallio, and Louhevaara, 1998; Evanoff, Borh, and Wolf, 1999; Hignett, 2001; Rivilis *et al*., 2007; Kim and Lee, 2010). In Thailand, despite the large number of studies described the best practices for successful participatory ergonomics interventions on work environment and health outcomes, no studies was done in healthcare setting, mostly done in industrial setting (Poosanthanasarn, 2005; Klangsin, 2007). Hence, the development of a PE program for nursing personnel in the hospital setting is in great need.

According to a study of Tongpoon (2009), the result revealed that 71.25% of Thai nurses who working in tertiary care hospital had work-related musculoskeletal injury. Consequently, this study will directly focus on development an effective WMSDs prevention program called Healthy Unit Guidance (HUG), based upon the principle of PE approach expected the sustainable program driving by nursing personnel themselves and all levels of stakeholders. It is also expected that an effective intervention will helps to strengthen nursing workforce ability to manage their work environment problems associated with MSDs and information obtained from this study will be useful for other hospital setting in order to develop an effective guidance for preventing WMSDs among nursing professional in the future.

1.2 Objectives

1.2.1 To develop and implement the Healthy Unit Guidance (HUG) program among nursing personnel.

1.2.2 To evaluate the effects of the Healthy Unit Guidance (HUG) program on work environments and health outcomes among nursing personnel.

1.3 Research Questions

1.3.1 Is the Healthy Unit Guidance (HUG) program effective in improving work environments and work ability among nursing personnel?

1.3.2 Is the Healthy Unit Guidance (HUG) program effective in reducing musculoskeletal symptoms and sick leave among nursing personnel?

1.3.3 Are nursing personnel who have received the Healthy Unit Guidance (HUG) program more improving work environment and work ability than nursing personnel who have not?

1.3.4 Are nursing personnel who have received the Healthy Unit Guidance (HUG) program more reducing musculoskeletal symptoms and sick leave than nursing personnel who have not?

1.4 Hypotheses

In order to test the effects of the Healthy Unit Guidance (HUG) program on work environments and health outcomes, the following hypothesis were generated:

Hypothesis I: The score of negative work environments, musculoskeletal symptoms and sick leave in nursing personnel receiving the Healthy Unit Guidance (HUG) program is significantly lower than those not receiving at 3 and 6 months post-intervention.

Hypothesis II: The score of positive work environments and work ability in nursing personnel receiving the Healthy Unit Guidance (HUG) program is significantly higher than those not receiving at 3 and 6 months post-intervention.

1.5 Scope of Study

This study was conducted in the tertiary care hospitals. Participants were female nursing personnel working at Maharaj Nakorn Chiang Mai hospital and Lampang hospital, residing in the northern part of Thailand. The period of data collection was from May 2010 to April 2011.

1.6 Term Definitions

Healthy Unit Guidance (HUG) Program refers to a process of the intervention that the researcher provided to nursing personnel working at hospital setting in order to improving their work environments (e.g. reduce negative factors and increase promotion factors) and health outcomes (e.g. reduce rate of musculoskeletal symptoms, decrease sick leave, and increase work ability). The program is developed based on participatory ergonomics concept and literature review. The HUG comprised a series of training workshop including establishing management support, strengthening participant‘s capacity, and evaluating work improvement achievements.

Participatory ergonomics is defined as the involvement of nursing personnel in planning and controlling a significant amount of their own work activities, with sufficient knowledge and power to influence both processes and outcomes in order to achieve desirable goals.

Participatory Action-Oriented Training (PAOT) refers to the training process designed to encourage and help hospital setting to undertake low-cost measures to improve work environments. The approach focuses on shop-floor action, planning and practical implementation. It focuses on achievements, builds on local practice, uses a learn- by-doing method, encourages the exchange of experiences and promotes nursing personnel involvement.

Work environments refer to work-related factors which influence musculoskeletal symptoms occurrence among nursing personnel including physical and psychosocial environments (both negative and positive aspects) measured by self-report questionnaire which was modified from the physical load index (Hollmann *et al*., 1999) and the Copenhagen Psychosocial Questionnaire (COPSOQ) (Kristensen *et al*., 2005; Aust *et al*, 2007) and literature reviews.

Physical work environment is defined as factors associated with the use of force in terms of pull, push, moving or transferring materials or patient and working position of the nursing personnel. This also included their perception on workplace environment where they belong (e.g. lighting, noise, temperature and odor).

Psychosocial work environment is defined as conditions that influence work-related stress include demands at work, work organization, and interpersonal relationship at work.

Health outcomes include musculoskeletal symptoms, sick leave and work ability of nursing personnel.

Musculoskeletal symptoms refer to a group of conditions include ache, pain, and discomfort which involve the nerves, tendons and muscles of nursing personnel measured by the Nordic Musculoskeletal Questionnaire (NMQ) which was available from the original paper by Kuorinka *et al*. (1987).

Sick leave refers to the amount day which nursing personnel away from work resulting from musculoskeletal symptoms measured by self-report questionnaire.

Work ability is defined as the balance between the demands of work and the resources of each nursing personnel individual measured by the Work Ability Index (WAI) (Tuomi *et al*., 1998) which translated in Thai by Orawan Kaewboonchoo and Kriengkrai Prahkarnkaeo.

Nursing personnel is female person who working full-time at tertiary care hospital includes registered nurses (RNs), practical nurses (PNs), and nurse aides (NAs).

CHAPTER II
LITERATURE REVIEWS

This chapter presents specific literatures relevant to the research effort. Six principle areas including nursing personnel, musculoskeletal disorders and ergonomic risk factors in nursing practices, problematic consequences of musculoskeletal disorders, strategies to manage ergonomic risk factors, and participatory ergonomic concept are presented. Then the conceptual framework adopted in this study is demonstrated.

2.1 Nursing Personnel

Nursing personnel play a vital role in producing and coordinating patient care in healthcare settings and occupy the front ranks in the delivery of personal health care services. They also be the backbone of health systems around the globe and provide a platform for efforts to tackle the diseases that cause poverty and ill-health (WHO, 2002).

A variety of tasks performed by the nursing professions have recently been summarized by World Health Organization (2002). Nursing services are a subsystem of health services that are provided by a range of personnel. Globally, these services share common attributes that include: caring for, supporting and comforting clients; continuously assessing and monitoring health needs and responses to interventions; advocacy and education of clients and communities; identifying care gaps and developing appropriate responses; delivering and coordinating health services across the care spectrum. Nursing also complement and support other health care services and thus help to ensure the successful implementation of interventions that welcome life, promote or restore health or, conversely, enable the means to a peaceful, dignified and pain-free death.

International Council of Nurses (2009) reported that most of nursing personnel have been employed in hospital setting, full-time working, 35 hours or more per week. Hospital nursing care, generally, is a task which requires duties to be carried

out entirely, without time delay and independent of circumstances, physically demanding as the handling of heavy loads is often involved (moving, repositioning and lifting patients), but also due to the movements and postures that are expected in many work situations. Apart from planned activities, which could be arranged with the assistance of colleagues, technical facilities, nursing always involves working in awkward positions, prolonged standing and lifting loads (Waters *et al*., 2006). Besides, there are numerous emergency situations where nursing personnel have to act quickly, often alone, exerting extreme effort in extreme stress. Working with the disabled, in intensive care or emergency units imposes particularly high demands on nursing personnel. Furthermore, in many occasions, work environment in hospital is not well adapted (transformable beds, internal transport of patients, bad architectural structure of the ward, etc). Consequently, nursing professional is a risky workforce for work-related illnesses and injuries.

In the USA, nursing ranks third among the top 10 most injury-prone jobs (U.S. Bureau of Labor Statistics, 2009). A recent survey of nurses over the age of 50 revealed that close to one-quarter having experienced a job-related injury within the past five years (Letvak, 2005). Musculoskeletal disorders (MSDs) or work-related musculoskeletal disorders (WMSDs) are one of the most frequently occurring for work-related injuries. A report of the U.S. Bureau of Labor Statistics (2009) shown that nurses‘ aides, registered nurses, and licensed practical nurses compose three of the top ten categories hardest hit with MSDs, with nurses‘ aides and attendants at the top of the list. Nursing personnel, additionally, have been consistently ranked with the highest rates of MSDs, exceeding even the traditional laboring occupations of truck driver, construction laborer, and maintenance worker.

De Castro (2006) states that WMSDs are the leading occupational health problem plaguing the nursing workforce. The prevalence of MSDs among nursing personnel is well documented worldwide, ranged from 47 to 87% (Ando *et al*., 2000; Fanello *et al*., 2002; Hofmann *et al*., 2002; Trinkoff *et al*., 2002; Eriksen, 2003; Smith *et al*., 2003; Smith *et al*., 2004; Alexopoulos, Burdorf, and Kalokerinou, 2006; Lorusso, Bruno, and Abbate, 2007). Similar to Thailand, although there has no national record for work-related musculoskeletal disorders among nursing workforce, a number of independent studies within these group shown the high prevalence rate of

MSDs, ranged from 56.3 to 81.1% (Sinsongsook, 2004; Kantiya, 2009; Tongpoon, 2009).

2.2 Musculoskeletal Disorders and Ergonomic Risk Factors in Nursing Practices

2.2.1 Musculoskeletal Disorders (MSDs)

Musculoskeletal disorders (MSDs) refer to a group of conditions that involve the nerves, tendons, muscles, and supporting structures of the body such as inter-vertebral discs (Silverstein and Evanoff, 2006). Often attributed to or exacerbated by the work environment, these disorders are also referred to as work-related musculoskeletal disorders (WMSDs) which can cause symptoms such as ache, pain, numbness, discomfort and tingling, as well as reduced worker productivity, lost time from work, temporary or permanent disability (Silverstein and Evanoff, 2006).

The most commonly reported body areas affected are the low back, the neck, and the upper extremity (Silverstein and Evanoff, 2006). Nelson, Fragala, and Menzel (2003) indicated that the prevalence of work-related back injuries in nursing is among the highest of any profession internationally. Besides, a review of low back pain and musculoskeletal disorders among Italian nursing personnel concluded that prevalence rates of low back pain observed among Italian nurses were very high when compared to the Italian general population, ranging from 33 to 86% (Lorusso, Bruno, and Abbate, 2007). Cameron *et al*. (2008) also indicated that the most frequently experienced musculoskeletal problem among older Canadian nurses was the lower back, with 57% of the nurses indicating they had experienced job-related pain or discomfort in their lower back in the past 12 months. The second area of problem was the neck (51%), following with shoulder (48%), upper back (40%), thigh/knee (39%), and ankle/foot (37%), respectively.

Although the primary concern are back injuries, which can be severely debilitating for nurses, the other types of musculoskeletal injuries can be occurred additional body parts such as the neck, shoulders, wrists, and knees (Sinsongsook, Taptagaporn, and Jiamjarasrangsi, 2005; Zeytinoglu, 2005; de Castro, 2006; Kantiya, 2009). Kee and Seo (2007) examined the prevalence of MSDs among nursing

personnel in Korea and found that the 12-month prevalence of MSDs in at least one body site ranged from 45.7 to 56.8%, and that the shoulder was the most susceptible to MSDs, followed by the knee, lower back, hand/wrist, neck, ankle/feet, finger, etc. Corresponding with a study of Tongpoon (2009), shoulder pain was the most prevalent occurred in Thai nurses followed with knees and back pain.

2.2.2 Work-related Musculoskeletal Disorders Causation

There are a growing number of theories and models that describe how work-related musculoskeletal disorders (WMSDs) are caused. Some focused on biomechanical mechanisms (Armstrong *et al*., 1993; NRC, 2001) while others focused on psychological or psychosocial mechanisms (Feuerstein, 1996; Carayon, Smith, and Haims, 1999). Consequently, Karsh (2006) concluded that both biomechanical and psychosocial mechanisms share many commonalities and proposed the integrated model that incorporates the various paths and mechanisms. This composite model illustrates the complexity of WMSD etiology by describing 35 proposed pathways between the 12 major constructs that have been proposed in previous models.

Figure 2.1 portrays this integrated model. Although the model is quite complicated, it reflects the evidence-based or hypothesized relationships that have been widely discussed. On the top of the model are the workplace factors that determine exposures. Path way ‗1‘ indicates that the social and cultural context of the organization will influence the way that work is organized. Path way ‗2‘ shows that the social and cultural context in the organization can also have a direct impact on psychological work demands because of the nature of the safety climate, politics or organizational culture, for example. The ‗3‘ and ‗4‘ arrows show a direct impact o f work organization on physical work demands and psychological work demands and also indicate that the impact of social/cultural context on physical and psychological work demands is mediated by the work organization. Because work organization is defined as the objective nature of work, the work organization will determine the physical and psychological characteristics of work. Pathways ‗5‘ and ‗6‘ show that

the environment at work (e.g. noise, lighting and temperature) can also directly influence physical and psychological work demands.

The reciprocal pathway _7‘ between physical and psychological work demands indicates that the two types of demands can influence each other. Highly repetitive jobs may influence perceptions of having low opportunities for control or, on the other hand, a job with a high level of work pressure may influence the length of time a worker maintains a certain posture in order to finish the job. The arrow labeled _8‘ shows the direct impact of physical work demands on physical strain. The mechanism by which the physical demands impact physical strain and subsequent physiological changes and the development of WMSDs may be through overexertion, cumulative loading, and differential fatigue or workstyle changes. Physical demands can clearly lead to physical strain such as tissue loads, but can also lead to psychological strain (_9‘) to the extent that the physical demands are psychologically stressful. The _10‘ pathway shows that psychological work demands can influence psychological strain. Psychological demands can have a direct impact on psychological strain if the psychological demands cause stress or anxiety. The direct effect of psychological demands on psychological strain and subsequent responses may be through workstyle changes, increased muscle tension or psychological stress.

The _11‘ and _12‘ pathways show that physical and psychological work demands may directly impact the individual through adaptation mechanisms such as improving physical or psychological capacity. The reciprocal pathway _13‘ shows that physical and psychological strain can affect each other. Psychological strain may impact physical strain by increasing muscle tension, whereas physical strain can influence psychological strain if the physical strain causes psychological stress.

Individual characteristics, such as capacity, tolerance and coping can mode rate many of the relationships. For instance, physical capacity can moderate the relationship between physical work demands and physical strain (_14‘) and coping mechanisms may moderate the relationship between psychological work demand s and psychological strain (_15‘). Capacity and internal tolerances may also impact the extent to which physical and psychological strain affects each other (_16‘). Physical and psychological strain can create physiological responses, which in turn can act as new doses for other physical and psychological responses (_17‘, _18‘).

The individual, work organization, physical and psychological strain and associated physiological responses can all impact the detection of symptoms or labeling and attribution (_19‘, _20‘, _21‘, _35‘) through mechanisms related to heightened sensitivity or negative affectivity. Once symptoms are perceived, an individual must label the symptom and attribute the symptom to something (_22‘) and, eventually, the symptoms may lead to a diagnosis of a WMSD (_23‘). However, even without symptoms, a WMSD may be present, which is indicated by pathway _24‘. Pathway s _25‘, _26‘, _27‘ and _28‘ show that the existence of a WMSD may feedback to impact physical and psychological strain and/or demands because a WMSD may cause a person to modify how he/she works (physical demands/strain) or increase psychological stress (psychological demands/strain). Similarly, the mere presence of symptoms may also lead a person to modify how he/she works and con tribute to stress (_29‘, _30‘, _31‘, _32‘). Finally, the detection of symptoms, _33‘, or the presence of a WMSD, _34‘, may lead to the redesign of work, thus impacting work organization. Although not included in the model, non-work activities may also impact strain and other responses.

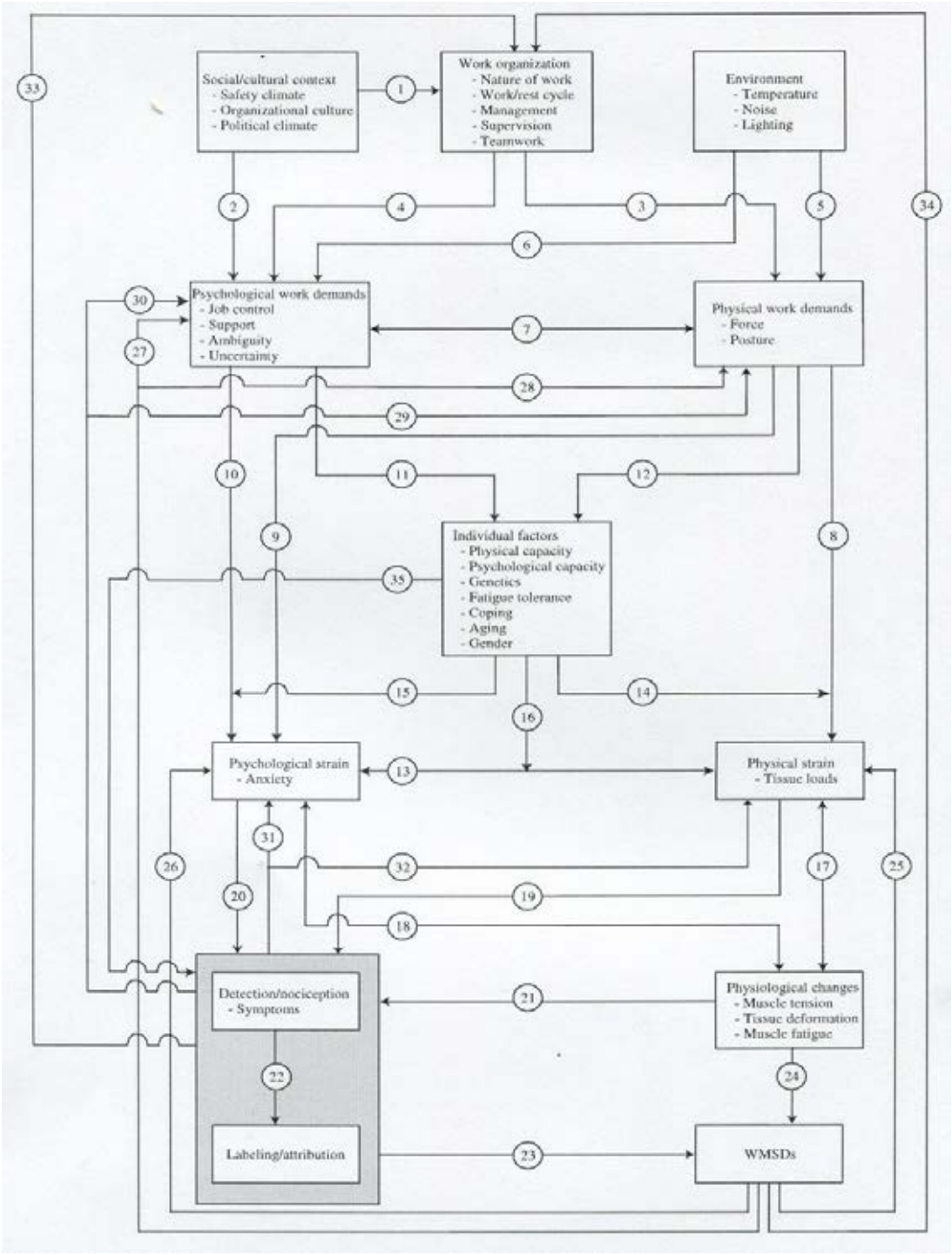

Figure 2.1 Integrated model of work-related musculoskeletal disorders causation

2.2.3 Ergonomic Risk Factors in Nursing Practices

Ergonomics is derived from two Greek words, *ergon* meaning work and *nomos* meaning laws, thus, the laws of work (Rogers, 2003; Warren, 2004). Ergonomics has been defined by several authors; however, Keyseling (2006) defines ergonomics as the study of humans at work to understand the complex interrelationships among people, their work environment (such as facilities, equipment, and tools), job demands, and work methods. Warren (2004) offers a simple but consistent definition: ergonomics is the study of how to fit work to the worker. Although ergonomics is concerned with matching work and job design to fit the capabilities of most people by adapting the product to fit the user, the design of work environment should be flexible enough to consider the need for individual variation (Rogers, 2003). The scope of ergonomics has been focused to build human-centered work environments and also practical measures to improve physical and psychosocial work demands (Kawakami, and Kogi, 2005), therefore, understanding the intricacy of ergonomic and its relationship with MSDs is necessary more specifically than the usual definitions allow.

Based on the integrated model of Karsh (2006), this complexity helps to explain difficulties encountered in interventions to control WMSDs. However, most evidences from literature review indicated that there are three dominant risk factors that can contribute to development of musculoskeletal disorders include individual factors, physical (biomechanical) demands and psychosocial demands (Baker, and Sanders, 2004; Karsh, 2006). In assessing the deeper roots of MSDs risk, it becomes evident that MSDs encompass a variety of conditions relating to ergonomic risk factors (Dillon, 2004).

2.2.3.1 Physical Work Demands

The field of ergonomics particular attending in physical (biomechanical) work demands or risk factors includes physical stressors and workplace conditions that pose a risk of injury or illness to the musculoskeletal system of the worker (Clark, 2004; Canadian Center for Occupational Health and Safety, 2010). The biomechanical

work demands have been recognized by related organizations and specialists includes awkward postures, forceful exertions, repetitive motions, localized contact stresses, vibration, and extremes temperature that arise from poorly designed workstations, tools and equipment, and improper work methods (Rogers, 2003; Clark, 2004; Warren and Sanders, 2004; Keyserling, 2006). The detail of each factor is as follows.

1) Awkward postures

Awkward posture at any joint may cause transient discomfort and fatigue. Prolonged awkward postures may contribute to disabling injuries and disorders of musculoskeletal tissue and/or peripheral nerves. Awkward trunk postures increase the risk of back injuries. Raising the elbow above shoulder height or reaching behind the torso can increase the likelihood of musculoskeletal problems in the neck and shoulders. Most awkward postures of the trunk and shoulder result from excessive reach distances, such as bending into bins to place or retrieve parts, reaching overhead to high shelves and conveyors, or reaching overhead or in front of the body to activate machine controls.

In addition, body postures determine which joints and muscles are used in an activity and the amount of force or stresses that are generated or tolerated. For example, more stress is placed on the spinal discs when lifting, lowering, or handling objects with the back bent or twisted compared with when the back is straight. Manipulative or other tasks requiring repeated or sustained bending or twisting of the wrists, knees, hips, or shoulders also impose increased stresses on these joints. Activities requiring frequent or prolonged work over shoulder height can be particularly stressful. In addition, static postures, positions that a worker must hold for long periods of time, can restrict blood flow and damage muscles.

2) Forceful exertions

Tasks that require forceful exertions, including lifting, pushing, and pulling, place higher loads of force on the muscles, tendons, ligaments, and joints. Increasing force means increasing body demands (e.g., greater muscle exertion along with other physiological changes necessary to sustain an increased effort). Forceful exertion of the hand, such as cutting with knives or scissors, tightening screws, ―snapping" together electrical connectors, and using the hands or fingers to sand or buff parts, can cause upper extremity disorders such as tendonitis or carpal tunnel syndrome.

Moreover, prolonged or recurrent experiences of this type combined with inadequate time for rest or recovery can lead not only to feelings of fatigue but also to musculoskeletal problems.

3) Repetitive motions

Because ergonomic risk factors are often related to specific work tasks, jobs that involve high repetition and/or duration. If motions are repeated frequently (e.g., very few seconds) and for prolonged periods such as an 8-hour shift, fatigue, irritation, muscle-tendon strain and nerve pressure can increase. Tendons and muscles can often recover from the effects of stretching or forceful exertions it sufficient time is allotted between exertions. Awkward postures and forceful exertions increase the effects of repetitive motions from performing the same work activities, for example, frequent lifting and repetitive/prolonged use of awkward truck postures increase the risk of back pain.

4) Localized contact stresses

Local mechanical stresses result from concentrated pressure during contact between body tissues and an object or tool. Repeated or continuous contact with hard or sharp objects such as non-rounded desk edges or unpadded, narrow tool handles may create pressure over one area of the body (e.g., the forearm or sides of the fingers) that can inhibit nerve function and blood flow. Grasping sharp edges, like tool handles, can concentrate force on small areas of the body, reduce blood flow and nerve transmission, and damage tendons and tendon sheaths.

5) Vibration

Exposure to local vibration occurs when a specific part of the body comes in contact with a vibrating object, such as a powered hand tool. Localized vibration or segmental vibration may contribute to the development of hand-arm vibration syndromes, such as vibration white finger. Exposure to whole-body vibration can occur while standing or sitting in vibrating environments or objects, such as when operating heavy duty vehicles or large machinery may be a factor that increases the risk of back pain.

6) Extreme temperature

Temperature, particularly cold temperature, has a modifying role in the relationship between other biomechanical risk factors and MSDs outcomes.

Temperature is a clear modifying factor in vibration-related MSDs. The primary problems associated with work in cold temperature are local discomfort in the hands and feet and decreased manual dexterity after several hours of exposure. Moreover, cold temperatures have been demonstrated to affect tactile sensitivity, reaction time, and the ability to perform complex tasks. Researchers found that after several hours of exposure to cold at 15.5 °C, workers‘ hands began to lose flexibility and dexterity; after exposure to cold at 7 °C workers lost up to 20% dexterity.

Lorusso, Bruno and Abbate (2007) concluded that physical workload was found to be significantly associated with low back pain in most studies that investigated physical risk factors. It should be noted that physical exposure levels were assessed by measuring the frequency of the execution of high risk tasks involving manual handling and fixed or awkward postures, or ascertained based on work category and working area.

Nursing practices often requires heavy physical work activities such as lifting heavy loads, working in awkward postures, transferring patients, operating hazardous equipment, etc. The performance of these tasks exposes nursing personnel to increased risk for work-related musculoskeletal disorders (ANA, 2003). Waters *et al.* (2006) indicated the reason for risk of back injuries among nurses that involving with the manual handling of patients where nurses must lift, lower, push, and carry patients. Especially on lifting of heavy patients, nurses have to standing over patients in awkward positions, walking on cement/hard floors, and performing other physically demanding tasks of the job make themselves highly prone to musculoskeletal disorders. Inadequate staffing is another risk factor that increases the potential for musculoskeletal injuries for nurses. Moreover, most stressful tasks, such as transferring patients from a bed to a chair or vice versa, may be done alone and manually due to lack of staff and equipment. Combined with high stress levels, inadequate staffing and equipment, performing many tasks manually when mechanical assistance is recommended, and long hours, nursing is among the top industries most in need of a new ergonomic standard and intervention in order to controlled musculoskeletal disorders hazards. Warming *et al*. (2009) illustrated that

the numbers of nurses reporting musculoskeletal complaint and the level of pain increased significantly during the three working days (15%–30% and 17%–37%, respectively) and decreased on the day off. Stress and transfer task were associated with low back pain and transfer tasks were associated with knee pain.

Considering healthcare setting, the complexity of nursing practices in patient care encompasses an assortment of variables that place nursing personnel at risk for MSDs. The interaction between factors related to the patient, nursing profession, physical environment poses dangerous ergonomic risk factors in the health care setting. Identifying these factors allows for clearer examination of their association with work-related musculoskeletal disorders. The sources or causes of work-related musculoskeletal injuries among nursing profession can be indicated as in three main aspects: unsafe patient handling, patient characteristics as a risk for injuries, and physical patient care environments (de Castro, 2006).

1) Unsafe patient handling

A variety of patient handling tasks exist within the context of nursing care, such as lifting, transferring, and repositioning patients. Continuous, repeated performance of these activities throughout one‘s working lifetime results in the development or exacerbation of musculoskeletal disorders. Nurses often lift, transfer, or reposition patients with outstretched arms or bent forward in awkward postures and positions also increasing the risk of injury. Because patient handling tasks are conventionally performed manually, nurses are significantly exposed to the ergonomic hazard associated with this high risk duty. Manual patient handling characterizes the lifting, transferring, and repositioning of patients without the use of assistive equipment.

Although the National Institute for Occupational Safety and Health (NIOSH) states safe lifting limits that the average worker should not lift more than 51 pounds (23.2 kilograms). In parallel, Thai Ministry of Labour states that the average worker should not lift more than 55 kilograms for male and 25 kilograms for female (Ministry of Labour, 2010). The parameters of these designations, however, cannot be appropriately generalized to nursing practice because it was derived on the basis of defined conditions that do not translate well to manual patient handling or other ergonomic hazards in the health care workplace.

2) Patient characteristics as a risk for injuries

Patient characteristics are particularly meaningful when determining the risk of injury associated with manual patient handling. Patient height, weight, body shape, and condition (e.g., contractures, spinal injuries, orthopedic conditions, post-surgical periods, and drains or intravenous line placement) become significant factors in patient handling. Patients are often at some degree of dependence and can offer limited, if any, levels of assistance in moving themselves or may have limited ability to comprehend instructions and to cooperate. Some may become agitated or combative, commonly because they experience pain while being moved. The changing profile of today‘s patient population makes patient handling challenging. In-patient care has been largely populated by patients with higher levels of acuity, a growing elderly population. And the rising numbers of bariatric (clinically obese) patients.

3) Physical patient care environments

The physical environment of care can further pose restrictions on movement and positioning within the specific context of patient handling as well as other nursing tasks. Depending on the care setting (e.g., standard hospital patient room, skilled nursing facility, home care), nursing staff must work within the constraints of the physical area to perform their duties, for example, in lifting patients or reaching for elevated monitors. Nurses may be forced into awkward, twisted positions because of limited work space. Hospital furniture and equipment as well as the presence of other hospital staff can create barriers that dictate damaging postures and movements.

Focusing on some specific unit in the hospital, particular in orthopaedic ward, MSDs are associated with excessive back and shoulder loading from manual patient handling, applying excessive forces during pushing and/or pulling of objects, awkward posturing during patient care, and working long hours (Waters *et al*., 2006). Orthopedic nursing personnel are routinely faced with a wide array of occupational hazards while caring for patients with orthopedic issues in a variety of settings that place them at risk for work-related MSDs (de Castro, 2006; Nelson and Baptiste, 2006). Sedlak *et al.* (2009) identified high-risk tasks in orthopedic nursing practices as follows.

1) Turning an orthopedic patient in bed (side to side)

Turning patients with orthopedic impairments from side to side in bed is a common activity. Patients are often repositioned to maintain alignment of the spine, limbs, and other body parts that have been injured or had surgical procedures. Individuals may have equipment attached to their body such as halo vests or external fixators to stabilize fractures. This can make turning in bed difficult, especially if the patient is experiencing pain, has altered levels of consciousness, or is uncooperative. The nurse or healthcare worker will need to move and turn the individual several times a day. It is imperative that the nurse and healthcare workers remain safe while moving the patient because the weight of the patient with the added equipment may increase the risk for injury.

2) Vertical transfer of a postoperative total hip replacement patient

Moving a patient who has had a total hip replacement from a supine position to sitting on the side of the bed position is a common activity performed by nurses. This task requires adherence to positional constraints identified by the surgeon so that the hip does not become dislocated. Orthopedic precautions need to be followed that may include weight-bearing limits on the lower extremities, abduction of the legs, prevention of internal rotation, and avoidance of hip flexion less than 90.

3) Vertical transfer of a patient with an extremity cast/splint

Moving a patient with a cast or splint on an extremity is commonly performed by nurses. The patient‘s level of pain, fatigue, and ability to cooperate and support the limb are all variables that make this task high risk. Additional risks to the caregiver include lifting heavy casts, traction weights, awkward postures, pushing/pulling, and twisting. During cast application, the limb must be held for a long period of time, making this task difficult due to the need to support the limb during the circumferential wrapping of the cast materials. The weight of the limb being lifted should not exceed the strength/capability of the caregiver.

4) Ambulation

Ambulation of an orthopedic patient, an intervention critical to reducing postoperative complications, is essential to reducing complications of immobility. Limitation of weight-bearing status, inability to grasp with the hand, and the use of

various immobility devices such as splints can make this task more difficult. The risk to the patient for falls is an additional concern.

5) Lifting or holding a limb with or without a cast or splint

The task of lifting and holding limbs (arms or legs) during casting or splinting is performed often in the orthopedic setting. The weight of a limb can be heavy and the physical demands of performing this task can often exceed the back and shoulder strength capability of the caregiver. When the demands of the task exceed the strength capability of the worker, risk of MSD increases (National Research Council/Institute of Medicine, 2001). In cases in which the weight of the limb exceeds recommended limits for one caregiver, then either additional help will be needed to perform the task or some type of assistive technology should be used.

A multiple logistic modeling showed that transporting patient by wheelchair (OR 5.48, 95% CI 1.11 - 27.05) and lifting objects between 10 - 25 kilogram (OR 2.27, 95% CI 1.01 -5.12) were significantly associated with persistent shoulder pain, and lifting objects between 5 - 10 kilogram (OR 2.65, 95% CI 1.07 - 6.54) were significantly associated with shoulder pain that limited work activities ($p<0.05$) (Sinsongsook, Taptagaporn, and Jiamjarasrangsi, 2005). Besides, Kantiya (2009) and Tongpoon (2009) indicated that the prevalence of musculoskeletal disorders among professional nurses during 12 month period was 81.1% and 71.25%, respectively. They also found that nursing care activities was associated with the occurrence of MSDs. Serious consequences can arise from manually moving/lifting the patients (Sedlak *et al*., 2009).

The major risk factors given for low back pain in care work were transfer, the replacement of diapers, and movement in a half-sitting posture (Minematsu, 2007). Besides, the RRs of neck-shoulder-arm pain for moving beds (1.16), helping patients to bath (1.16), and helping patients to shampoo (1.17) tended to be higher. Relatively higher RRs for low back pain were also noted for items that suggested work postures including frequent bending forward or half sitting (1.29), much static work (1.20), and frequent lifting and handling of objects (1.16). The items suggesting control of one‘s own work— such as much unplanned work (1.17) and difficulties in lowering workloads at reduced working capacity (1.14) also tended to have relatively higher

RRs for LBP. Among the items suggesting work organization, RRs for LBP and neck-shoulder-arm pain tended to be slightly higher for extra work due to poor physical condition of colleagues (1.14 and 1.12, respectively) (Ando *et al*., 2000).

Additionally, environment at work such as noise and light have been documented for their effects on the workers. There is evidence that worker perceive higher sound levels as stressful. Noise induced stress in nurses is associated with reported emotional exhaustion and/or burnout lead to an increase in turnover intention (AIA Architect, 2005). A previous study indicated that lower noise levels were linked with a number of positive effects on staff, including reduced perceived work demands, increased workplace social support, and improved quality of care for patients (Blomkvist, Cole, and Ulrich, 2005). However, levels of light are not as obviously expressed. The most obvious effect of light on humans is in enabling vision and performance of visual tasks. Boyce, Hunter, and Howlett (2003) indicated that performance on visual tasks gets better as light levels increase. Individuals may feel stressed if they are not capable to perform tasks due to inadequate levels of lighting. Concordance with a study by Alimoglu and Donmez (2005) which found that nurses exposed to daylight for at least 3 hours a day experienced less stress and were more satisfied at work. Considering odors, there are negative components of air quality which has been linked to health and stress in the workplace. Feeling of poor air quality in the workplace can result in workers‘ dissatisfaction (Mroczek, 2005).

2.2.3.2 Psychosocial Work Demands

Psychosocial work demands, more subjective aspects, refer as stressor conditions perceived as threatening, harmful, or bothersome, or that place demands on employees that provoke physiologic adaption responses (Davis and Heaney, 2000). Specific types of stressors include quantitative work demands, availability of social support, job ambiguity, conflict, job control, job strain, jab satisfaction, and job security (Edwards, 2004). Although many studies address the contributions of psychosocial variables to work-related injuries and illness, the importance of these factors was identified through the demand-control model studies of Karasek and his colleagues (Karasek and Theorell, 1990). In this model, high levels of psychological

job demands may contribute to the development of WMSDs when they occur in an occupational setting in which the worker has little ability to decide what to do or how to do a particular job task and little opportunity to use or develop job skills. Further, these adverse effects are hypothesized to occur more frequently in a work environment in which there is little social support from co-workers or supervisors (Silverstein and Evanoff, 2006).

A number of literature reviews have concluded that work-related psychosocial risk factors (such as high job demand, job dissatisfaction, stress, low social support and perceived control at work) also play a significant role in developing MSDs prevalence (Linton, 2001; Bongers, Kremer, and ter Laak, 2002; Bartys, Burton and Main, 2005; Tweedy, 2005; Lorusso, Bruno, and Abbate, 2007). Josephson and Vingard (1998) found that exposure to adverse psychological work conditions in combination with physical demands increased the strength of the relationship to the risk of MSDs compared to either condition alone. For example, psychosocial factors like low job satisfaction and lack of social support have been found related to low back pain and neck/shoulder pain among nurses (Smedley *et al*., 2003). Some study (Alexopoulos *et al*., 2003) indicated that psychosocial factors, such as high perceived exertion and high job demand, may be more related to neck pain than low back pain.

2.2.3.3 Individual Factors

Individual factors may also cause or contribute to MSDs such as genetic cause, age, gender, smoking, length of employment, and other factors (Tweedy, 2005). Among the individual factors, age and length of employment were shown to be important factors in most. However, length of employment but not age was associated with low back pain. Similarly, reported that the risk of low back problems was equally high both in younger and in older nurses. Multiple logistic modeling showed that the 41-50 years age group (OR 2.95, 95 % Cl 1.02 - 8.52) was significantly associated with persistent shoulder pain (Sinsongsook *et al.*, 2005). Noteworthy, all the studies investigating relationship with gender showed females to be at greater risk of low back pain. Conversely, no association was found between back complaints and anthropometric variables, smoking, sporting activity and

motherhood (Lorusso, Bruno, and Abbate, 2007). A study by Skillgate *et al*. (2009) suggests that smoking is a risk factor for long-term sick leave due to unspecific back or neck pain. Moderate alcohol consumption tends to have a protective effect, at least among women in the public sector. Tweedy (2005) summarized that nurses who worked 12-hr shifts, rotating shifts, sleep was inadequate, more frequent patient-handling, experienced more frequent pain or discomfort in the lower back, thigh/knee, lower leg, and ankle/foot areas. Both patient handling tasks and shift type were significantly associated with symptoms in over half of the body regions.

In summary, the physical (biomechanical) risk factors associated with work at the individual level do not represent the full spectrum of possible risks (Dillon, 2004). Moreover, the effects of physical and psychosocial risk factors may be amplified by extreme environment conditions. In addition, ergonomic hazards may arise from poor job design and faulty organizational factors, such as excessive work hours, shift work, imbalanced work-to-rest ratios, and work environment in hospital is not well adapted (Rogers, 2003; Clark, 2004). The level of risk depends on the duration that nursing personnel is exposed to risk factors, the frequency at which they are exposed, and the magnitude of the exposure (Lei *et al*., 2005). Consequently, all risk factors that they encounter in the hospital setting account for many serious MSDs as mentioned earlier.

2.3 Problematic Consequences of Musculoskeletal Disorders

MSDs are widespread occupational health problem with sever consequence for the worker and the organization (Morse, 2004). A recent survey of nurses over the age of 50 revealed that over one third suffered from MSDs related to the job (Letvak, 2005). Nurses also felt those musculoskeletal problems that they experienced interfered with their ability to perform their job. Sheikhzadeh *et al.* (2009) indicated that a high prevalence of WMSD among perioperating nurses was found to be the main causes of absenteeism from work. Consequences of these MSDs to the nurse include career-ending injuries, higher susceptibility to future injury, and fear of injury. Moreover, the loss of use of the hands and arms can have a profound effect on almost every aspect of life: work, child care, home maintenance, hobbies or sports (Morse, 2004).

For organizational aspect, MSDs impacts include high cost of worker‘s compensation insurance, increased sick leave, pain and fatigue, and diminished productivity (Nelson, 2006). In the United States, The overall cost of such disorders related to patient care is estimated at over $25 million per year with substantial additional unmeasured costs (Veterans Health Administration, 2005). These disorders lead to financial losses associated with workers‘ compensation insurance, or similar forms of social security in place (Lei *et al*., 2005). In 2007, moreover, MSDs accounted for 29 percent of all workplace injuries requiring time away from work and involved a median of 9 days compared with 7 days for all nonfatal injury and illness cases (U.S. Bureau of Labor Statistics, 2009). Parallel to the UK, It is now generally acknowledged that MSDs have the potential to lead to long and serious disability of the employee, and impose heavy costs on employers and on society. The Health and Safety Executive (HSE) estimate the cost to the economy to be 5.7 billion per year (Buckel, 2005).

The impact of MSDs on the nursing workforce may lead to adverse consequences at the organizational level, as well as, through increased absenteeism, lost work time, burnout, decreased retention, high turnover, and threatened recruitment. Among the U.S. nursing workforce, the extent of musculoskeletal disorders is particularly distressing when contemplated in the context of the current nursing shortage. Injuries secondary to patient handling tasks compound factors such as the aging of nursing workforce, declining retention and recruitment rates, and lowering social value of nursing to worsen the shortage problem (de Castro, 2006).

Corresponding with a research in 2002, nursing is in crisis has been documented. According to many experts, a global nursing shortage has begun and is expected to grow slowly until there is a shortage of vacancy rate of almost 20% nationwide. Daily work environment is a large contributor to the nursing shortage. An online health and safety survey study produced many key findings in relation to work health and safety. More than 60% of nurses in the study feared a disabling back injury. Eighty percent of the survey participants continued to work despite experiencing back pain. Three quarters of the nurses surveyed indicated that unsafe working conditions affected their ability to deliver quality care, and almost 90%

reported that health and safety concerns influenced their decisions to continue working in the field of nursing (Palmer, 2003).

The International Council of Nurses (2007) indicates the situation, within nursing, in both developed and developing countries is that the nursing workforce is aging (the average age of the nurse in many countries exceeds 40). Over the next 10 to15 years these countries will experience a large exodus of nurses from their workforce as nurses retire just at a time when demand for nursing and health care is on the rise; one of the reasons being the growth in the older population. This trend, if left unaddressed, is set to deepen the current shortage of employed nurses, particularly in countries where there is a shortfall of new nurses entering the labour market. Since the quality of patient care is fundamentally linked to the availability of nursing personnel, the extent to which shortages exist in the nursing profession will affect the ability of health care organizations to meet the health care needs of the public.

According to a study in the US, more than 25% of nurses reported working 12 hours or more a day and 33% worked more than 40 hours a week (Trinkoff *et al*., 2006). In parallel, a report of Asia nursing workforce profile indicated that Thai nurses have the highest average hours overtime per month (80 hours) comparing with other countries (10-40 hours) (International Council of Nurses, 2008). These workplace issues affect Thai nurses in order to expose the workplace hazards longer than others. Thus, the suitable ergonomic intervention designed to reduce the ergonomic risk factors or incidence of MSDs is needed (Warren, 2004).

2.4 The Strategies to Prevent and Control of Ergonomic Risk Factors

The basic framework for an ergonomically based injury-prevention program generally consists of administrative, work practice, and engineering controls (Rogers, 2003; Clark, 2004).

Administrative controls refer to changing in the way that work in a job is assigned or scheduled that reduces the magnitude, frequency, or duration of exposure to ergonomic risk factors. Examples of administrative controls for MSD Hazards include employee rotation, job task enlargement, alternative tasks, and alteration of

work pace. Administrative policies and strategies can be a powerful deterrent to work-related injuries.

Work practice controls are changes in the way an employee performs the physical work activities of a job such as postural improvement, proper body mechanics, pacing, timely rest stops, use of personal protective equipment, economizing of movements getting assistance from others, and on-the-job stretching exercises. The design of a job and associated processes often dictate how the worker will physically orient themselves and define functional motions to carry out necessary tasks. These areas tend to be the responsibility of the employed once proper training and engineering controls have been put in place.

Engineering controls include design of workstation, tools, proper maintenance, environmental layout, mechanical assist for material handling, and alterations in processes. The first line of defense in reducing risks of injury in the workplace is to start with proper design of the working environment, tools, and processes. The goal is to –design out" known ergonomic hazards. Recent times have seen increased mechanization, automation, and intensive safety campaigns that have produced increased general safety in the workplace. Although risk of traumatic injuries is reduced, MSD conditions continue to be problematic. The human interface with this sophistication has produced work demands characterized by fixed positions, body stasis, intense concentration, and highly repetitive movements using the same anatomic structures. These physical and mental stresses are well recognized and merit a strategic position in concept of ergonomics.

For illustration, conceptualize an ergonomics equation may be presented as follows.

Demands of job = Human functional capacity

When the psychophysical demands of work are balanced with human psychophysical capacity, efficient productivity and outcomes are realized. The goal of ergonomics is to achieve and optimum –fit" between work and worker. This balance is best achieved by adjusting the left side of this equation (through engineering improvements) rather than expecting the worker to make all the adjustments on the

right side of the equation (through work practice changes). The structure of the work environment, design of tools, and physical demands of the job will directly influence how the worker uses his or her physical and mental resources. Additional examples of engineering considerations include mechanization, hoists, lifts, conveyors, robotics, air quality, noise, temperature, lighting, walking surface, and so forth.

Although it is true that strictly engineering interventions (left side of the equation) can remedy existing hazards immediately, it also has been realized that expensive changes in the workplace may not improve injury statistics. One must realize that the right side of this ergonomics equation presents many opportunities to affect workers‘ health and productivity sometimes with comparatively less expense associated with engineering changes (Warren, 2004).

Regarding to hospital setting, a study in USA suggested that the simple ergonomic and engineering solution can be adopted to improve the work environment of nursing personnel. A successful ergonomic program designed to prevent or reduce work-related musculoskeletal disorders, however, must involve a good understanding of the roles and responsibilities of nursing personnel (Sheikhzadeh *et al*., 2009). Besides, the Occupational Safety and Health Administration (OSHA) recommends an effective process that should be tailored to management ergonomics hazard in health care setting as the following (Tweedy, 2005).

1) Provide management support

Strong support by management crates the best opportunity for success. Employers should develop clear goals, assign responsibilities to designated staff members to achieve those goals, provide necessary resources, and ensure that assigned responsibilities are fulfilled. Providing a safe and healthful workplace requires a sustained effort, allocation of resources, and frequent follow-up that can only be achieved through the active support of management.

2) Involve employees and identify problems

Employees are a vital source of information about hazards in their workplace. Their involvement adds problem-solving capabilities and hazard identification assistance, enhances worker motivation and job satisfaction, and leads to greater acceptance when changes are made in the workplace.

3) Implement solutions

When problems related to ergonomics are indentified, suitable options can then be selected and implemented to eliminate hazards. Effective solutions usually involve workplace modifications that eliminate hazards and improve the work environment. These changes can affect the use of both equipment and work practices. When choosing methods for lifting and repositioning residents, individual factors should be taken into account. Such factors include the resident‘s rehabilitation plan, the need to restore the resident‘s functional abilities, medical contraindications, emergency situations, and the resident; dignity and rights.

4) Provide training

Training is necessary to ensure that employees and managers can recognize potential ergonomics issues in the workplace and understand the measures that are available to minimize the risk of injury. Ergonomics training can be integrated into general training regarding performance requirements and job practices. Training programs can go a long way toward increasing safety awareness among both managers and employees. Training and education can ensure that employees are sufficiently informed about workplace hazards. Soliciting suggestions from workers about ergonomic hazards can help improve work practices.

5) Address reports of injuries

Even in establishments with effective safety and health programs, injuries and illnesses may occur. Work-related MSDs should be managed in the same manner and under the same processes as any other occupational injury or illnesses. Like many injuries and illnesses, employers and employees can benefit from early reporting of MSDs. Early diagnosis and intervention, including alternative-duty programs, are particularly important in order to limit the severity of injury, improve the effectiveness of treatment, minimize the likelihood of disability or permanent damage, and reduce the amount of associated worker‘s compensation claims and costs.

6) Evaluate ergonomics efforts

Health care leaders should evaluate the effectiveness of their ergonomics efforts and follow-up on unresolved problems. Evaluation helps sustain the effort to reduce injuries and illnesses, track whether or not ergonomic solutions are working, identify new problems, and reveal areas where further improvement is needed.

Evaluation and follow-up are central to continuous improvement and long-term success.

Based on OSHA recommendation, the American Nurses Association (ANA) has launched the Handle With Care® campaign in response to the significant number and severity of work-related back injuries and other musculoskeletal disorders among nurses. The campaign seeks to build a health care industry-wide effort to prevent back and other musculoskeletal injuries. This is being done through developing partnerships and coalitions, education and training increasing use of assistive equipment and patient-handling devices, reshaping nursing education incorporate safe patient handling, and pursuing federal and state ergonomics policy by highlighting technology-oriented safe-patient handling benefits for patients and nurses (de Castro, 2006; Hughes, 2006). The successful of campaign on reducing nurses injuries have been reported in several studies (Hignett, 2001; Yassi *et al*., 2001; Owen, Keene, and Olson, 2002; Hefti *et al*., 2003, Evanoff *et al*., 2003, Haiduven, 2003, Mutch, 2004). de Castro (2006) indicated that injuries among nursing staff have dramatically declined since incorporating patient handling equipment and devices along with an institutional commitment to safest available methods. In a work environment that values and ergonomic approach and applies a formal program, nurses are provided a safe workplace in which to practice without the threat of injury. Additional benefits include decreased fatigue, increased job satisfaction, not working in pain, and sustainability of professional careers.

In UK, a number of leading organizations recognize that a high prevalence of MSDs is a symptom of _system failure‘. Thus, programmes for the prevention of MSDs should be incorporated within a wider ergonomics approach to the continuous improvement of work systems, organizational design, use of technology and the work environment. This requirement is best described as an ergonomics approach. However, effective prevention based on a participatory model that engages key stakeholders is important. This is demonstrated by the key elements identified for ergonomic intervention that include: commitment from senior management, worker involvement, risk assessment, control measures and instruction and training (Buckle, 2005).

In parallel, practical ergonomics approaches that are built on local achievements and that focus on participatory training methods have proven useful for facilitating concrete workplace improvements in the existing conditions of developing countries, particularly in Asia (Kawakami, Batino, and Khai, 1999). Direct participation of workers and employers has been promoted in ergonomics training aimed at immediate solutions and continuous improvement (Kawakami and Kogi, 2005). Considering the limited number of ergonomists and occupational health experts and the need of workers‘ participation, it is logical to develop and carry out widely-applicable, participatory ergonomic training programs for covering the working population (Kawakami, Batino, and Khai, 1999). Due to the scope of ergonomics practical measures to improve physical and mental workloads (Kawakami and Kogi, 2005), the participatory ergonomics is needed for MSDs prevention. Ideally, the PE approach encourages workers to be involved in controlling their own work activities, which consequently decreases work organization or psychosocial risk factors for MSDs (Haines and Wilson, 1998).

2.5 Participatory Ergonomics

Participatory ergonomics (PE) can be described as a concept involving the use of participative techniques and various forms of participation in the workplace. PE was defined by Nagamachi (1995) as the workers' active involvement in implementing ergonomic knowledge and procedures in their workplace. This worker effort is supported by their supervisors and managers, in order to improve their working conditions and product quality. Kuorinka (1997) defined PE as practical ergonomics with participation of the necessary actors in problem solving. In the context of systemic approach, Wilson and Haines (1997) offered PE definition as the involvement of people in planning and controlling a significant amount of their own work activities, with sufficient knowledge and power to influence both processes and outcomes in order to achieve desirable goals. In other words, PE refers to the workers being given the opportunity and power to use their knowledge to address ergonomic problems and solutions relating to their own working activities.

The term PE has come to include a wide variety of methods and techniques. However, all these methods have a common thread of active worker involvement that runs through them. Groups of front-line workers are taught fundamental principles of ergonomics and draw on their own experiences to suggest solutions to work-related health and safety problems. Worker participation is necessary throughout the entire process and workers require the power to influence and make decisions concerning their job and work environment. The PE approach can lead to: participation in society, organization of production according to socio-technical principles, and development of ergonomics from ―micro", which involves individual design for a single user workstation, to ―macro", which looks into resolving issues from a holistic approach (Occupational Health and Safety Agency for Healthcare in British Columbia, 2009).

However, there are differences in the understanding and application of PE projects between the countries. In the USA, PE tends to be used at a macroergonomics level, for the development and implementation of technology (Holden *et al*., 2008). In Europe, PE approaches have been applied at all levels of ergonomic interventions, with the key factor being the involvement of all stakeholders in the project (Hignett, Wilson, and Morris, 2005). Whereas in Asia, PE was mostly used in training method called Participatory Action-Oriented Training (PAOT) for workplace ergonomic improvement. To meet diversifying ergonomic needs, participatory steps reviewed are found to usually follow a good-practice approach easily adjustable according to worker needs. These steps are found to usually focus on low-cost improvements (Kawakami and Kogi, 2005; Kogi, 2006; Kim and Lee, 2010). These cultural differences need to be addressed with culturally sensitive approaches, but the fundamental of a participatory approach to tackle MSDs transcends these differences and offers real possibilities to achieve improvements (Hignett, Wilson, and Morris, 2005).

PE appears to be the most effective method of applying ergonomics in the workplace (Kogi, 2006; Domanski *et al*., 2008). It is an increasingly utilized tool to improve working conditions, productivity and product quality, without interrupting the work process (Carrivick, Lee, and Yau, 2002; Hignett, Wilson, and Morris, 2005; Manothum *et al*., 2009). Moreover, it has a positive impact on musculoskeletal symptoms; therefore, it is broadly used to reduce work related musculoskeletal

disorders in several workforces (National Research Council, 2001; Loisel *et al*., 2001; Carrivick, Lee, and Yau, 2002; Hignett, Wilson, and Morris, 2005; Udo *et al*., 2006; Klangsin, 2007; Rivilis *et al.,* 2008; Boynton and Darragh, 2008; Driessen *et al*., 2008; Institute for Work and Health, 2008; Pehkonen *et al*., 2009), as well as in nursing personnel (Pohjonen, Punakallio, and Louhevaara, 1998; Evanoff, Borh, and Wolf, 1999; Hignett, 2001; Kim and Lee, 2010)

Carrivick, Lee, and Yau (2002) evaluated the effectiveness of a participatory workplace risk assessment team in reducing the risk and severity of musculoskeletal injury among cleaners in health care setting. They found that the intervention was associated with significant reductions of two-thirds in musculoskeletal injury rate, 65% in workers‘ compensation claims cost per hour worked, and 40% in hours lost per hour worked. Cleaners also experienced a significant two- third post-intervention reduction in non-musculoskeletal injury rate; but the corresponding changes in severity rates were not significant. The intervention supports the adoption of a participatory approach to reducing the rate and consequence of musculoskeletal injuries in the workplace.

Anema *et al.* (2003) indicated that PE intervention was effective on return-to-work rate (HR = 1.7 [95% CI 1.2 to 2.3]; p=0.003). Workers with a PE intervention improved more on functional status and pain intensity than workers without this intervention. Ergonomic solutions were targeted more at work design and organization of work (58.9%) than at workplace and equipment design (38.9%). Almost half (48.9%) of the ergonomic solutions were completely or partially implemented within three months after the first day of sick leave. Most workers were satisfied about the PE program (median 7.8 on a 10-point scale). Main obstacles to implementation according to the ergonomists were technical or organizational difficulties (50.0%) and physical disabilities of the worker (44.8%). The conclusions are the PE intervention had a positive effect on return-to-work of workers sicklisted due to subacute low back pain. The compliance, acceptance and satisfaction related to the PE-program were good for all participants.

A systematic review of Cole *et al*. (2005) on effectiveness of PE interventions for improving health outcomes found a wide spectrum of health outcome measures in the studies. The studies described a variety of ergonomic changes that were identified

and implemented as a result of the PE intervention. Most of these changes focused on improving the physical design of equipment and workplaces. Some involved changing job tasks, job teams or how work was organized. Others involved formulating new policies or specific health and safety training. Nine of the ten studies reported that PE interventions had positive effects on health outcomes including reducing musculoskeletal symptoms, workers‘ compensation claims, and lost days from work or sickness absence. Additionally, Tompa *et al.* (2009) found that the PE intervention was associated with a significant reduction (at the 95% confidence level) in the end duration of weekly indemnity claims, the number of all denied workers' compensation claims, as well as the number of denied workers' compensation claims for musculoskeletal injuries.

Regarding to hospital setting, Evanoff *et al.* (1999) reported a PE project that was carried out with hospital orderlies to see if direct worker participation in problem-solving would improve job satisfaction, injury rates, lost time and musculoskeletal symptoms. They found a decrease in risks of work injury, with a reduction in the relative risk of 50% as well as a reduction in total days lost. The survey found a great and statistically significant reduction in the proportion of workers with musculoskeletal symptoms.

A review study of Hignett, Wilson, and Morris (2005), additionally, showed the various achievement of PE approach in health care setting. For example, the use of PE in risk management projects for MSDs which finally indicated that _PE shows promise as an approach which could be used to evaluate changes in understanding and behavior of people at work as far as risk management is concerned‘. The most successful strategies involved changes in work organization, working practices and the design of the working environment. The review referred to a few studies result, some showed an overall reduction of 48% in patient transfer incidents, a 67% reduction in lost work days, and costs reduced by 32% in the first year and 44% in the second year. Besides, some study showed the effects and feasibility of a 12 month ergonomic intervention on work content and load in home care work found that the ergonomic measures improved both physical and mental work content and working conditions, and prevented the decline of work ability in the intervention group. Moreover, a retrospective study about a 5 year PE intervention program showed 36%

reduction in musculoskeletal sickness absence; 33% reduction in manual handling incidents; and an increase in completed risk actions from 33 to 76%.

As mentioned previously, PE provides value added beyond the practical and powerful contributions of traditional ergonomics across a wide range of situations, cultures and problems. Imada and Nagamachi (1995) stated that ergonomics alone cannot solve all the contemporary issues. Without improved organizational support, team processes, team building, role definition, role clarity, communication, management commitment and a supportive culture, the successes of the program will be limited. Moreover, the absence of a singular "best-one-and-only", though, participatory practice speaks to the importance of the process rather than any single event or approach. Although, the outcomes of a participatory process may not produce results too different from the usual expert consultant intervention. The different, however, is the effect on those who participate. Arguably, the most important outcomes in the process include the improved ownership of the ergonomic ideas, the acceptance of the proposed solutions, the confidence and competence to solve problems, satisfaction with the outcome, and willingness to change. These outcomes are particularly beneficial in environments where change is continuously driven by technology, changing customer needs, quality initiatives (TQM) and competitive demands for continuous improvement. Therefore, the scope needs to be expanded beyond the physical level and should begin to address the psychosocial and organizational facets of work. Arguably, injuries and productivity advantages of the future may be more dependent upon these macroergonomic variables than the physical aspect alone. This begs the need for ergonomics as a multidisciplinary field to continuously define its frontiers.

Hignett (2003) reported on a systematic review looking at the range of interventions used to reduce musculoskeletal injuries associated with patient handling tasks. It was found that the best results were obtained when multifactor intervention strategies included worker participation. The review allocated a quality appraisal score for each paper and then ranked the successful intervention strategies. The most successful strategies involved changes in work organization, working practices and the design of the working environment.

A number of authors have suggested typologies for employee participation in order to explore the degree of involvement of employees in decision-making. This ranges from a top-down approach with information flowing from management to workers on plans for action; gathering of information and experience from workers; consultation where workers can make suggestions and present points of view; negotiations in formalized committees; through to joint decision-making in agreement between involved parties The ranked dimensions highlight the importance o f the involvement of workers, with the top two relating to consultation in decision-making and involvement of workers at all levels in an organization. It is interesting to note that the permanence of the ergonomics input was ranked as the lowest, suggesting that ergonomic input is perhaps project specific rather than a permanent organizational role (Hignett, Wilson, and Morris, 2005).

Participatory ergonomics interventions generally involve the development of ergonomics teams consisting of participants from both the management and worker groups within an organization. These teams seek ways to reduce workplace health risk exposures through redesign of processes, tools, and equipment. The team should include participants from various departments and various levels within the organization in order to ensure that those who have first-hand experience about the issues being investigated have a say in how to address them (Kuorinka, 1997), and that all stakeholders potentially influenced by a change are included in the decision making process (Tompa *et al*., 2009).

Hignett, Wilson, and Morris (2005) indicated that most of the participatory ergonomics projects have both macro and micro dimensions and involved many levels of staff. PE programs can have many factors and some will be more inevidence than others depending on the industry, problem being addressed and even geographical locality. Most workplace PE interventions involve forming an ergonomics ~~t~~eam" which guides the intervention process. This group usually includes employees, managers, ergonomists, health and safety personnel, and research experts. The team typically undergoes training to familiarize them with ergonomic principles. Combining outside expertise with the organization‘s unique experience makes it possible to devise ergonomic interventions tailored to the needs of that particular workplace. This may increase the chance that the intervention will be successful (Cole

et al., 2005). Moreover, the success of PE can be attributed to the involvement of workers in the entire process—from identifying the risks and hazards, to recommending solutions, to implementing the solutions and evaluating the outcomes (Domanski *et al*., 2008).

2.5.1 Factors for success in participatory ergonomics

To increase the likelihood of a successful participatory ergonomic (PE) program, create PE teams with appropriate members, address key facilitators/barriers, involve the right people from the workplace in the overall PE process, provide ergonomic training, involve a PE champion to guide and monitor the process, define participants‘ responsibilities, and make decisions using group consultation have been considered (Institute of Work and Health, 2008).

1) Create teams with appropriate members

In most reviewed documents, a team is an important aspect of PE programs. Some type of team was formed. The type of team seems flexible and depends on the needs of each workplace. Teams could be steering committees, change teams a cross departments, or department/workgroup teams. Regardless of the nature of the team, having appropriate members such as workers, supervisors or advisors is important. Creating the right team was often described as a facilitator – or as a barrier – if the makeup of the team wasn‘t addressed. Issues of communication support of PE programs and including a PE champion in the process emphasizes the need to have appropriate people on the PE team.

2) Address key facilitators/barriers

To increase the chances of a successful pro- gram, it is important to be aware of potential facilitators and barriers in initiating and putting the PE program into practice. The facilitators and barriers that were mentioned most often, and should be considered, were: management support of the PE intervention, ergonomic training (which is a separate recommendation), resources such as staff time, funds or materials, creating an appropriate team (also a separate recommendation), communication levels, and organizational training/knowledge in general areas such as team-building skills. It is also important to be aware of other potential facilitators and

barriers. PE programs should be adapted to specific workplaces. Each workplace has its own risk factors for injury.

3) Involve the right people from the workplace in the overall PE process

The PE team will likely ask others in the workplace for feedback, guidance or information about their work tasks during the PE process. Beyond the PE team, it is important to establish who else will be involved in these consultations. Our review found that other than workers, supervisors and internal or external specialists or advisors were key actors in the overall process. These participants likely represent the right mix of skills or knowledge to help the PE process move forward.

4) Provide ergonomic training

Another important element of the PE process is ergonomic training, which was described in most of the documents. Often, it was specifically mentioned as a facilitator, or else as a barrier if it wasn‘t sufficiently provided. Ergonomic training usually addresses many other facilitators related to the PE process. These include having a detailed plan for the PE process, identifying easy changes to make first, as well understanding the nature of work and production requirements. The nature of the training is flexible. It can be tailored to specific workplace risks/hazards or targeted solutions. Ergonomic training can be delivered by an ergonomist or other professional to workers, the PE team and supervisors. Training allows managers, supervisors, and employees to understand ergonomic solution and hazards associated with a job or production process, ways to prevent and control these hazards, and their health/medical consequences (Rogers, 2003).

5) Involve a PE champion to guide and monitor the process

An ergonomic champion was involved in most PE interventions. This person's exact role varied, but usually involved multiple tasks or duties emphasizing the importance of the role. This role was most often held by an ergonomist, but it could also be taken up by others in the workplace or by a researcher. The champion would essentially guide and monitor the PE process.

6) Define participants‘ responsibilities.

The following responsibilities were essential for participants involved in the process: identify the problem, develop solutions and implement change. The tasks of initiating, guiding and monitoring the PE process were not considered the

responsibility of the participants as often. This might be because the PE champion often took charge of these tasks.

7) Make decisions using group consultation

Most often, decisions were made through group consultation. This approach suggests that the group makes decisions on what needs to be done, and management gets involved in any decisions on resources and implementation. This appears to be a realistic way of progressing toward change in a workplace setting. Facilitators such as communication, working relations and workplace climate were highly supported and are important to this type of decision-making.

Clark (2004) indicated that two additional key components of a comprehensive ergonomic program are the safety committee and ergonomics team.

1) Safety Committee

Safety committees and their policies and procedures should not be just paper-bound; they should be functionally strong. An organization‘s philosophy toward production can be in conflict with its position on safety. If safety is regarded as inferior to manufacturing, priority will be directed to productivity or services, with a comparatively weaker commitment to the prevention of work injuries. In light of workers‘ compensation costs associated with MSDs, organization is appreciating the need to harmonize production needs with preservation of employee health and well-being. The concept of process safety management is one way of addressing the possible conflict between manufacturing goals and injury prevention. Process safety management is reflective of an organization‘s total plan to integrate safety seamlessly with all operations. Safety committees alone, as isolated entities, do not necessarily create the highest possible level of safety. It is a comprehensive means of managing process safety by recognizing and understanding in a safe manner, reducing injury risks.

2) Ergonomics Team

An ergonomics team may be a subcommittee of the safety committee or a stand-alone task force given the imperative to undertake all issues pertaining to ergonomics and MSDs. Because of the multifaceted nature of ergonomic science, an ergonomics team should be composed of representatives from management, labor,

engineering, maintenance, human resources procurement, health care, safety personnel, union, and consultants. Production workers should play a prominent role in decision making because they are the key players who must live and work with the final outcomes.

The mission of an ergonomics team should be to recognize ergonomic hazards and solve problems that are predisposing or causing work-related injuries arising from cumulative trauma. Such a task force will become most effective when it becomes educated and skilled in problem analysis, abatement planning, medical management, surveillance, and training. Not organizations to contract the services of a consultant with expertise in ergonomics to provide the initial start-up team training and organizational layout.

In view of the success of ergonomics in Asia, the common strategies furthering the local improvement action should include: focusing on local self-help initiative and starting from existing good examples; developing support tools and training local trainers for sustained action; and promoting facilitator roles of ergonomists (Kawakami, Batino, and Khai, 1999). Kogi (2008) indicated that trainers who commonly acted as facilitator were found to play multiple roles in helping managers and workers take initiative and achieve immediate improvements. The participatory steps were more successfully facilitated when the trainers supported (a) building on local good practice, (b) focusing on a range of basic ergonomics principles, and (c) stepwise progress through feedback of achievements. Training and education is the final critical component of an ergonomics program for employees potentially exposed to musculoskeletal disorder risk.

Positive effects of ergonomics-based training have been proved by many recent studies (Klangsin, 2007; Wu, Chen, and Chen, 2009; Kim and Lee, 2010, Manothum *et al.*, 2009). Wu, Chen, and Chen (2009) studied effects of ergonomics-based wafer-handling training on reduction in musculoskeletal disorders among wafer handlers. The identified risk factor ratio (IRFR) in the workplace and workers‘ musculoskeletal disorders (MSD s) were collected before and after the training. The results of the IRFR from pre- to immediately post-training proved that the implementation of the training significantly increased safe behavior in work practices. A significant decrease ($p < 0.05$) in the prevalence of MSD from pre- to post-training

was found in the legs (a drop of 19.3%). Although an obvious reduction in the prevalence of MSD was also found in the lower back (a drop of 12.0%) and feet (a drop of 6.5%), these decreases were not statistically significant from pre- to post-training. They concluded that one year after training, no significant decreases in the prevalence of MSDs were found for any body parts except the legs and the ergonomics-based training intervention is considered as a success to reduce risk factors associated with improper work methods and postures, but little data could validate its effectiveness on prevention of all the MSD problems. Amick III *et al*. (2006) recommend studies follow workers between four and 12 months after the intervention is completed. However, studies longer than 12 months may run the risk that workers who participated in the intervention are no longer employed.

In recent years, a number of participatory approaches such as the Participatory Action Oriented Training (PAOT) program have been conducted for work improvement. Exemplary programs using PAOT include WISE (Work Improvement in Small Enterprises), WIND (Work Improvement in Neighborhood Development) and WISH (Work Improvement for Safe Home) (Kawakami *et al*., 2004). The WISE method, for example, is designed to encourage and help small enterprises to undertake low-cost measures to improve productivity, quality and working conditions. The approach focuses on shop-floor action, planning and practical implementation. It links working conditions with other management goals, focuses on achievements, builds on local practice, uses a learn- by-doing method, encourages the exchange of experiences and promotes workers‘ involvement. As a result of the training, the trainees are able to identify potential improvements in working conditions and productivity, prepare realistic plans for improvement and develop low-cost solutions based on their own experiences.

PAOT approach was originally developed by Thurman, Louzine, and Kogi (1988, cited in Khai, Kawakami, and Kogi, 2005) and has indicated that workers and employers who are directly trained can spread the contents of their learning to their organization and field. This participatory approach was to encourage workers to become voluntarily involved in improvement activities through the use of an organized system consisting of active participation and cooperation between management and labor. In addition, the effectiveness of successfully implemented

PAOT approach in producing effective low-cost solutions to unique problems that cause work-related injuries in diverse workplaces (e.g., farm villages and factories) has been well documented (Khai *et al*., 1996 ; Kawakami *et al*., 2004; Klangsin, 2007; Kogi, 2008).

Yoshikawa *et al*. (2006) explained the features of training tools and their merits for achieving workplace improvements (see in Table 2.1).

Table 2.1 The features of training tools and their merits for achieving workplace improvements

Training tools	Features of the tools	Main merits
1. Action checklists	guide workers on how to indentify existing good points and available low-cost improvements	help users rapidly select locally practicable improvements using local resources
2. Local good examples	present locally achieved good examples as means of reducing occupational risks in healthcare work	promote the use of low-cost improvements leading to solving local problems
3. Group work methods	focus on the prioritization of immediate improvements and help amalgamate different ideas	facilitate participatory steps for planning and implementing priority low-cost improvements
4. Training manuals	guide trainers and workers on practical methods for conducting participatory action-oriented training	support the organization of participatory multifaceted action training events by local trainers

A study of Thongsuk *et al*. (2006) demonstrated the action checklist for work improvement among health care workers in Phattalung Province, Thailand. The action checklist consisted of 31 items that were classified into four categories corresponding

to biological, chemical and ergonomic hazards and job stress. Unfortunately, it was not specific for improve activities which were expected to prevent musculoskeletal problems among nursing personnel.

Based on the Participatory Action Oriented Training (PAOT) approach, Koo *et al*. (2006) conducted the Participatory Action-Oriented Approach Program (PAOAP) for preventing musculoskeletal disorders in health care workers, and indicated that it had a high potential as an intervention program for preventing work-related MSDs in hospitals. Besides, Kim and Lee (2010) developed Participatory Action Oriented Training for Hospital Nurses (PAOTHN) to prevent musculoskeletal disorders in hospital nurses. This method included organizing short-term training courses or workshops with the active support of instructors trained in participatory methods. The multidisciplinary team conducted the trainer workshop to develop a comprehensive intervention protocol, which yielded several practical and low-cost solutions to reduce the risk factors for musculoskeletal disorders. They developed action checklist based on ergonomics concept consisted of 43 items that were focused on five areas of nursing tasks (i.e., patient care and treatment; safe handling of drugs, medical devices, and equipment; workstation design; physical environment; and welfare facilities and administration). The most desirable immediate outcome of this intervention is improvement of the self-help skills of nurses, including assessing the risk factors in their nursing environments and determining effective solutions. The long-term goal of this intervention is to produce safe working environments for hospital nurses by increasing the number of nurse participants who can act as change agents by implementing participatory-action principles to correct potential environmental risk factors in hospital settings

2.5.2 Evaluation of Participatory Ergonomic Intervention

2.5.2.1 Process Evaluation

Process evaluation of PE implementation is significant for understanding how changes are carried out. Literature on PE processes examining the implementation of PE interventions both qualitative and quantitative is available (Kuorinka *et al*., 1994;

Rice *et al.*, 2002). Similarly a literature exists on the effectiveness of PE in improving work environment by reducing exposures or risk factors for MSD i.e., exposure change evaluations. For example, a randomized controlled trial by Straker and colleagues (2004) demonstrated reductions in a variety of important indicators of biomechanical exposure. Such changes in exposure are important to overall judgments of the effectiveness of PE. Sufficient details about PE processes and biomechanical exposure reduction are needed to better evaluate improvements in health outcomes (Cole *et al*., 2003). An ascent formal economic evaluation literature on the efficiency of workplace interventions in achieving changes in both employee health and production outcomes is also developing (Dul, 2004). Economic evaluations may address the relative cost–benefit of implementing PE in different kinds of workplaces. In the scientific literature, evaluation studies often focus on particular aspects of PE. In summary, a number of steps along a pathway by which PE might improve both employee health and productivity have been shown in Figure 2.2 (Rivilis *et al*., 2008).

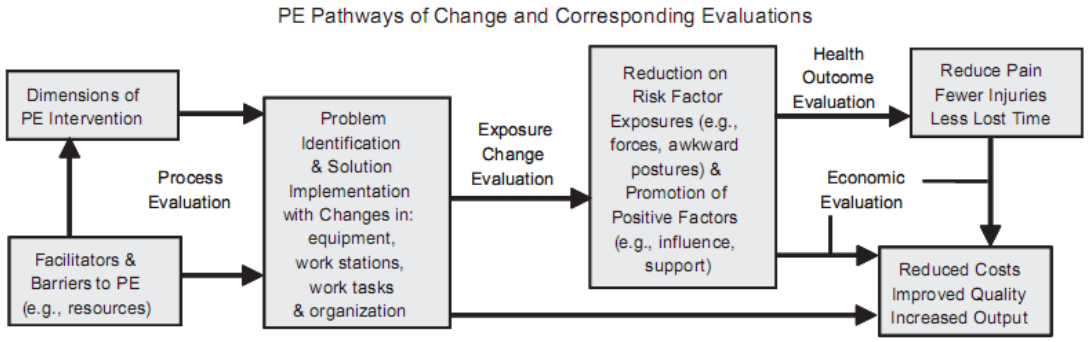

Figure 2.2 Participatory ergonomics pathways of change and corresponding evaluations.

Although a wide range of ergonomic tools can be used within a participatory framework it is usual to see a progression, with the expert ergonomist facilitating the process from problem identification and definition through to the testing of solutions. The steps may include problem analysis using both quantitative and qualitative methods to facilitate the overall process and data collection in the real world setting (Hignett, Wilson, and Morris, 2005).

Haines *et al* (2002) suggested that the participatory ergonomics framework (PEF) can be used as a first basis to produce practical guidance on participatory ergonomics programs. This framework was developed by the UK Health and Safety Executive based on a number of previous studies of ergonomists. It has nine different dimensions which were summarized in Table 2.2.

Table 2.2 The participatory ergonomics framework (PEF)

Dimension	Categories
Permanence	Ongoing-Temporary
Involvement	Full direct-Partial direct-Representative
Level of influence	Entire organization-Department/work group
Decision-making	Group delegation-Group consultation-Individual consultation
Mix of participants	Operators-Supervisors-Middle Management Union Personnel-Specialist/Technical Staff-Senior Management
Requirement	Compulsory-Voluntary
Focus	Designing equipment or tasks-Designing jobs, teams of work organization-Formulating policies or strategies
Remit	Process development-Problem identification-Solution generation-Solution evaluation-Solution implementation-Process maintenance
Role of ergonomics specialist	Initiates and guides process-Acts as a team member-Trains participants-Available for consultation

2.5.2.2 Outcome Evaluation

1) **Work Environments**

Current techniques for assessing work environments or exposure to risk and positive factors associated with WMSDs include self-reports, observational methods,

and direct measurement (Li and Buckle, 1999; David 2005). Self-reports from workers can be used to collect data on workplace exposure to both physical and psychosocial factors by using methods that include worker diaries, interviews and questionnaires. Generally, data collection has been by written records. Related information on demographic variables, reported symptoms, including pain and postural discomfort, and/or levels of subjective exertion may be gathered as well. These methods have the apparent advantages of being straight forward to use, applicable to a wide range of working situations and appropriate for surveying large numbers of subjects at comparatively low cost (David, 2005).

A number of methods have been developed for systematically recording workplace exposure to be assessed by an observer and recorded on pro-forma sheets. The number of exposure factors assessed by different techniques varies. Some permit only postural assessments various body segments to be made, but the majority assess several critical physical exposure factors. The Quick Exposure Check (QEC), for example, has been designed for use by occupational health and safety practitioners to assess exposure to risk factors for WMSDs and to provide a basis for ergonomic intervention at the workplace. Subsequently it should be used to evaluate the effectiveness of any interventions made (David *et al*., 2008). This method has the advantage of being inexpensive and practical for use in a wide range of work places where using other methods of observing workers would be difficult because of the disruption caused. However, it requires extensive technical support from highly trained staff for effective operation and can be time consuming to use in practice and have been found more suitable for use in recording and analyzing simulated tasks, rather than for conducting practical assessments in the workplace (David, 2005). However, the self-report questionnaire for assessing physical work load or physical work environment preferred for hospital setting is the Dortmunder model, the physical workload index (Janowitz *et al.*, 2006). The model constructed based on biomechanical aspects, modified by Hollmann *et al.* (1999). However, a major problem with these methods is that worker perceptions of exposure have been found to be imprecise and unreliable.

In assessing psychosocial work environment, the job content questionnaire (JCQ) has been the most popular self-administered instrument since formulated by

Karasek in 1979. It validity has been studied in several version, particular in Thai (Phakthongsuk, 2009). The JCQ is based on the job demand-control-support (JDCS) model, which is composed of three major components that describe psychosocial work characteristics: psychological demand, job control or decision latitude and social support. Psychological demand refers to the measure of stress factors involved in accomplishing the work load, organizational constraints on task completion and job-related conflicting demand. Job control or decision latitude relates to the freedom permitted to the worker in how to perform tasks and how to meet the job demand and is assessed as a composite of skill discretion and decision authority. According to the model, a high level of skill gives the worker control over which specific skills to use to accomplish the task and make decisions that reduces possible adverse effects of psychological demand. Social support refers to overall levels of helpful social interaction available on the job both from coworkers and supervisors (Phakthongsuk and Apakupakul, 2008). However, Aust *et al.* (2007) argued that JCQ itself not fit enough for assessing psychosocial work environment in hospital setting due to it is focused primarily on task completion and quantitative demands. It is less appropriate in human service, where, e.g. emotional demands also play an important role. Therefore, they proposed the Copenhagen psychosocial questionnaire (COPSOQ-1) which was indicated that suitable to measure the psychosocial work environment of hospital workers. However, the COPSOQ-I has some limitation such as it did not include a scale on rewards at work, the COPSOQ-II which constructed by Kristensen *et al.* (2005) can solve this problem.

The validity and reliability of a questionnaire for assessing physical work load was tested by Hollmann *et al.* (1999). This instrument has demonstrated acceptable test–retest reliability when used in a health care setting ($r = 0.65$), and convergent and discriminant validity was satisfactory. This questionnaire had been also used in numerous studies (Jager *et al*., 2000; Janowitz *et al*., 2006). In parallel, the Copenhagen Psychosocial Questionnaire (COPSOQ) for psychosocial work environment assessment was tested by Aust *et al.* (2007). The majority of the scales showed satisfying in internal consistency ($\alpha > 0.70$). Only two scales, possibilities for development ($\alpha = 0.65$) and demands for hiding emotions ($\alpha = 0.47$) had alphas of

less than 0.70. The authors suggested that it is a suitable instrument to measure the psychosocial work environment of hospital workers. In this study, to ensure that all risk and positive factors have been accounted, the work environment questionnaire using in this study will be developed based on the physical workload index, COPSOQ-I, COPSOQ-II and literature reviews.

2) **Health Outcomes**

Rivilis *et al.* (2008) conducted a systematic review on effectiveness of participatory ergonomic interventions on health outcomes and indicated that there were three broad categories of health outcomes: (1) symptoms of MSD-related pain and /or discomfort, most often from questionnaire; (2) injury records in-plant or lost time claims for workers‘ compensation; and (3) sick leave in general or lost workdays specifically due to MSD. Most common was the measurement of MSD symptoms, likely in keeping with their greater frequency (symptom scores on all participants) and greater sensitivity to change during the course of a PE intervention. Various questionnaire instruments captured different attributes of these MSD related symptoms including the frequency or severity of symptoms overall, the intensity of pain, and the location of symptoms by body region e.g., low back pain occurrence in the past year. Changes in injuries and lost time or sick leave, extracted from administrative data bases were reported. Few studies included more than one health outcome: both symptoms and injury data, or both symptoms and sick leave, and all three.

Additional study indicated that all common chronic diseases decrease work ability. Mental disorders and coronary heart disease had the strongest negative influence on work ability. Depression, back and neck problems, and hypertension had a smaller effect on work ability on the individual level, but, because they are so prevalent, they decreased the average work ability of the entire population the most. The work ability of those employed was affected the most by depression and back problems. According to previous research, especially musculoskeletal disorders affect perceived ability to cope at work (Gould *et al*., 2008).

In this study, as regards literature reviews, health outcomes include MSDs rate, sick leave, and work ability among nursing personnel will be considered.

The Instrument for Measuring MSDs

A tool widely used for investigating the prevalence of MSDs in occupational settings is the Nordic Musculoskeletal Questionnaire (NMQ) which was available from the original paper by Kuorinka *et al*. (1987). As a screening for MSDs related to ergonomic exposure, the questionnaire can be self-administered or used in interviews, and is well suited for studying the history of MSDs and disability in occupational populations because the questions concentrate on symptoms most often encountered in an occupational setting, particularly those affecting the low-back, neck and shoulders (Sanders, 2004). The reliability of the questionnaire was found to be acceptable. However, the questionnaire is subject to recall bias, particularly since some questions ask for musculoskeletal symptoms and problems experienced during the previous 12 months. The validity and reliability of the questionnaire was found to be acceptable (Kourinka *et al*., 1987; Crawford, 2007).

The Instrument for Measuring Work ability and Sick leave

Work ability is defined as the balance between the demands of work and the resources of the individual (Gould *et al*., 2008). The conceptualization of ‗work ability' that is chosen in this contribution has to be understood in a preventive context where interventions ensure that workers are properly accommodated and that future alienation, work disability and premature retirement will be minimized. Nowadays, one of the most important challenges in the domain of personnel management is to find out whether influential factors (i.e. work conditions) can be detected that stimulate or hinder the development of individual employability throughout a career. Employability can be defined as ‗the behavioral tendency directed at acquiring, maintaining and using qualifications that are aimed to enhance the ability to cope with a changing labour market during all career stages' (van der Heijden and Thijssen, 2003).

Costa and Sartori (2002) indicated that nurses appeared to have lower mean scores for work ability compared with both biologist-technicians and physicians in all age groups. Moreover, this effect turned out to be stronger with ageing. While the work ability index predicts the risk of work disability or the future ability to cope and remain at work especially in ageing people (Tuomi *et al*., 1997), the outcomes regarding our nurses‘ sample are alarming. Health and the decline in health status and their perceived consequences for managing work have an important role among nurses, in any stage of life.

The work ability index (WAI) has been developed in the early 80‘s by researchers from the Finnish Institute of Occupational Health (FIOH) as an instrument aimed at evaluating how well workers are performing in their present job and how their performance is expected to be with respect to future work demands, health, and mental resources (Tuomi *et al*, 1991). The model underlying the WAI is mainly explained by four factors: job demands and environment (28% of explanation rate), work organization and work community (20%), professional competence (15%) and life style (13%) (Tuomi, 2001). More specifically, these four factors significantly influence how well or how poorly a worker uses his or her resources. A system of feedback exists on how he or she is doing at work and it models and improves his/her motivational factors too.

The WAI can be used as a monitoring instrument for both individuals and groups among occupational health personnel; it has proved to be helpful in high stress level detection and prevention (Kloimuller *et al*., 2000), a predictor for disability pension and mortality (Tuomi *et al*., 1991, 1997) and a good indicator of occupational risk factors for early retirement (Tuomi, 2001). The WAI questionnaire entails seven dimensions, each covered by means of one or more questions: current work ability compared with the best during one‘s lifetime, work ability in relation to the demands of the job, number of diagnosed diseases, subjective estimated work impairment due to diseases, sickness absence or sick leave during past year, own prognosis of work ability two years later and mental resources. It has been translated into 15 languages including Thai and is highly applicable for cross-cultural comparisons.

2.6 Conceptual Framework

According to Krash‘s integrated model (2006) and literature review, there are three dominant risk factors that can contribute to development of work-related musculoskeletal disorders (WMSDs) include individual factors, physical demands and psychosocial demands. As such hospital setting, the complexity of nursing practices in patient care encompasses an assortment of variables that place nursing personnel at risk for MSDs. The interaction between factors related to the patient, nursing profession, work environment poses dangerous ergonomic risk factors to nursing personnel lead them plagued at the top ten occupation hardest hit with this problem. Thus, preventing the occurrence of MSDs among nursing workforce by implemented an efficiency intervention program is needed.

Participatory ergonomics (PE) is an effective method which suitable for WMSDs controlling in the workplace. The scope of PE intervention has been multi-faceted to build human-centered work environments and also practical measures to improve physical and psychosocial demands. Therefore, it is predicted that whether the work environments will be improved, the consequence of better improving will affect positively on worker health outcomes.

In this study, the PE pathways of change and corresponding evaluations which was available from the original paper by Rivilis *et al.* (2008) provides an applicable framework for understanding the consequences of the Healthy Unit Guidance (HUG) program, a tailored PE intervention for nursing personnel. This program comprised a series of workshop with participatory action-oriented training (PAOT) method to establish management support, strengthen participants‘ capacity, and evaluation work improvement achievements. It is anticipated that the HUG program intervention will enhance work environments and improve health outcomes (e.g. reduced sick leave, increased work ability, and reduced MSDs rate) among nursing personnel. The conceptual framework for this study is shown in Figure 2.3.

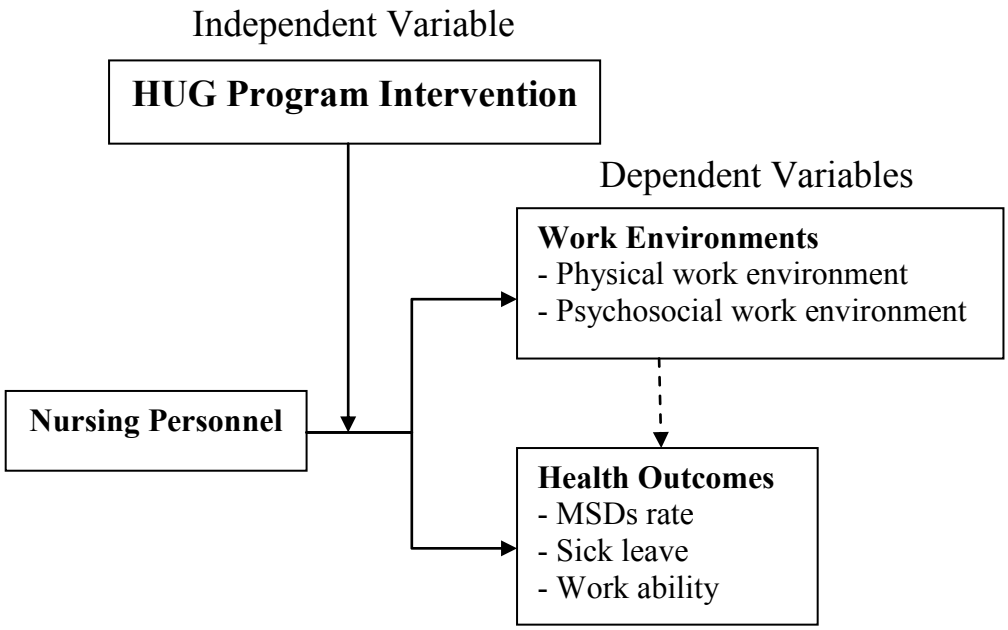

Figure 2.3 Conceptual framework

CHAPTER III
METHODOLOGY

This chapter focused on the methodological approach description included the research design, population and sample, protection of human rights, intervention protocol, research instruments, and procedures for data collection and analysis.

3.1 Research Design

This study was a quasi-experimental study using a pre-test and post-test control group design to evaluate the differences in work environments and health outcomes of nursing personnel who received and not received the Healthy Unit Guidance (HUG) program, a participatory ergonomics (PE) approach. Timeframe for data collection and intervention are shown in Table 3.1.

Table 3.1 Timeframe for data collection and intervention

	Baseline		**Posttest at 3 months post intervention**	**Posttest at 6 months post intervention**
Intervention Group	O_{I1}	X	O_{I2}	O_{I3}
Control Group	O_{C1}		O_{C2}	O_{C3}

O_{I1} and O_{C1} refer to scores of work environments and health outcomes prior to participating in the HUG program for the intervention (O_{I1}) and the control (O_{C1}) participants, respectively.

X refers to the HUG program which will be given to the intervention group.

O_{I2} and O_{C2} refer to scores of work environments and health outcomes at 3 months after the completion of the intervention for the intervention group (O_{I2}) and the control (O_{C2}) participants, respectively.

O_{I3} and O_{C3} refer to scores of work environments and health outcomes at 6 months after the completion of the intervention for the intervention group (O_{I3}) and the control (O_{C3}) participants, respectively.

3.2 Population and Sample

3.2.1 Population and setting

The target population of this study was nursing personnel includes registered nurses (RNs), practical nurses (PNs) and nurse aides (NAs) working at hospital setting. The study was conducted at two tertiary care hospitals; Maharaj Nakorn Chiang Mai hospital (1500-bed hospital) and Lampang hospital (800-bed hospital). To control threat to internal validity, only female nursing personnel who work in orthopedic ward were selected in order to achieve similarity of participants‘ work task characteristics and environments.

3.2.2 Inclusion Criteria

The inclusion criteria used for participants‘ recruitment in this study were: 1) 18 years of age or older, 2) having experience on working at the hospital at least 6 months, 3) full-time working, 4) regular shift work, and 5) willing to participate in the study.

3.2.3 Exclusion Criteria

The samples were excluded from this study if they meet any following criteria: 1) had been diagnosed with any musculoskeletal disorders by a physician, 2) employed less than 50% of normal working time (< 20 hours/week), and 3) pregnant.

3.2.4 Sample Size

The sample size were determined based on a result from previous participatory ergonomics intervention study (Klangsin, 2007), which indicated that 73% of the subjects had a successful outcome on reducing musculoskeletal symptoms. If we observe a 30% (effect size) absolute improvement for those on this study intervention, with a power (1-β) of 0.80 and $\alpha = 0.05$ at two-tailed test, the sample sizes can be calculated as follow (Kasiulevicius *et al*., 2006):

$$n \text{ (size per group)} = \frac{P_1(1- P_1) + P_2(1 - P_2) \times (Z_\alpha+Z_\beta)^2}{(P_1 - P_2)^2}$$

Where $P_1 = 0.73$ and $P_2 = 0.43$, $Z_\alpha = 1.96$ when $\alpha = 0.05$, and $Z_\beta = 0.84$ when $\beta = 0.20$, 80% power.

$$n/\text{group} = \frac{[0.73 (1 - 0.73) + 0.43 (1 - 0.43)] \times (1.96+0.84)^2}{(0.73 - 0.43)^2}$$

$$= 38.5$$

$$\approx 39 \text{ samples/group}$$

A sample size of 78 was needed for test the effects of the HUG program. However, the total of 91 voluntary participants who met inclusion criteria was recruited into this study. Forty-five participants working at Maharaj Nakorn Chiang Mai hospital were assigned into the intervention group and 46 participants working at Lampang hospital were assigned into the control group. One participant from the intervention group dropped-out before completing the study because of working abroad one month, which makes 45 participants at the end of the study. The attrition rate of this study was 1.1%. In conclusion, the sample in this study included 90 nursing personnel (45 participants per group).

3.3 Research Instruments

Data will be collected by self-reported questionnaire which was separated into four parts including participants‘ demographic and working data, work environments, musculoskeletal symptoms, work ability and sick leave (Appendix A).

Part 1: Demographic and working data includes age, height, weight, marital status, educational level, income, exercise, household physical activity, smoking, alcohol consumption, health status, job title, years of employment, working hour, shift work, patient handling tasks/day and received ergonomic training.

Part 2: Work environments were measured by questionnaire which was separated into two parts include physical and psychosocial work environment.

The physical work environment part was developed based on the physical workload index modified by Hollmann *et al*. (1999) and Janowitz *et al*. (2006). A questionnaire with 19 items was presented as pictograms. Five of the items described postures of the trunk: straight, upright (T1) (trunk bent 5 degrees forward), slightly inclined (T2) (trunk bent 45 degrees forward), strongly inclined (T3) (trunk bent 75 degrees forward), twisted (T4), and laterally bent (T5). Three items asked for the following positions of the arms: 2 arms below shoulder height (Al), 1 arm above shoulder height (A2), and 2 arms above shoulder height (A3). Five items asked for positions of the legs: sitting (LS), standing (L2), squatting (L3) (trunk bent 15 degrees forward), kneeling on one or both knees (L4), and walking or moving (L5). Six items described the lifting of weights. Three concerned lifting with the trunk upright (Wul-Wu3) and 3 with the trunk inclined 60 degrees (Wil-Wi3). Each set of 3 items asked for lifting, pushing, pulling or carrying of light weights (<10 kg; Wu2 & Wi2), medium weights (10-20 kg; Wu2 & Wi2) and heavy weights (> 20 kg; Wu3 & Wi3).

Participants were asked to record their physical work environment with an average frequency of occurrence of body positions or the handling of loads during ordinary daily work. The answers will be given on a 5-point rating scale ranging from "never" to "very often". The weighting factors from a biomechanical model were multiplied by the item scores of the corresponding body postures reported in the questionnaire and then added to an index of physical work load. Index of physical work load = 0.974 x score of T2 + 1.104 x score of T3 + 0.068 x score of T4 + 0.173

x score of T5 + 0.157 x score of A2 + 0.314 x score of A3 + 0.405 x score of L3 + 0.152 x score of L4 + 0.152 x score of L5 + 0.549 x score of Wul + 1.098 x score of Wu2 + 1.647 x score of Wu3 + 1.777 x score of Wil + 2.416 x score of Wi2 + 3.056 x score of Wi3. The item scores were coded as follows: "never" = 0, "seldom" = 1, "sometimes" = 2, "often" = 3, "very often" = 4. Total yield score is between 0 (the best physical work environment) and 56.2 (the worst physical work environment). Moreover, the perception on workplace environment (e.g. noise, lighting and temperature) was given on a 5-point rating scale ranging from "never" to "very often". Total yield score of workplace environment is between 0 (the best physical work environment) and 4 (the worst physical work environment).

The questionnaire on psychosocial work environment part was developed based on the Copenhagen Psychosocial Questionnaire (COPSOQ version I and II) modified by Kristensen and Borg (2003) and Aust *et al*. (2007). The 57-item questionnaire, 17 scales, cover three main areas of the psychosocial work environment: 1) demands at work, 2) work organization, and 3) interpersonal relations at work. For the demand at work area, quantitative demands (3 items), work pace (1 item), cognitive demands (4 items), emotional demands (4 items) and demands for hiding emotions (3 items) will be used. The work organization area includes influence at work (4 items), possibilities for development (4 items), meaning of work (3 items) and commitment to the workplace (4 items). Whereas the interpersonal relations at work comprises predictability (2 items), rewards (5 items), role clarity (3 items), role conflicts (4 items), quality of leadership (4 items), social support from supervisor (3 items), social support from colleagues (3 items) and social community at work (3 items).

The scale was built on 1–5 items (questions). All items had 5 response categories. There are two kinds of categories set depending on the direction of each question: 1) always, often, sometimes, seldom, never/hardly ever and 2) to a very large extent, to a large extent, somewhat, to a small extent, to a very small extent. Scales were built by summing up the numerical values attached to the response categories of the items. All scales were transformed to a range from 0 to 100: the weights are 0, 25, 50, 75, and 100, to make the scoring on the different scales comparable. Directions of the scores follow the label of the scale; i.e. a high score on

the emotional demand scale indicates high emotional demands, a high score on the predictability scale indicates high predictability, and so on.

Part 3: Musculoskeletal symptoms were measured by questionnaire which was modified from the Nordic Musculoskeletal Questionnaire (NMQ) (Kourinka *et al*., 1987). A 36-item questionnaire provides the workers to identify areas of the body causing musculoskeletal problems. Completion is aided by a body map to indicate nine symptom sites being neck, shoulders, upper back, elbows, low back, wrist/hands, hips/thighs, knees and ankles/feet. Respondents are asked if they have had any musculoskeletal trouble (such as ache, pain, discomfort and numbness) in the last 12months, 3 months, and 7 days which has prevented normal activity. The prevalence rate of musculoskeletal symptoms could be computed by using the following equation:

$$\text{MSDs rate} = \frac{\text{all new and pre-existing MSD cases during a time period}}{\text{Population during the same time period}} \times 100$$

Part 4: Work ability and sick leave were measure by the work ability index (WAI) which has been developed by the Finnish Institute of Occupational Health (FIOH) (Tuomi *et al*., 1998) which translated in Thai by Orawan Kaewboonchoo and Kriengkrai Prahkarnkaeo. The WAI questionnaire entails seven dimensions, each covered by means of one or more questions: current work ability compared with the best during one‘s lifetime, work ability in relation to the demands of the job, number of diagnosed diseases, subjective estimated work impairment due to diseases, sickness absence or sick leave during past year, own prognosis of work ability two years later and mental resources. The result of the work ability level is being a score of 7-49 (the worst rating is 7 and the best rating is 49). The scoring of the responses is shown in Table 3.2.

Table 3.2 Items covered by the work ability index, the number of questions used to evaluate each item, and the scoring of the responses.

Item	Number of questions	Scoring of the responses
1. current work ability compared with the lifetime best	1	0-10 points (value circled in the questionnaire)
2. work ability in relation to the demands of the job	2	score weighted according to the nature of the work (formula for the calculation appears below Table 3)
3. number of current diseases diagnosed by a physician	1	at least 5 diseases = 1 point, 4 diseases = 2 points, 3 diseases = 3 points, 2 diseases = 4 points, 1 diseases = 5 points, No disease = 7 points
4. estimated work impairment due to diseases	1	1-6 points (value circled in the questionnaire; the worst value should be chosen)
5. sick leave during the past year (12 months)	1	1-5 points (value circled in the questionnaire)
6. own prognosis of work ability two years from now	1	1, 4 or 7 points (value circled in the questionnaire)
7. mental resources (note: item 7 refers to the worker‘s life in general, both at work and during leisure time)	3	the points of the question series are added together and the sum is modified as follows: sum 0-3 = 1 point, sum 4-6 = 2 points, sum 7-9 = 3 points, sum 10-12 = 4 points

In item 2 work ability is assessed in relation to both the physical and mental demands of the job. The response to the question is weighted according to whether the work is primarily physical or mental. The term ―work ability score" refers to the number of the response circled in the questionnaire. The work ability score for the physical demands of the job is multiplied by 1.5 and for the mental demands of the job is multiplied by 0.5.

Due to sick leave is one of the WAI dimensions, the amount of this variable could be counted by this questionnaire. However, the number of sick leave within the

last three months was added in the demographic data form in terms of monitor short term effects of an intervention program.

Validity and reliability of the questionnaire

Validity

The questionnaire was assessed for content validity by a panel of experts who are the specialists in occupational health and safety including two ergonomists, one occupational physician and two nurse professors who specialized in psychosocial work (Appendix B). The contents were adjusted according to their comments and suggestions. The content validity index (CVI) was 0.99.

Reliability

The questionnaire was tested with 15 nursing personnel working in orthopedic ward at Nakornpink Hospital, Chiang Mai province. The internal reliability coefficient of the whole questionnaire (Cronbach‘s alpha) was 0.80.

3.4 Protection of Human Rights

The study was approved by the Research Ethic Committee of Faculty of Medicine, Chiang Mai University, Thailand (No. 285/2016, Appendix C). The participants were informed in the cover letter of human subject protections about the main purpose of the study, right of the subjects, confidentiality, potential risks, and benefits of participation. All of participants signed the consent by wiliness to participate in the study before starting baseline assessment.

3.5 Intervention Protocol

Based on the participatory ergonomic concept, and inspired by Participatory-Action-Oriented Training for Hospital Nurses (PAOTHN) to prevent musculoskeletal disorders in hospital nurses of Lee *et al.* (2009) with extended study by Kim and Lee (2010), the Healthy Unit Guidance (HUG) program was developed. The purpose of

the HUG program intervention is to enhance the involvement of nursing personnel and all stake holders in planning and controlling a significant amount of their own work activities, with sufficient knowledge and power to influence both processes and outcomes, in order to improving their work environments (e.g. physical and psychosocial work environment) and health outcomes (e.g. reduce prevalence of musculoskeletal symptoms, decrease sick leave, and increase work ability).

To develop an intervention based on the participatory approach, the researcher selected a large-size tertiary care hospital located in Chiang Mai province, Thailand. Prior to implement HUG program, the researcher met with the hospital board and committee to obtain their approval and support of the study. Then, meeting with the supervisor and head nurses of orthopedic ward was carried out in order to clarify the scope and details of HUG program intervention.

HUG program comprised a series of workshop included establish management support, participant‘s capacity strengthening, and evaluation work improvement achievements. The length of the intervention program was designed to cover a period of 5 months. The details of each intervention component are presented as follows:

1) The first workshop: Establish management support

The first 7-hour workshop was conducted aims to form and train the facilitators. Ten volunteer nurses from the targeted orthopedic ward were participated as a facilitator team. They were trained by the researcher on the basic principles ergonomics for healthcare setting and participatory action oriented training (PAOT) methodology, the structure of and how to use an action checklist, simple and practical low-cost improvements, and roles of facilitators. After finishing the lectures, they were given time to discuss the development of an action checklist focused on the nursing field as well as educational material for participants. The final HUG action checklist was built. It consisted of 52 items of work improvement ideas following seven nursing tasks that are closely related to musculoskeletal disorders in nursing personnel: 1) patient care and treatment, 2) medical equipment storage and handling, 3) work station design, 4) workplace environment, 5) planning and time management, 6) social support at work, and 7) welfare facilities.

2) The second workshop: Participant‘s capacity strengthening

The 7-hour workshop was conducted based on PAOT approach with the following contents: In the first session, the researcher explains the background of the program, including the pervasive nature of the problem and the urgent need for an effective intervention. In the second session, participants begin assessing and visiting the assigned unit where they practiced activities based on the action checklist. Participants are encouraged to revise the action list, which is tailored to address the problems identified in their work environments. The third session is devoted to presenting improvement principles and showing local good examples of nursing care by the facilitator, followed by group discussion. Participants are instructed to present three good points and three points to be improved based on the results of the action-checklist exercise. The same method is carried out for each of the five areas of concern. The last hour of this workshop was ended with the proposal of short-term (within 1-2 months) and long-term (within 3-6 months) work improvement plan of each unit.

To sustain the developed strategies, researchers visit participants‘ working units in order to monitor progress and encourage the participants to continue to improve their work environment after the participatory work shop. Due to participants usually complete the first set of short-term improvements in one to three months after training, the follow-up visits was carried out during this period.

In summary, in this workshop, it could imply that participants completed four main activities: 1) visit a hospital unit and conduct the checklist exercise, 2) have seven technical sessions that include group discussions, 3) develop improvement proposals for their own units, and 4) implement priority improvements and organize follow-up activities. For fully relies on the self-help of participants in solving problems, therefore, the trained facilitators only help the participants to identify their action points through the action checklist, and support their self-help efforts in improving their own units.

3) The third workshop: Evaluation work improvement achievements

The 3-hour workshop was carried out to follow up and evaluation work improvement achievements. Representative of participants provided an interim presentation of innovative achievements after 3 months of the completion of work improvement, in order to create an atmosphere in which participants share good solutions for improvement and motivate one another by sharing successful results. All stakeholders (e.g. participants, facilitators, and committee and board of the hospital) were invited to attend the achievement workshop presentation. An achievement contest was held as a final presentation after the participant workshop. While all the participating units are commended for their unique efforts to improve their work environments, the three most creative and practical methods that have a significant impact are deemed the winners of the contest.

3.6 Material for the Participatory Action-Oriented Training (PAOT)

The instrument for intervention consisted of material for the participatory action-oriented training (PAOT) on exposure assessment and problem solving workshop and tools for evaluate the intervention processes. The detail of each instrument is described below.

3.6.1 Action Checklist

The action checklist is a practical training tool to assist training participants in finding improvement methods based on their own ideas consisted of a principle, question, answer, and remarks. Local good examples (e.g., photographs) were also inserted to help participants to clearly understand the principles. Additionally, each item contained the question ‗‗Do you propose the action?'', with possible answers of ‗‗No'', ‗‗Yes'', and ‗‗Priority'', where ‗‗No'' means that the participant feels satisfied with the current status or condition; ‗‗Yes'' means that the participant is not satisfied, and needs to make corrections or modifications; and ‗‗Priority'' means that the item has a higher priority than those marked ‗‗Yes'', and hence needs to be improved

immediately. In this study, the HUG action checklist consisted of 52 essential items in the following seven areas of nursing task s that are closely related to musculoskeletal disorders in nursing personnel. The detail of HUG action checklist is shown in Appendix D.

3.6.2 Photographs Showing Before-After Improvement

Photographs play a vital role in showing the workplace improvement. Due to PE intervention focused on multi-facet solutions, work improvements in the same work task might not be similar. Taking photographs before and after improvement will depicts evidence in changing clearly.

3.6.3 Participatory Ergonomics Evaluation Form for Investigator

This form was conducted based on the participatory ergonomics framework (PEF) (Haines *et al*., 2002) for checking the degree of PE initiatives of each unit groups of participant. It has nine different dimensions include permanence of initiative, involvement, level of influence, decision-making, mix of participants, requirement, focus, remit and role of ergonomics specialist.

3.6.4 Comment for Participants and facilitators

These forms were used for participants to evaluate each intervention session and the perceived usefulness and satisfaction of each topic learned and practiced each workshop. These data helped investigator to evaluate participants‘ thoughts and the performance that they received from each session of program intervention.

3.7 Data Collection

Data collection was done after receiving permissions from the administrator of the hospital. The description of data collecting procedures in the intervention and the control group is summarized as follows:

Intervention Group

Each eligible participant from all orthopedic wards (8 units) who is able to participate in the intervention program received a package of documents including an invitation letter, the description of the study, the study consent form, and the researcher‘s address and telephone number. The researcher asked the participants to return the consent form within two weeks after receiving the package. Participants were informed about their rights that they could ask any question related to the study or refuse to participate in the study. Within two weeks after receiving informed consent, the questionnaire was distributed to the participants in order to assess their baseline data. The program intervention was begun after baseline data of all participants has been collected completely. The same questionnaire was used again for follow-up assessment, 3 and 6 months after the program intervention was done.

Control Group

Participant were received a package of documents including an invitation letter, the description of the study, the study consent form, and the researcher‘s address and telephone number. The researcher asked the participants to return the consent form within two weeks after receiving the package. Within two weeks after receiving informed consent, the questionnaire will be distributed to the participants in order to assess their baseline data. The same questionnaire was used again for follow-up assessment, 8 and 11 months after the first enrollment.

3.8 Data Analysis

Demographic characteristics of the study participants were described by mean and standard deviation for continuous variables and by frequency and percentage for categorical variables. T-test for two independent samples or Chi-square test was used to test the difference between intervention and control groups in continuous variables and categorical variables, respectively. Comparison of work environments and health outcomes scores between the two groups were analyzed using t-test, repeated measure analysis of variance as well as Mann-Whiney U test with 95 percent confidence intervals and level of significance was set at $p < 0.05$.

CHAPTER IV
RESULTS AND DISCUSSIONS

This chapter presents the findings of a quasi-experimental control-group pretest and posttest design which aimed to examine the effects of the Healthy Unit Guidance (HUG) program on work environments and health outcomes among nursing personnel. Discussion on effects of HUG program on work environments and health outcomes is presented in this chapter as well. The results of this study are presented in five sections as follow:

Part I Demographic and Work Characteristics of Participants

Part II Work Improvement Achievement

Part III Comparison of work environment scores at baseline, three months and six months after completing intervention

Part IV Comparison of health outcome scores at baseline, three months and six months after completing intervention

Part V Intervention Feedback from Participants and Facilitators

4.1 Demographic and Work Characteristics of Participants

The participants of this study were female nursing personnel including registered nurses (RNs), Practical Nurses (PNs) and Nurse Aides (NAs) who were working in the orthopedic ward of two tertiary care hospitals located in northern Thailand. These two hospitals are included in the study because of their analogous of working environment. A total of 218 nursing personnel were reviewed, only 91 participants met inclusion criteria. Forty-five participants working at Maharaj Nakorn Chiang Mai hospital were assigned into intervention group and 46 participants working at Lampang hospital were assigned into control group. One participant from the intervention group dropped-out before completing the study because of working abroad one month, which makes 45 participants at the end of the study. The attrition rate of this study was 1.1%. Demographic and work characteristics of all participants are presented in Table 4.1 and 4.2.

The age of participants in the intervention group ranged from 20 to 53 years, with a mean of 36.2 years (SD = 8.7). The average height and body mass index of participants were 157.4 cm (SD = 4.8) and 21.8 kg/m^2 (SD = 2.8), respectively. A mean hour of household physical activity among this group was 14.9 hours per week (SD = 13.6). The majority of participants had completed bachelor degree (64.4%). About 51.1% of participants were not married and 55.6% had income less than 20,000 baht per month. It was found that 40.0% of participants did exercise at least three times per week. About one fourth of participants had been drinking alcohol (20.0%). All of them were non-smokers.

Data from the control group showed similar demographic characteristics as the intervention group. The age of participants ranged from 23-55 years, with a mean of 38.2 years (SD = 7.1). The average height and body mass index of participants in this group had comparable with the intervention group. A mean hour of household physical activity per week among participants in the control group was slightly higher than those in the intervention group (16.8 hours/week, SD = 15.3). Most of the participants hold bachelor degree or higher (73.3%) and married (75.6%). More than half of them (55.6%) had income equal or greater than 20,000 baht per month. Approximately 68.9% of the participants did exercise at least three times per week. Only about 17.8% of participants had been drinking alcohol. None of them were smokers.

Comparing demographic characteristics of participants between intervention and control group, it was found that both groups had no statistical difference in most of characteristics except marital status and exercise. The demographic characteristics of participants in both groups are shown in Table 4.1.

Table 4.1 Demographic Characteristics of Participants

Continuous variables	Intervention group (n=45) Mean(SD)	Control group (n=45) Mean(SD)	*p*-value[a]
Age, y	36.2(8.7)	38.2(7.1)	.223
Range	20-53	23-55	
Height, cm	157.4(4.8)	157.8(4.3)	.660
Range	150-167	148-168	
Body Mass Index, kg/m^2	21.8(2.8)	21.9(2.9)	.841
Range	17.3-29.8	16.6-29.9	
Household physical activity, hr/wk	14.9(13.6)	16.8(15.3)	.533
Range	0-59	0-70	
Categorical variables	**Intervention group (n=45) n (%)**	**Control group (n=45) n (%)**	***p*-value[c]**
Education level			
< Bachelor degree	16(35.6)	12(26.7)	.362
≥ Bachelor degree	29(64.4)	33(73.3)	
Marital status			
Single	23(51.1)	9(20.0)	.007[d]
Married	20(44.4)	34(75.6)	
Divorced/Separated	2(4.4)	2(4.4)	
Income, baht/month			
< 20,000	25(55.6)	20(44.4)	.292
≥ 20,000	20(44.4)	25(55.6)	
Exercise			
< 3 times/week	27(60.0)	14(31.1)	.006[d]
≥ 3 times/week	18(40.0)	31(68.9)	
Alcohol drinking			
No	36(80.0)	37(82.2)	.788
Yes	9(20.0)	8(17.8)	
Current smoking			
No	45(100)	45(100)	-
Yes	0(0)	0(0)	
Perceived health status			
Good-Very good	28(62.2)	34(75.6)	.172
Poor-Fair	17(37.8)	11(24.4)	

[a] t- test, [b] Mann-Whitney U test, [c] χ^2-test, [d] Statistical assessing group different < .05

The year of employment among participants in the intervention group ranged from 1 to 27 years, with a mean of 12.2 years (SD =7.2). It was slightly lower when compared to the average year of employment of participants in the control group (13.6 years, SD = 8.0). The mean of working hour per week in the intervention and the control groups were 48.8 (SD = 12.8) and 47.0 (SD = 9.4), respectively. The majority of participants in both groups were registered nurses (55.6% of participants in the intervention group and 71.1% of participants in the control group). It was found that the percentage of participants who performed shift work in the intervention group (91.1%) and control group (80.0%) was high. Most of participants had number of patient handling task per day between 3 to 10 cases (91.2% of participants in both group). Only about 11.1% of participants in the intervention group and 26.7% of participants in the control group were not received ergonomics training. Comparing work characteristics of participants between intervention and control group, it was found that both groups had no statistical difference in all of characteristics. The work characteristics of participants in both groups are presented in Table 4.2.

Table 4.2 Work Characteristics of Participants

Continuous variables	**Intervention group (n=45) Mean(SD)**	**Control group (n=45) Mean(SD)**	***p*-value**[a]
Year of employment, y	12.2(7.2)	13.6(8.0)	.384
Range	1-27	1-33	
Working hour per week	48.8(12.8)	47.0(9.4)	.924[b]
Range	40-96	40-84	
Categorical variables	**Intervention group (n=45) n (%)**	**Control group (n=45) n (%)**	***p*-value**[c]
Job title			
Registered Nurses	25(55.6)	32(71.1)	.126
Other nursing staffs	20(44.4)	13(28.9)	
Performed Shift work			
No	4(8.9)	9(20.0)	.134
Yes	41(91.1)	36(80.0)	
Patient handling tasks per day, case			
0-2	2(4.4)	1(2.2)	.766
3-10	41(91.2)	41(91.2)	
> 10	2(4.4)	3(6.6)	
Received ergonomics training			
No	5(11.1)	12(26.7)	.059
Yes	40(88.9)	33(73.3)	

[a] t- test, [b] Mann-Whitney U test, [c] χ^2-test, [d] Statistical assessing group different < .05

4.2 Work Improvement Achievement

Three months after completing of HUG intervention, a total of 29 work improvement achievements from 8 orthopedic wards were carried out by nursing personnel in the intervention group themselves. These achievements were categorized into seven technical areas of improvement. The highest changes were shown on patient care and treatment (8 tasks, 27.6%) follows by workstation design (7 tasks, 24.1%) and storage and handling of medicines, medical devices and equipments (6 tasks, 20.7%). Examples of work improvement achievement in each technical area are presented in Table 4.3.

Table 4.3 Work improvements achievement undertaken by nursing personnel

Technical area	work improvements	
	n	**%**
Patient care and treatment	8	27.6
- Apply lifting team to move and transfer a patient to or from the bed		
- Introduce guideline for safety lifting to all staff members		
- Use the rubber draw sheet as an assistant device for repositioning patient in the bed		
- Organize sufficient space for work in properly position		
Medical equipment storage and handling	6	20.7
- Use a step to address height difficulties		
- Clean the rolling wheels of the medical equipment		
Work station design	7	24.1
- Clear transport ways		
- Use a soft-pad wrist support while using mouse for computer work		
- Install multi-storage shelves to categorize medicines		
- Reorganize the stuffs for easy access		
Workplace environment	1	3.4
- Provide artificial lighting adequate for the type of nursing activities		
Planning and time management	1	3.4
- Organize short-informal letter for urgent situation		
Social support at work	2	6.9
- Promote the healthier climate where nursing staff can encourage each other		
Welfare facilities	4	13.9
- Reorganize and redecorate resting room		
- Assign a staff to be in charge of safety and health in the unit		
Total	**29**	**100**

Examples of workplace improvement achievement photo are illustrated in Appendix E.

4.3 Comparison of work environment scores at baseline, three months and six months after completing intervention

The work environment score in this study will be split into two parts: physical work environment and psychosocial work environment. Due to physical work environment was defined as risk factors associated with musculoskeletal disorders, the lower score indicated the better physical work environment. Considering psychosocial work environment score, there are composed of both risk factors and positive factors associated with musculoskeletal disorders. Therefore, directions of the scores follow the label of the scale. Comparison of work environment scores at baseline, three months and six months after completing intervention in the intervention and control groups are presented as follows.

Physical work environment

Effect of the HUG program on physical work environment was measured by Hollmann‘s physical load index. With regards to each point of evaluation, it was found that physical work environment score of the intervention group was higher than the control group at baseline. However, the physical work environment score of the intervention group decreased from baseline to month-3 and slightly increased at month-6. It is obvious that the physical work environment score of the intervention group appeared to be lower than the control group at month-3 and month-6 (Figure 4.1).

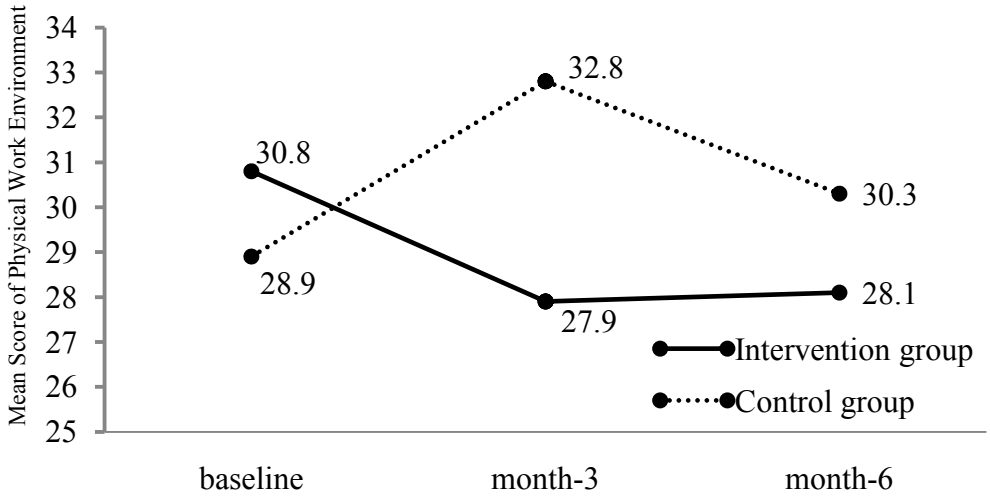

Figure 4.1 Changes in physical work environment of intervention and control group at baseline, month-3 and month-6

As physical work environment scores of control and intervention groups were normally distributed, independent-samples t-test was used to test for mean difference over time. After exploring the effect of HUG program intervention on physical work environment score, it was found that mean score of physical work environment among the intervention group reduced significantly compared with the control group at month-3 (p = .002), but not reduced significantly at month-6 (p = .138) as shown in Table 4.4.

Table 4.4 Comparison the mean score of physical work environment by group

PWE	Mean(SD)		t	df	*p*-value
	Control group (n=45)	Intervention group (n=45)			
Baseline	28.9(9.8)	30.8(9.8)	0.924	88	.358
Month-3	32.8(8.1)	27.9(8.4)	-2.859	88	.002*
Month-6	30.3(9.9)	28.1(9.3)	-1.097	88	.138

PWE = Physical Work Environment

*p-value < .01

Additionally, mean score of perception on workplace environment (e.g. lighting, noise, temperature, and odor) was assessed by a separated questionnaire. The workplace environment score of the intervention group had not changed from baseline to month-3 but slightly declined from month-3 to month-6. Consider the control group, score of workplace environment showed no difference over time (Figure 4.2). T-test for independent samples was used to test for mean difference of workplace environment score between the intervention and the control group. It was found that there was no significant difference between the two groups in workplace environment at baseline, month-3 and month-6 as presented in Table 4.5.

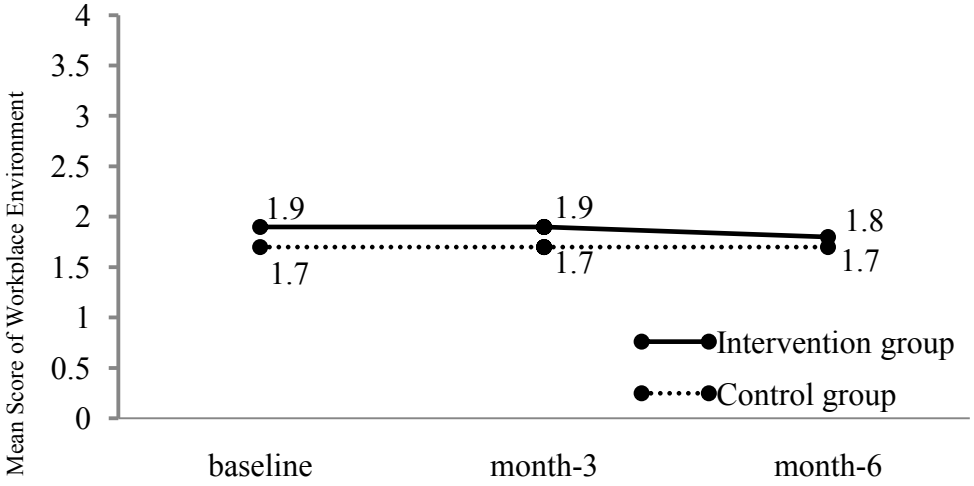

Figure 4.2 Changes in workplace environment of intervention and control group at baseline, month-3 and month-6

Table 4.5 Comparison the mean score of perception on workplace environment by group

Workplace Environment	Mean(SD) Control group (n=45)	Mean(SD) Intervention group (n=45)	t	df	p-value
Baseline	1.7(0.7)	1.9(0.6)	1.636	88	.105
Month-3	1.7(0.7)	1.9(0.7)	1.664	88	.100
Month-6	1.7(0.7)	1.8(0.3)	0.881	88	.190

Psychosocial work environment

Regarding psychosocial work environment score resulting from HUG program intervention, it was measured by questionnaire which was developed based on the Copenhagen Psychosocial Questionnaire (COPSOQ). The questionnaire cover three main scales of psychosocial work environment including demand of work, work organization and interpersonal relations at work. The details of all finding are shown in Table 4.6 and 4.7.

Compared to the control group, the intervention group had significantly higher scores only on two of the seven interpersonal relations at work scales, predictability ($p = .039$) and rewards ($p = .017$), at baseline measurement. After three months of the completing HUG program intervention, mean scores of psychosocial work environment among the intervention group were changed dramatically in all three main scales. Mean scores on four of the five demand at work scales included qualitative demands (-2.1), work pace (-1.6), cognitive demands (-1.3), and emotional demand (-1.5) were reduced among the intervention group. However, all scores had no significantly difference when compared with the control group. Mean scores on three of the four work organization scales included influence at work (+3.8), possibilities for development (+0.6), and meaning of work (+0.4) were increased in the intervention group. Of these factors, only influence of work score had significantly increased when compared with the control group ($p = .006$). Mean scores on four of seven positive factors of interpersonal relations at work scales included rewards (+0.6), social support from supervisor (+0.7), social support from colleagues (+3.5), and social community at work (+2.6) were increased among the intervention group. Among these factors, only social support from supervisor score had significantly increased when compared with the control group ($p = .018$). Mean score of a negative factor of interpersonal relations at work scales (i.e. role conflicts) was slightly reduced (-0.3), but had no significantly different compared with the control group. All mean scores of psychosocial work environment between the intervention and the control groups at baseline and month-3 are presented in Table 4.6.

Table 4.6 Comparison the mean score of psychosocial work environment between the intervention and the control groups at baseline and month-3

Psychosocial work environment	At baseline		*p*-value[a]	Month-3		*p*-value[a]
	Control group Mean(SD)	Intervention group Mean(SD)		Control group Mean(SD)	Intervention group Mean(SD)	
Demand at work						
Quantitative demands	39.1(17.4)	40.6(15.8)	.673	32.6(16.6)	38.5(15.7)	.042
Work pace	68.3(18.8)	62.7(18.3)	.878[b]	63.3(20.4)	61.1(24.7)	.451[b]
Cognitive demands	59.4(11.8)	60.3(16.5)	.784	58.2(15.2)	59.0(16.5)	.402
Emotional demands	52.6(15.1)	52.9(16.6)	.934	54.3(14.6)	53.6(19.3)	.424
Demands for hiding emotions	58.1(18.0)	57.0(17.7)	.683[b]	56.5(17.8)	55.5(20.0)	.408
Work organization						
Influence at work	33.2(9.3)	39.4(16.1)	.099	35.2(15.1)	43.2(14.8)	.006[b,d]
Possibilities for development	64.2(12.2)	62.9(12.2)	.629	63.2(12.8)	63.5(13.7)	.457[b]
Meaning of work	77.4(14.8)	75.9(17.9)	.670	79.8(14.7)	76.3(15.6)	.137
Commitment to the workplace	59.3(14.3)	58.8(14.7)	.856	58.2(15.9)	58.1(13.4)	.482
Interpersonal relations at work						
Predictability	60.3(14.4)	65.6(12.6)	.039[b]	59.2(12.8)	60.8(14.3)	.441[c]
Rewards	50.3(11.4)	56.1(11.2)	.017	51.2(10.9)	56.7(14.2)	.159[c]
Role clarity	70.0(15.0)	71.7(14.4)	.592	69.4(14.0)	70.0(11.9)	.422[b]
Role conflicts	41.3(14.1)	42.4(14.1)	.710	39.0(14.8)	42.1(13.7)	.156
Quality of leadership	58.1(16.3)	62.1(15.3)	.348[b]	55.7(16.3)	61.8(18.3)	.017[b]
Social support from supervisor	59.4(17.1)	65.0(15.1)	.080	59.4(18.7)	65.7(17.6)	.018[d]
Social support from colleagues	60.7(15.1)	65.9(12.5)	.057[b]	63.7(13.5)	69.4(12.2)	.182
Social community at work	79.6(11.0)	79.6(14.3)	.903[b]	79.6(13.0)	82.2(14.0)	.211[b]

[a] t-test, [b] Mann-Whitney U test, [c] ANCOVA (adjust for baseline data), [d] p-value < .05

In summary, after three months of completing the intervention, HUG program had effect on increasing scores of promotion factor of psychosocial work environment included influence of work and social support from supervisor (all p-values < .05)

Considering the effect of HUG program on psychosocial work environment at month-6, comparison the mean score of all scales among the intervention and the control groups are presented in Table 4.7. Mean scores on three of the five demand at work scales were reduced among the intervention group; qualitative demands (-1.3), work pace (-1.6), and emotional demand (-0.9). However, all scores had no significantly difference when compared with the control group. Mean scores on all work organization scales were increased in the intervention group, with ranged between +0.8 to +4.5. However, only influence of work score had significantly increased when compared with the control group (p = .003). Mean scores on five of seven positive factors of interpersonal relations at work scales included rewards (+0.1), quality of leadership (+1.1), social support from supervisor (+0.5), social support from colleagues (+3.0), and social community at work (+2.4) were increased among the intervention group. Among these factors, only social support from supervisor score had significantly increased when compared with the control group (p = .010). Mean score of a negative factor of interpersonal relations at work scales (i.e. role conflicts) was slightly reduced (-0.6), but had no significantly different compared with the control group.

In conclusion, after six months of completing the intervention, HUG program still had effect on increasing scores of promotion factor of psychosocial work environment included influence of work and social support from supervisor (all p-values < .05)

Table 4.7 Comparison the mean score of psychosocial work environment between the intervention and the control groups at baseline and month-6

Psychosocial work environment	At baseline		*p*-value[a]	Month-6		*p*-value[a]
	Control group Mean(SD)	Intervention group Mean(SD)		Control group Mean(SD)	Intervention group Mean(SD)	
Demand at work						
Quantitative demands	39.1(17.4)	40.6(15.8)	.673	38.3(13.4)	39.3(11.6)	.335[b]
Work pace	68.3(18.8)	62.7(18.3)	.878[b]	63.3(20.3)	61.1(24.7)	.451[b]
Cognitive demands	59.4(11.8)	60.3(16.5)	.784	61.4(14.8)	60.4(12.3)	.367
Emotional demands	52.6(15.1)	52.9(16.6)	.934	52.6(13.2)	53.2(16.6)	.430
Demands for hiding emotions	58.1(18.0)	57.0(17.7)	.683[b]	56.5(13.5)	56.1(17.9)	.456
Work organization						
Influence at work	33.2(9.3)	39.4(16.1)	.099	35.6(11.5)	43.9(16.5)	.003[d]
Possibilities for development	64.2(12.2)	62.9(12.2)	.629	69.2(11.9)	66.5(14.9)	.177
Meaning of work	77.4(14.8)	75.9(17.9)	.670	78.7(8.6)	78.7(15.4)	.307[b]
Commitment to the workplace	59.3(14.3)	58.8(14.7)	.856	61.0(11.4)	59.6(13.8)	.302
Interpersonal relations at work						
Predictability	60.3(14.4)	65.6(12.6)	.039[b]	62.5(13.8)	61.4(14.1)	.307[c]
Rewards	50.3(11.4)	56.1(11.2)	.017	53.3(13.4)	56.2(13.1)	.152[c]
Role clarity	70.0(15.0)	71.7(14.4)	.592	72.6(17.2)	71.7(16.7)	.398
Role conflicts	41.3(14.1)	42.4(14.1)	.710	39.6(14.6)	41.8(13.8)	.200[b]
Quality of leadership	58.1(16.3)	62.1(15.3)	.348[b]	57.9(11.0)	63.2(13.9)	.071[b]
Social support from supervisor	59.4(17.1)	65.0(15.1)	.080	58.7(11.4)	65.5(15.6)	.010[d]
Social support from colleagues	60.7(15.1)	65.9(12.5)	.057[b]	64.4(10.4)	68.9(11.4)	.089[b]
Social community at work	79.6(11.0)	79.6(14.3)	.903[b]	81.5(10.8)	82.0(11.9)	.422[b]

[a] t-test, [b] Mann-Whitney U test, [c] ANCOVA (adjust for baseline data), [d] p-value < .05

4.4 Comparison of health outcome scores at baseline, three months and six months after completing intervention

In this study, findings of health outcomes include musculoskeletal symptoms, sick leave and work ability of nursing personnel are presented separately.

Musculoskeletal symptoms

The 12-month prevalence rate of musculoskeletal symptoms in the intervention and the control group was 82.2% and 75.6%, respectively. Shoulder was the most common MSD, affecting 62.2% of nursing personnel in the intervention group. This was followed by MSD of neck (48.9%), lower back (46.7%), and wrists/hands (42.2%). Contrast with rate of MSD among the control group, the most common MSD occurred at lower back (46.7%), followed by upper back (42.2%), and knees (37.8%). The details of MSD in each part of body among two groups are shown in Figure 4.3.

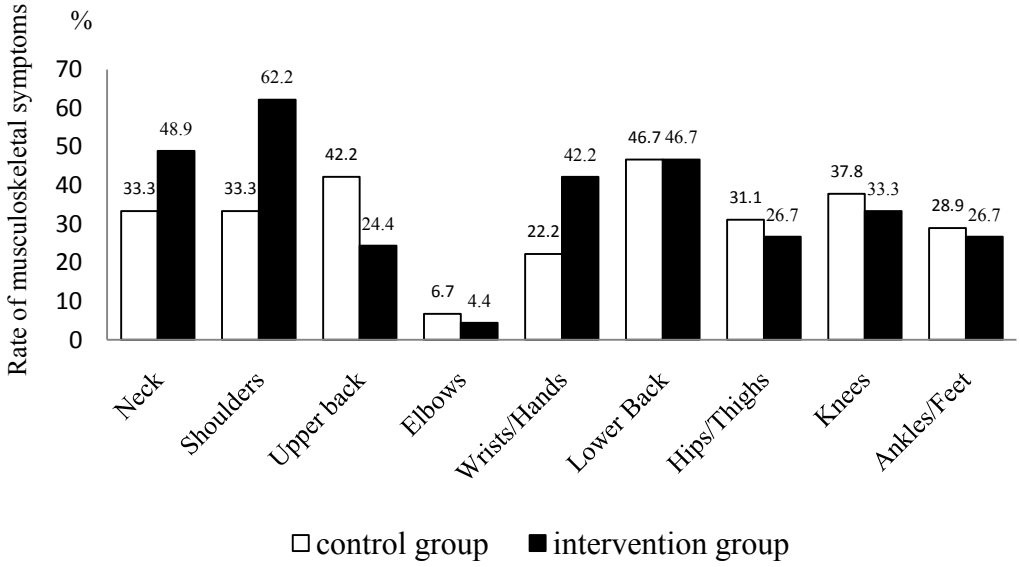

Figure 4.3 Rate of musculoskeletal symptoms in the past 12 months among the intervention and the control group

The 3-month prevalence rate of musculoskeletal symptoms at baseline measurement of the intervention and the control group was 40.0% equally. At month-3 post intervention, it was reported higher than at pre-intervention among both groups (57.8% for the intervention group, 60.0% for the control group). Regards finding at month-6 post intervention, although the MSD rate among the intervention group was higher than those at baseline assessment, it was slightly deceased compared with month-3 post intervention. Nevertheless, there were no changes of MSD rate during month-3 and month-6 post intervention among the control group (Figure 4.4).

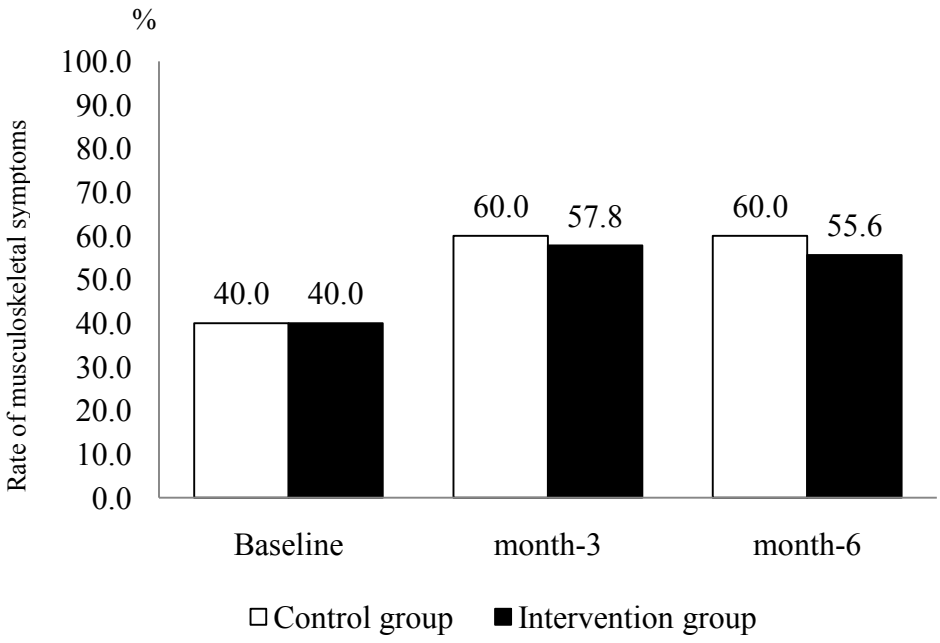

Figure 4.4 Rate of musculoskeletal symptoms in the last 3 months between intervention and control group at baseline, month-3 and month-6

Considering the7-day prevalence rate of musculoskeletal symptoms, the intervention group reported the MSD rate less than the control group at baseline measurement. Additionally, more MSD rate among the intervention group has been reported at month-3 and month-6 after the intervention was done. Contrast with the control group, it was found that the rate of MSD was dropped at month-3 and increased at month-6 (Figure 4.5).

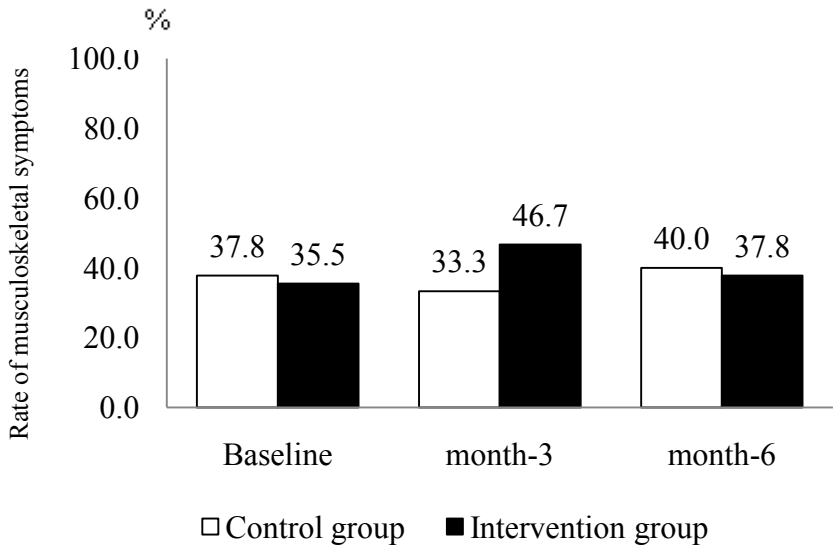

Figure 4.5 Rate of musculoskeletal symptoms in the last 7 days between intervention and control group at baseline, month-3 and month-6

sick leave

There are no day of sick leave reported by the intervention group at before and after intervention. However, we found that 2.2 percent of the control group had 2-day sick leave due to musculoskeletal problems during month-3 and month-6 measurement as shown in Table 4.8.

Table 4.8 Comparison day of sick leave related to MSDs among the control and the intervention group

	Control group (n=45)		**Intervention group (n=45)**	
sick leave	**n**	**%**	**n**	**%**
baseline	0	-	0	-
month-3	1	2.2	0	-
month-6	1	2.2	0	-

Work ability

Figure 4.6 show the mean score of work ability of the intervention and control group at baseline assessment, was 40.3 and 42.1, respectively. Mean score of work ability among the intervention group appears slightly increased at month-3 (+0.8) and month-6 (+0.7) as disparity as those of the control group which appears the same at month-3 and slightly increased (+0.1) at month-6 after completing the intervention.

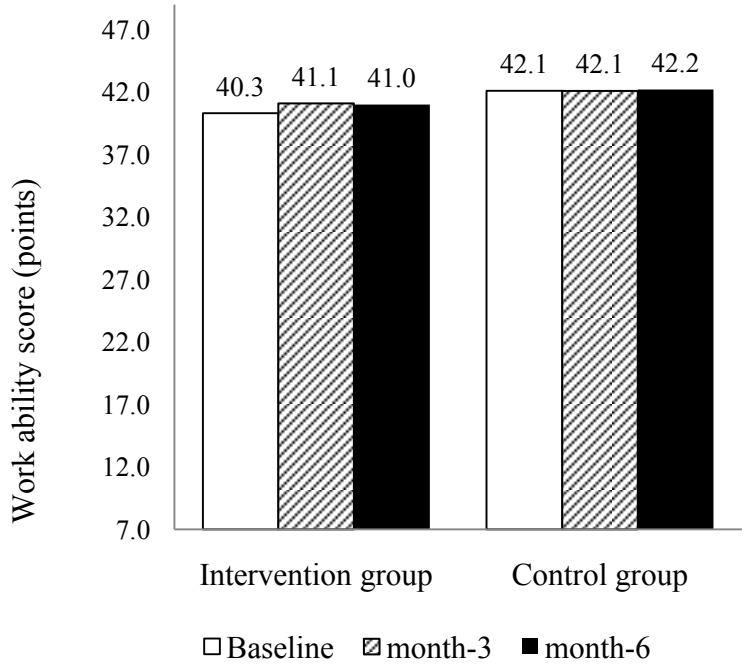

Fig 4.6 Mean score of work ability of the intervention and control group

Repeated measures analysis of variance was used to compare mean scores of work ability between the two groups. A statistically significant difference between the two groups was not found ($F = 0.56$, $p = .571$) as shown in Table 4.9.

Table 4.9 Baseline and posttest mean and standard deviation for work ability

Work Ability	Time of evaluation						Time effect		Group x Time effect		Group effect	
	Time 1		Time 2		Time 3							
	Mean	SD	Mean	SD	Mean	SD	F	p	F	p	F	p
Intervention group (n=45)	40.3	4.3	41.1	3.8	41.0	3.7	1.56	.222				
Control. group (n=45)	42.1	3.5	42.1	3.5	42.2	2.7	0.13	.883	1.02	.366	0.56	.571

Time 1 = baseline measurement, Time 2 = 3 months after intervention was done, Time 3 = 6 months after intervention was done

4.5 Intervention Feedback from Participants and Facilitators

The responses of participants and facilitators on the HUG program intervention were carried out from the questionnaire with open-ended questions at the end of the intervention. The main purpose was to assess the feelings or ideas of nursing personnel towards the intervention. The findings indicated that the participants felt the good points and points to be improved of HUG program intervention as follows:

4.5.1 Process evaluation of PAOT method

1) Good points of the participant training

Most of the participants expressed that they can gain more knowledge from the training. The reflections of good feeling are appeared in their comments at the end of the training. Examples of expressed feeling are shown as follow:

"It makes me realize the easy ways to create our workplace safely and how to work with team member. (I.D.2)

"I feel happy in getting new variety ideas on work improvement." (I.D.4)

"It makes me have a good attitude towards work." (I.D.6)

"This training provides me an opportunity to participate and comment as I need. I feel good in having people who pay attention on what I think and what I want to say for a long time." (I.D.12)

"I love the exchange experience session, it makes me get more ideas for work improvement." (I.D. 16)

"The training makes me have much motivation to work." (I.D. 25)

"I feel good and cheerful on improving our unit with my colleagues" (I.D.37)

"Have fun." (I.D.41)

2) Points to be improved of the participant training

Most of the participants suggested that this training should be provided for all nursing staffs. They also need more time to participate in group work. A few of participants complained about the workshop venue and coffee break.

4.5.2 Process evaluation of HUG program

Process evaluation of HUG program was measured by the participatory ergonomics framework (PEF), to clarify dimensions of organizational context which may influences the achievement of the program. Follow-up visit, at 6 months after PAOT training was done, found that most of orthopedic unit (seven of the eight units still continuing improve their working conditions and working environment. The direct involvement by all nursing staffs was seen in 5 units. The level of influence on which participatory ergonomics takes place is seen in entire organization. Most of decision-making preferred for group consultation. The major range of people who participated in the program was staffs to head nurse. Only one unit claimed that participate in the program is compulsory. Work improvement mostly focused on designing equipment or tasks, followed by designing jobs, teams of work organization. The broad activities that participants involved were solution implementation, solution planning and problem identification. All facilitators act as the team member. It was found that seven of the eight facilitators act as initiates and guides the process. The process evaluation of HUG program by facilitators is shown in Table 4.10.

Table 4.10 Process evaluation of HUG program by facilitators (n=8)

Dimension	n	%
Permanence		
Ongoing	7	87.5
Temporary	1	12.5
Involvement		
Full direct	5	62.5
Partial direct	2	25.0
Representative	1	12.5
Level of influence		
Entire organization	8	100.0
Department/work group	0	0
Decision-making		
Group delegation	0	0
Group consultation	5	62.5
Individual consultation	3	37.5
Mix of participants		
Staffs	1	12.5
Staffs - Head nurse	6	75.0
Staffs - Head nurse - Supervisor	1	12.5
Requirement		
Compulsory	1	12.5
Voluntary	7	87.5
Focus		
Designing equipment or tasks	6	75.0
Designing jobs, teams of work organization	5	62.5
Formulating policies or strategies	2	25.0
Remit		
Problem identification	5	62.5
Solution planning	6	75.0
Solution implementation	8	100.0
Solution evaluation	2	25.0
Role of facilitator		
Initiates and guides process	7	87.5
Acts as a team member	8	100.0
Train participants	0	0
Available for consultation	5	62.5

4.6 Discussion

In the present study, the authors investigated the effects of the Healthy Unit Guidance (HUG) program, a tailored participatory ergonomic intervention, for nursing personnel in enhancing their work environments and health outcomes. The effects of HUG program on all outcome variables are discussed as follow:

4.6.1 Effect of HUG program on work environments

This study aims to replicate existing findings about the effect of participatory ergonomics intervention on work environments The findings indicates that nursing personnel who had received the HUG program more improving work environments than nursing personnel who had not. It was showed by reduced score of risk factors for physical work environment and increased score of promotion factors of psychosocial work environment (e.g. influence at work and social support from supervisor) significantly after implementation of the intervention. Other research has indicated that using participatory approach can increase perception on work environments (Fredrikson *et al*., 2001). A few studies indicated that workers who engaged with the participatory approach program were perceived to decrease physical load (Pehkonen *et al*., 2009) and increase psychosocial work environment in terms of social support from supervisor and colleagues (Ikeda, 2009).

A possible explanation may be that the relationship between the HUG program intervention and its effect on work environment is direct; the relationship between practical training in improving working conditions and safe work methods. Prior review studies (Hignett, 2003; Driessen *et al*., 2008) documented that the most successful strategies of participatory ergonomic intervention involved changes in work organization, working practices and the design of working environment. Similar to the improvement achievements of this study, they are mostly focused on changing of work environments by designing equipment or tasks, therefore, their perception on work environments had been improved at post-intervention.

Additionally, increasing of promotion factors of psychosocial work environment might be occurred because of the participatory training method. Performing work improvement by their own initiative ideas may be makes worker have much perception on influence at work. Moreover, some work improvement activity such as promote the healthier climate where nursing staff can encourage each other may be effective in many ways (e.g. increased familiarity between colleagues and supervisor, improved human relations) and can also raise social support at work.

4.6.2 Effect of HUG program on health outcomes

The second aim of the study was to investigate the effects of the HUG program on health outcomes. It was anticipated that an effective PE program would reduce the rate of musculoskeletal symptoms and sick leave, and increase score of work ability among nursing staffs.

Musculoskeletal Symptoms

Ideally, since the ultimate goal of HUG intervention is to prevent musculoskeletal disorders, complaint rates would be used as the outcome variable in an evaluation of intervention. The expected outcome would be found that the rate of musculoskeletal symptoms decreased after implemented the intervention. Nevertheless, it was found that the report on musculoskeletal symptoms among the intervention group at month-3 and month-6 after intervention is not decreased. A feasible explanation may be involved with time of measurement.

A study reviews of Bos *et al.* (2006) states that the possible to measure a decrease in musculoskeletal symptoms after one year or earlier of ergonomic intervention is questionable. The results of this study indicate that after six months or earlier of completing the intervention, a decrease in musculoskeletal symptoms has not been found. This finding is in line with previous studies, which indicated that although the PE intervention is an effective method to reduce musculoskeletal symptoms, the prevalence rate of musculoskeletal pain reduced dramatically after one year of implementation. (Carrivick *et al.*, 2002; Hignett *et al.*, 2005; Udo *et al.*, 2006).

Consistent with a prior review of Coel *et al*. (2005) found partial evidence that PE interventions had a small, positive impact on musculoskeletal symptoms, particularly in short term evaluation. Thus, in this study, six months or earlier after implementing HUG program is not suitable time to see changes on musculoskeletal symptoms obviously.

The rising of MSD at 3 months after completing the intervention reported by nursing personnel in both intervention and control group was very interesting. Prior study indicated that the familiar with the definition of MSDs may increase worker pay more attention to report (Siddharthan, 2006). Furthermore, it might be occurred from the different seasoning workload from time to time in the hospital. Unfortunately, the researcher did not record the daily number of patients handling tasks, a probably risk factor of MSDs, of both intervention and control group during the follow-up period. Hence, this factor should be considered in the further study.

Sick leave

Lund *et al*. (2006) indicated that the physical work environment in terms of uncomfortable working positions, lifting or carrying loads, and pushing or pulling loads increased the risk of onset of long term sickness absence among female and male employees in Denmark. For female employees, the negative effects of poor physical work conditions were further increased if the psychosocial work conditions were also poor. In this study, thus, day of sick leave among the intervention group did not increase may be due to the reducing of physical work environment risk factors and increasing of positive factors of psychosocial work environment, but not enough to see evidently changes within 6 months. Moreover, the relationship between an intervention and sickness absence is much more complicated. Many individual and organizational factors influence the decision of the employee to report sick leave (Bos *et al*., 2006).

Work ability

Considering work ability, the present result indicated that mean score of work ability among nursing personnel in the intervention group appears slightly increased after HUG program implementation. Consistent with a study of Pohjonen *et al.* (1998) described an investigation into the effects and feasibility of a 12 month ergonomic intervention on work content and load in home care work and found that the ergonomic measures improved both physical and mental work content and working conditions, and prevented the decline of work ability in the intervention group. According to previous researches, some chronic diseases decrease work ability especially musculoskeletal disorders as much as poor work environment in terms of high physical and psychosocial demands of work (Pohjonen, 2001; Gould *et al*., 2008). The more numbers of work environment improved, the higher work ability score should be increased. Therefore, it could explain the increased score of work ability among nursing personnel in the intervention group after implementation of the HUG program, even if it was not different significantly compared with the control group.

CHAPTER 5
CONCLUSION AND RECOMMENDATIONS

This chapter is organized into four sections: findings and conclusion, implication of finding, limitations, and recommendations for further research.

5.1 Findings and Conclusion

This quasi-experimental, pre-test and post-test control group design was conducted to examine the effects of the Healthy Unit Guidance (HUG) program, a participatory ergonomic intervention, on work environments and health outcomes among nursing personnel. The participant consisted of 90 female nursing staffs working in orthopedic ward of two tertiary care hospitals located in northern Thailand. Participants from selected hospital were allocated in the intervention group (n = 45) and received the HUG program. Whereas participants from another hospital were allocated in the control group (n = 45) and received usual practice. The work environments and health outcomes (e.g. musculoskeletal symptoms, sick leave, and work ability) were measured by self-reported questionnaire at baseline, three and six months after the completion of the intervention. Data collection was conducted from May 2010 to April 2011.

Findings of the study are summarized as follows:

1) Physical work environment in terms of physical demand at work among the intervention group reduced significantly compared with the control group at month-3 after the HUG intervention was done ($p = .002$), but not reduced significantly at month-6 ($p = .138$).

2) Workplace environment (e.g. lighting, noise, temperature, and odor) among the intervention group had not changed from baseline to month-3 but slightly declined from month-3 to month-6, while it showed no difference over time among the control group.

3) After three months of completing the intervention, HUG program had effect on increasing promotion factors of psychosocial work environment. It was found that

only influence of work and social support from supervisor had significantly increased when compared with the control group (p-value = .003 and .01, respectively).

4) After six months of completing the intervention, HUG program still had effect on increasing promotion factors of psychosocial work environment included influence of work and social support from supervisor (all p-values < .05)

5) The 7-day and 3-month prevalence rate of musculoskeletal symptoms among the intervention and the control groups was not reduced compared at pre-intervention measurement.

7) There was no day of sick leave reported by the intervention group at before and after intervention. It was found that 2.2 percent of the control group had 2-day sick leave due to musculoskeletal problems during month-3 and month-6 measurement.

8) Work ability among the intervention group appears slightly increased at month-3 and month-6 as disparity as those of the control group which appears the same at month-3 and slightly increased at month-6 after completing the intervention. A statistically significant difference between the two groups was not found ($F = 0.56$, $p = .571$)

In summary, HUG program, the designed participatory ergonomic intervention demonstrated the positive outcome on work environments, particularly in reducing physical work environment risk factors for musculoskeletal disorders and increasing promotion factors of psychosocial work environment. However, its effect on health outcomes should have been investigated in a long-term period after intervention.

5.2 Implication of findings

1) The study provides a strategy towards participatory ergonomics approach to improve work environments and health outcomes among nursing personnel. This may be benefit for occupational health professional who is seeking for the practical effective intervention on improving workplace environment and preventing musculoskeletal disorder in hospital setting.

2) In terms of nursing education, a new effective program can be integrated into the curriculum and learning activities. This would improve competency in

general nurses to manage their work environments in healthcare setting, as well as prevent work-related musculoskeletal disorders caused by workplace ergonomic hazards

5.3 Limitation of the study

This study has some limitations due to using only self-reported questionnaire as the measurable tool which might affected on the results in term of recall bias of participants. Therefore, observation technique for work environments and systemically record of health outcomes should be used for further study. All of the participants are female nursing personnel working at the large size hospital, thus, results of this study cannot be generalized to a broad workforce. Although sample size is appropriated for this study design, studies with large samples would be conducted in the future to confirm more precise findings. Moreover, without randomization, it may be argued in the bias in allocation of participants.

5.4 Recommendations for further research

1) This study provided a new participatory ergonomic intervention program. Replication of this study with a larger sample size, employing a randomized control trial, and comparison between multiple settings should be conducted in the future.

2) Due to work environments has both objective and subjective aspects, it should be evaluated not only from an objective aspect (e.g. using questionnaire), but also form a subjective aspect (e.g. observation, direct reading measurement, and air sampling).

3) A one year follow-up study should be done to identify long term effectiveness of HUG program on health outcomes.

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APPENDICES

APPENDIX A

Healthy Unit Guidance Questionnaire

No……

In order to participate in this study, you are required to complete the questionnaire which is separated into 4 parts. Please follow the instructions of each part.

Part 1 Demographic and Work Data

Instructions: Please fill in the blank or check √ in the box.

1. What is your age?…….years
2. What is the highest education that you completed successfully?
   ☐ High school
   ☐ Diploma
   ☐ Bachelor
   ☐ Master
   ☐ PhD
3. What is your marital status?
   ☐ Single
   ☐ Married
   ☐ Separated / Divorced / Widow
4. How tall are you? about.....cm
5. What is your weight? about……...kg
6. What is your professional?
   ☐ Registered Nurse
   ☐ Licensed Practical Nurse
   ☐ Nurse Aide
7. How long have you been working in this hospital?.....years
8. How many hours do you work normally per week (including regular overtime)?.....hours/week
9. How many days per week do you work normally?.....days/week

10. Are you working in shift?
    - ☐ No
    - ☐ Yes
11. How about your salary per month?...…….baht/month
12. How many case of patient handling tasks per day
    - ☐ 0 - 2
    - ☐ 3 - 10
    - ☐ > 10
13. Does your workplace provide sufficient mechanical lift or transfer device?
    - ☐ No
    - ☐ Yes
14. Have you been received any training on biomechanical or ergonomics issue?
    - ☐ No
    - ☐ Yes
15. How is your health status in general?
    - ☐ Good
    - ☐ Reasonably good
    - ☐ Not too bad
    - ☐ Poor
16. How often do you exercise?
    - ☐ ≥ 3 times/week
    - ☐ < 3 times/week
17. How often do you do household physical activities per week?.....hours.
18. How often do you drink alcohol?
    - ☐ Never
    - ☐ Once per month or less often
    - ☐ 2–4 times per month
    - ☐ 2–3 times per week
    - ☐ 4 times per week or more often
19. Do you smoke or did smoke in the past?
    - ☐ Yes, I'm smoking nowadays
    - ☐ Yes, I did smoke in the past
    - ☐ No, I never smoked

20. Have you had any accident the last six months?

☐ No

☐ Yes (specify.....)

21. Have you had any musculoskeletal disease diagnosed by a physician?

☐ No

☐ Yes (specify.....)

22. Have you been surgeries on musculoskeletal system the last three months?

☐ No

☐ Yes (specify.....)

23. Have you been absent from work because of musculoskeletal symptoms the last three months?

☐ No

☐ Yes (specify.....days)

24. Are the demands of your work primarily?

☐ Mental

☐ Physical

☐ Both metal and physical

Part 2 Work Environments

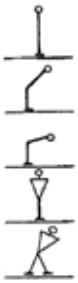
1. Physical work environment

Directions: The following statements concern your perception about your workplace environment. Please indicate the strength of your agreement by putting a √ in each statement box.

No	Item	Very often	Often	Sometimes	Seldom	Never
1	The noise level in my work environment often makes it difficult to work					
2	The light level in my work environment often makes it difficult to work					
3	The temperature in my work environment is not acceptable.					
4	There is strong odor in my work.					

Directions: Please estimate, how often you have to work in the body posture displayed below, and how often you have to lift, push, pull or carry the weights indicated by putting a √ in each statement box:

Trunk



straight, upright
slightly inclined
strongly inclined
twisted
laterally bent

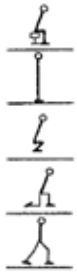
never	seldom	sometimes	often	very often

Arms

both arms below shoulder height
one arm above shoulder height
both arms above shoulder height

never	seldom	sometimes	often	very often

Legs



sitting
standing
squatting
kneeling with one knee or with both
walking, moving

never	seldom	sometimes	often	very often

Weight, lifted / carried with upright trunk

light (up to 10 kg)
medium (10 - 20 kg)
heavy (more than 20 kg)

never	seldom	sometimes	often	very often

Weight, lifted / carried with inclined trunk

light (up to 10 kg)
medium (10 - 20 kg)
heavy (more than 20 kg)

never	seldom	sometimes	often	very often

2. Psychosocial work environment

Directions: The following statements concern your perception about your work environment. There is no "right" or "wrong" answers. Your task is to indicate the strength of your agreement by putting a √ in each statement box. Take your time and consider each statement carefully.

No.	Item	Always	Often	Sometimes	Seldom	Never/ hardly ever
1	Is your workload unevenly distributed so it piles up?					
2	How often do you not have time to complete all your work tasks?					
3	Do you have to do overtime?					
4	Do you have to work very fast?					
5	Do you have to keep your eyes on lots of things while you work?					
6	Does your work require that you remember a lot of things?					
7	Does your work demand that you are good at coming up with new ideas?					
8	Does your work require you to make difficult decisions?					
9	Does your work put you in emotionally disturbing situations?					
10	Do you have to relate to other people's personal problems as part of your work?					
11	Are you required to treat everyone equally, even if you do not feel like it?					
12	Do you have a large degree of influence concerning your work?					
13	Do you have a say in choosing who you work with?					
14	Can you influence the amount of work assigned to you?					

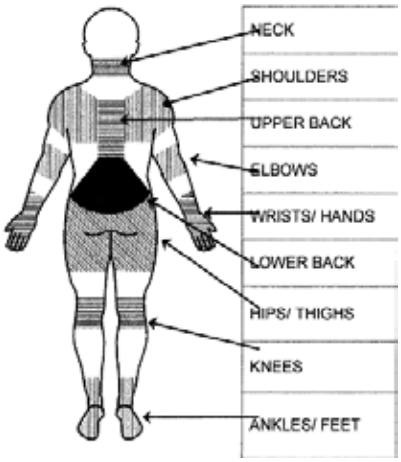
No.	Item	Always	Often	Sometimes	Seldom	Never/ hardly ever
15	Do you have any influence on what you do at work?					
16	How often do you consider looking for work elsewhere?					
17	How often is your nearest superior willing to listen to your problems at work?					
18	How often do you get help and support from your nearest superior?					
19	How often does your nearest superior talk with you about how well you carry out your work?					
20	How often do you get help and support from your colleagues?					
21	How often are your colleagues willing to listen to your problems at work?					
22	How often do your colleagues talk with you about how well you carry out your work?					
23	Is there a good atmosphere between you and your colleagues?					
24	Is there good co-operation between the colleagues at work?					
25	Do you feel part of a community at your place of work?					

No.	Item	To a very large extent	To a large extent	Somewhat	To a small extent	To a very small extent
26	Is your work emotionally demanding?					
27	Do you get emotionally involved in your work?					
28	Does your work require that you hide your feelings?					
29	Are you required to be kind and open towards everyone – regardless of how they behave towards you?					
30	Does your work require you to take the initiative?					
31	Do you have the possibility of learning new things through your work?					
32	Can you use your skills or expertise in your work?					
33	Does your work give you the opportunity to develop your skills?					
34	Is your work meaningful?					
35	Do you feel that the work you do is important?					
36	Do you feel motivated and involved in your work?					
37	Do you enjoy telling others about your place of work?					
38	Do you feel that your place of work is of great importance to you?					
39	Would you recommend a good friend to apply for a position at your workplace?*					
40	At your place of work, are you informed well in advance concerning for example important decisions, changes, or plans for the future?					

No.	Item	To a very large extent	To a large extent	Somewhat	To a small extent	To a very small extent
41	Do you receive all the information you need in order to do your work well?					
42	Is your work recognized and appreciated by the management?					
43	Does the management at your workplace respect you?					
44	Are you treated fairly at your workplace?					
45	Are there good prospects in your job?					
46	Is your salary fair in relation to your effort at work?					
47	Does your work have clear objectives?					
48	Do you know exactly which areas are your responsibility?					
49	Do you know exactly what is expected of you at work?					
50	Do you do things at work, which are accepted by some people but not by others?					
51	Are contradictory demands placed on you at work?					
52	Do you sometimes have to do things, which ought to have been done in a different way?					
53	Do you sometimes have to do things, which seem to be unnecessary?					
To what extent would you say that your immediate superior…						
54	- makes sure that the individual member of staff has good development opportunities?					
55	- give high priority to job satisfaction?					
56	- is good at work planning?					
57	- is good at solving conflicts					

Part 3 Musculoskeletal Symptoms

Please answer by putting a cross (X) in the appropriate box, one box for each question. Please answer every question even if you have never had trouble in any parts of your body. This picture shows how the body has been divided. You should decide for yourself which part (if any) is or has been affected.



	Have you at any time during the last 12 months had trouble (such as ache, pain, discomfort, numbness) in:	During the last 12 months have you been prevented from carrying out normal activities (e.g. job, housework, hobbies) because of this trouble in:	During the last 3 months have you had trouble in:	During the last 7 days have you had trouble in:
NECK	☐ No ☐ Yes	☐ No ☐ Yes	☐ No ☐ Yes	☐ No ☐ Yes
SHOULDERS	☐ No ☐ Yes	☐ No ☐ Yes	☐ No ☐ Yes	☐ No ☐ Yes
UPPER BACK	☐ No ☐ Yes	☐ No ☐ Yes	☐ No ☐ Yes	☐ No ☐ Yes
ELBOWS	☐ No ☐ Yes	☐ No ☐ Yes	☐ No ☐ Yes	☐ No ☐ Yes
WRISTS/HANDS	☐ No ☐ Yes	☐ No ☐ Yes	☐ No ☐ Yes	☐ No ☐ Yes
LOWER BACK	☐ No ☐ Yes	☐ No ☐ Yes	☐ No ☐ Yes	☐ No ☐ Yes
HIPS/THIGHS	☐ No ☐ Yes	☐ No ☐ Yes	☐ No ☐ Yes	☐ No ☐ Yes
KNEES	☐ No ☐ Yes	☐ No ☐ Yes	☐ No ☐ Yes	☐ No ☐ Yes
ANKLES/FEET	☐ No ☐ Yes	☐ No ☐ Yes	☐ No ☐ Yes	☐ No ☐ Yes

Part 4 Work Ability

1. Current work ability compared with the lifetime best

   Assume that your work ability at its best has a value of 10 points. How many points would you give your current work ability?

   (0 means that you cannot currently work at all)

   0 1 2 3 4 5 6 7 8 9 10

   completely work ability

   unable to work at its best

2. Work ability in relation to the demands of the job

   How do you rate your current work ability with respect to the **physical** demands of your work?

very good (5)	**rather good (4)**	**moderate (3)**	**rather poor (2)**	**poor (1)**

   How do you rate your current work ability with respect to the **mental** demands of your work?

very good (5)	**rather good (4)**	**moderate (3)**	**rather poor (2)**	**poor (1)**

3. Number of current diseases

   ☐ None

   ☐ ……. diseases (please specify)

   Diseases diagnosed by a physician……..

   Diseases diagnosed by your own opinion……...

4. Estimated work impairment due to diseases

   Is your illness or injury a hindrance to your current job?

   Circle more than one alternative if needed.

   There is no hindrance/ I have no diseases……. (6)

   I am able to do my job, but it causes some symptoms……. (5)

   I must s**ometimes** slow down my work pace or change my work methods……. (4)

   I must **often** slow down my work pace or change my work methods……. (3)

   Because of my disease, I feel I am able to do only part-time work…….. …… (2)

   In my opinion, I am entirely unable to work……. (1)

5. Sick leave during the past year (12 months)

How many **whole days** have you been off work because of a health problem (disease or health care or for examination) during the past year (12 months)?

None at all…….. (5)

At the most 9 days……. (4)

10-24 days…….. (3)

25-99 days…….. (2)

100-365 days…….. (1)

6. Own prognosis of work ability two years from now

Do you believe that, from the standpoint of your health, you will be able to do your current job two years from now?

unlikely…… (1)

not certain…… (4)

relatively certain……. (7)

7. Mental resources

Have you recently been able to enjoy your regular daily activities?

often (4)	**rather often (3)**	**sometimes (2)**	**rather seldom (1)**	**never (0)**

Have you recently been active and alert?

always (4)	**rather often (3)**	**sometimes (2)**	**rather seldom (1)**	**never (0)**

Have you recently felt yourself to be full of hope for the future?

continuously (4)	**rather often (3)**	**Sometimes (2)**	**rather seldom (1)**	**Never (0)**

Thank you very much.

APPENDIX B
LIST OF EXPERTS

There are five experts who have validated the content of the questionnaire as following:

Name	Address
1. Assist.Prof. Dr. Nivit Chareanjai	Industrial Engineering Department Faculty of Engineering Chiang Mai University
2. Assoc.Prof. Dr. Orawan Kaewboonchoo	Nursing Department Faculty of Public Health Mahidol University
3. Dr. Jarat Singkeaw	Sarapee Hospital Sarapee District Chiang Mai Province
4. Assist.Prof. Dr. Weeraporn Sutthakorn	Faculty of Nursing Chiang Mai University
5. Dr. Thanee Kaewthummanukul	Faculty of Nursing Chiang Mai University

APPENDIX C

ETHIC CERTIFICATE OF APPROVAL

Certificate of Approval

No. 285/2010

Name of Ethics Committee : Research Ethics Committee 3,
Faculty of Medicine, Chiang Mai University
Address of Ethics Committee : 110 Intavaroros Rd., Amphoe Muang,Chiang Mai, Thailand 50200

Principal Investigator : Wanpen Songkham
College of Public Health Sciences, Chulalongkorn University

Protocol title: Effects of a Healthy Unit Guidance (HUG) Program on Work Environments and Health Outcomes among Nursing Personnel
Study code : 10AUG010332
Sponsor : -

Documents filed	Document reference
Research protocol	- Version 1.0 date 29 July 2010
Patient information sheet / Informed consent documents	- Version 1.0 date 29 July 2010
Case Record Form	- Version 1.0 date 29 July 2010
Principal Investigator Curriculum vitae	- Version 1.0 date 29 July 2010

Opinion of the Ethics Committee/Institutional Review Board : PLS. CHECK ONE

__✓__ Approval
_____ Conditional approval (Specify on space below)
.....
.....

DECISION : By expedited review process
Date of Approval : September 23 , 2010 **Expiration Date: September 22 , 2011**

APPENDIX D

HUG ACTION CHECKLIST

แบบสำรวจ HUG

คำแนะนำในใช้แบบสำรวจ

1. ก่อนใช้แบบสำรวจให้อ่านรายละเอียดในแต่ละหัวข้อให้เข้าใจ และเดินสำรวจสถานที่ทำงานอย่างคร่าวๆ
2. เดินสำรวจสถานที่ทำงานอย่างละเอียดเพื่อค้นหามาตรการการปรับปรุงในแต่ละหัวข้อที่ระบุไว้ในแบบสำรวจ หากจำเป็นอาจสอบถามรายละเอียดจากบุคลากรพยาบาล แล้วให้ทำเครื่องหมาย ✓ ใน O ดังนี้
   - 2.1 ถ้าพบว่ามาตรการนั้นได้ดำเนินการไปแล้ว หรือไม่มีความจำเป็นต้องปรับปรุง ให้ทำเครื่องหมาย ✓ ใน O หน้าคำว่า “**ไม่มี**”
   - 2.2 ถ้าพบว่ามาตรการดังกล่าวเป็นประโยชน์ ให้ทำเครื่องหมาย ✓ ใน O หน้าคำว่า “**มี**” และอธิบายข้อเสนอแนะหรือบริเวณที่จะทำการปรับปรุงลงในช่องว่างหลังคำว่า “**เรื่องที่ควรปรับปรุง**”
3. หลังจากทำการสำรวจเรียบร้อยแล้ว ให้ทบทวนดูความเรียบร้อยและถูกต้องของแบบสำรวจอีกครั้ง และพิจารณาเลือกจุดตรวจสอบที่เครื่องหมายในช่อง “**มี**” เลือกหัวข้อเพียง 2-3 หัวข้อ ซึ่งหากดำเนินการปรับปรุงแล้วจะเกิดประโยชน์มากที่สุด แล้วทำเครื่องหมายสำหรับหัวข้อที่เลือกในช่อง “**ควรปรับปรุงโดยเร็ว**”
4. แบบสำรวจนี้เป็นแบบสำรวจทั่วไป ท่านอาจ “เพิ่ม” “ ลด” หรือ “ประยุกต์” บางข้อให้เหมาะสมกับสถานที่ทำงานนั้นๆ ได้

1) การดูแลผู้ป่วยและการพยาบาล

1. จัดทีมในการยกหรือเคลื่อนย้ายผู้ป่วย
   ท่านมีข้อเสนอแนะเพื่อปรับปรุงหรือไม่
   O ไม่มี O มี
   O ควรปรับปรุงโดยเร็ว
   เรื่องที่ควรปรับปรุง
   .....
   .....

2. ใช้อุปกรณ์ในการยกหรือเคลื่อนย้ายผู้ป่วย
   เช่น กระดานเลื่อน
   ท่านมีข้อเสนอแนะเพื่อปรับปรุงหรือไม่
   O ไม่มี O มี
   O ควรปรับปรุงโดยเร็ว
   เรื่องที่ควรปรับปรุง
   .....
   .....

3. ใช้อุปกรณ์ช่วยจัดท่าผู้ป่วยบนเตียง
   (เช่น แผ่นพลิกตัว แผ่นรองขา Monkey bar)
   ท่านมีข้อเสนอแนะเพื่อปรับปรุงหรือไม่
   O ไม่มี O มี
   O ควรปรับปรุงโดยเร็ว
   เรื่องที่ควรปรับปรุง
   .....
   .....

4. จัดให้มีพื้นที่กว้างพอสำหรับการทำงานแต่ละ
   กิจกรรม
   ท่านมีข้อเสนอแนะเพื่อปรับปรุงหรือไม่
   O ไม่มี O มี
   O ควรปรับปรุงโดยเร็ว
   เรื่องที่ควรปรับปรุง
   .....
   .....

5. หลีกเลี่ยงท่าทางการทำงานที่ไม่เหมาะสมในขณะ
   ทำกิจกรรมการพยาบาล
   ท่านมีข้อเสนอแนะเพื่อปรับปรุงหรือไม่
   O ไม่มี O มี
   O ควรปรับปรุงโดยเร็ว
   เรื่องที่ควรปรับปรุง
   .....
   .....

6. ใช้เทคนิคในการยกที่ถูกต้องเพื่อหลีกเลี่ยงการบิดหรือก้มตัวมากเกินไป
ท่านมีข้อเสนอแนะเพื่อปรับปรุงหรือไม่
O ไม่มี O มี
O ควรปรับปรุงโดยเร็ว
เรื่องที่ควรปรับปรุง
.....
.....

2) การจัดเก็บและการขนย้ายยา อุปกรณ์และเครื่องมือทางการแพทย์

7. จัดยา อุปกรณ์และเครื่องมือทางการแพทย์ที่ใช้บ่อยไว้ในบริเวณที่หยิบใช้งานได้ง่าย
ท่านมีข้อเสนอแนะเพื่อปรับปรุงหรือไม่
O ไม่มี O มี
O ควรปรับปรุงโดยเร็ว
เรื่องที่ควรปรับปรุง
.....
.....

8. ใช้ล้อเข็นหรืออุปกรณ์ที่มีล้อในการขนย้ายสิ่งของที่มีน้ำหนักมาก
ท่านมีข้อเสนอแนะเพื่อปรับปรุงหรือไม่
O ไม่มี O มี
O ควรปรับปรุงโดยเร็ว
เรื่องที่ควรปรับปรุง
.....
.....

9. ใช้บันไดหรือม้านั่งที่มั่นคงแข็งแรงเมื่อต้องหยิบของในที่สูง
ท่านมีข้อเสนอแนะเพื่อปรับปรุงหรือไม่
O ไม่มี O มี
O ควรปรับปรุงโดยเร็ว
เรื่องที่ควรปรับปรุง
.....
.....

10. ใช้อุปกรณ์หรือเครื่องมือทางการแพทย์ที่มีล้อขนาดใหญ่ และมีตัวล็อคล้อ

ท่านมีข้อเสนอแนะเพื่อปรับปรุงหรือไม่

O ไม่มี O มี

O ควรปรับปรุงโดยเร็ว

เรื่องที่ควรปรับปรุง

.....

.....

11. จัดยาฉีดและอุปกรณ์การให้ยาไว้ในบริเวณเดียวกัน

ท่านมีข้อเสนอแนะเพื่อปรับปรุงหรือไม่

O ไม่มี O มี

O ควรปรับปรุงโดยเร็ว

เรื่องที่ควรปรับปรุง

.....

.....

12. กล่องอุปกรณ์ ชั้นวางของ และปุ่มเครื่องมือต่างๆ มีการติดป้ายหรือฉลากที่มีสีสันมองเห็นได้ชัดเจน

ท่านมีข้อเสนอแนะเพื่อปรับปรุงหรือไม่

O ไม่มี O มี

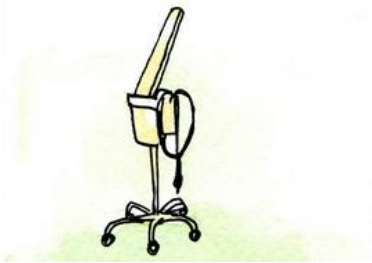
O ควรปรับปรุงโดยเร็ว

เรื่องที่ควรปรับปรุง

.....

.....

13. เลือกใช้อุปกรณ์ที่สามารถเคลื่อนย้ายได้ง่ายและมีน้ำหนักเบา



ท่านมีข้อเสนอแนะเพื่อปรับปรุงหรือไม่

O ไม่มี O มี

O ควรปรับปรุงโดยเร็ว

เรื่องที่ควรปรับปรุง

.....

.....

3) การออกแบบสถานที่ทำงาน

14. จัดทำทางเดินให้อยู่ในสภาพดีและไม่มีสิ่งกีดขวาง

ท่านมีข้อเสนอแนะเพื่อปรับปรุงหรือไม่

O ไม่มี O มี

O ควรปรับปรุงโดยเร็ว

เรื่องที่ควรปรับปรุง

.....

.....

15. มีการวางแผนผังการทำงานที่เหมาะสม เพื่อลดระยะทางในการขนย้ายสิ่งของ
ท่านมีข้อเสนอแนะเพื่อปรับปรุงหรือไม่
O ไม่มี O มี
O ควรปรับปรุงโดยเร็ว
เรื่องที่ควรปรับปรุง
.....
.....

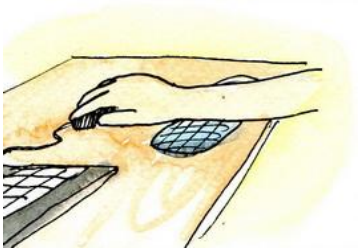
16. จัดสถานที่ทำงานให้สามารถทำงานได้อย่างมีประสิทธิภาพและสะดวกในการทำงาน
ท่านมีข้อเสนอแนะเพื่อปรับปรุงหรือไม่
O ไม่มี O มี
O ควรปรับปรุงโดยเร็ว
เรื่องที่ควรปรับปรุง
.....
.....

17. จัดตำแหน่งการนั่งทำงานหน้าคอมพิวเตอร์อย่างเหมาะสม
ท่านมีข้อเสนอแนะเพื่อปรับปรุงหรือไม่
O ไม่มี O มี
O ควรปรับปรุงโดยเร็ว
เรื่องที่ควรปรับปรุง
.....
.....

18. มีการปรับระดับความสูงในการทำงานให้อยู่ในระดับข้อศอกหรือต่ำกว่าระดับข้อศอกเล็กน้อย
ท่านมีข้อเสนอแนะเพื่อปรับปรุงหรือไม่
O ไม่มี O มี
O ควรปรับปรุงโดยเร็ว
เรื่องที่ควรปรับปรุง
.....
.....

19. โต๊ะที่ทำงานสามารถปรับระดับได้
ท่านมีข้อเสนอแนะเพื่อปรับปรุงหรือไม่
O ไม่มี O มี
O ควรปรับปรุงโดยเร็ว
เรื่องที่ควรปรับปรุง
.....
.....

20. ใช้แผ่นรองเมาส์หรือแป้นพิมพ์ที่นุ่ม เพื่อป้องกันแรงกดเฉพาะจุด

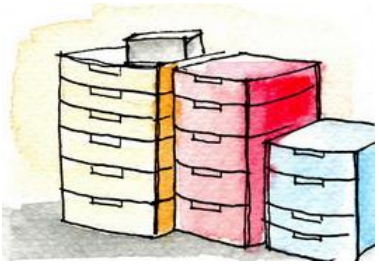


ท่านมีข้อเสนอแนะเพื่อปรับปรุงหรือไม่
O ไม่มี O มี
O ควรปรับปรุงโดยเร็ว
เรื่องที่ควรปรับปรุง
.....
.....

21. เก้าอี้ที่ใช้นั่งทำงานมีสภาพดีและมีพนักพิงแข็งแรง

ท่านมีข้อเสนอแนะเพื่อปรับปรุงหรือไม่
O ไม่มี O มี
O ควรปรับปรุงโดยเร็ว
เรื่องที่ควรปรับปรุง
.....
.....

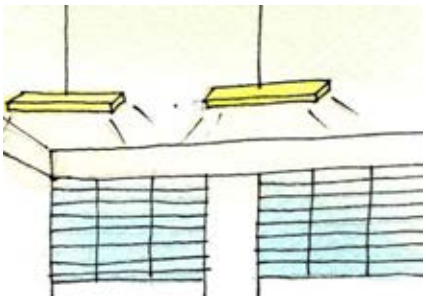
22. ใช้ลิ้นชักหรือชั้นวางของที่มีหลายๆ ชั้นในการจัดหมวดหมู่ยาหรือเวชภัณฑ์



ท่านมีข้อเสนอแนะเพื่อปรับปรุงหรือไม่
O ไม่มี O มี
O ควรปรับปรุงโดยเร็ว
เรื่องที่ควรปรับปรุง
.....
.....

4) สภาพแวดล้อมการทำงาน

23. มีการจัดแสงสว่าง การระบายอากาศ เสียงและอุณหภูมิให้เหมาะสมกับการทำงาน



ท่านมีข้อเสนอแนะเพื่อปรับปรุงหรือไม่
O ไม่มี O มี
O ควรปรับปรุงโดยเร็ว
เรื่องที่ควรปรับปรุง
.....

24. มีป้ายเตือนให้ระวังการยกของที่มีน้ำหนักมาก

ท่านมีข้อเสนอแนะเพื่อปรับปรุงหรือไม่
O ไม่มี O มี
O ควรปรับปรุงโดยเร็ว
เรื่องที่ควรปรับปรุง
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25. มีการระบุเส้นทางการเคลื่อนย้ายเมื่อเกิดเหตุฉุกเฉินติดไว้บริเวณที่มองเห็นได้ชัดเจน
ท่านมีข้อเสนอแนะเพื่อปรับปรุงหรือไม่
O ไม่มี O มี
O ควรปรับปรุงโดยเร็ว
เรื่องที่ควรปรับปรุง
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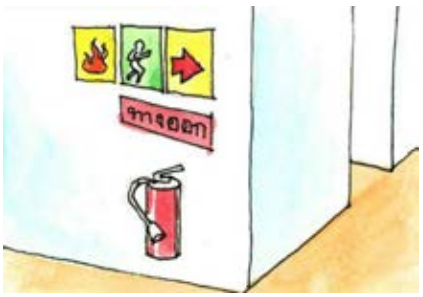

26. จัดหาเอี๊ยมตะกั่วที่มีน้ำหนักเบาให้กับคนทำงานในช่วงที่มี X-ray เคลื่อนที่
ท่านมีข้อเสนอแนะเพื่อปรับปรุงหรือไม่
O ไม่มี O มี
O ควรปรับปรุงโดยเร็ว
เรื่องที่ควรปรับปรุง
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5) การวางแผนงานและการบริหารจัดการเวลา

27. มีการจัดประชุมสรุปงานสั้นๆ ก่อนการทำงาน
ท่านมีข้อเสนอแนะเพื่อปรับปรุงหรือไม่
O ไม่มี O มี
O ควรปรับปรุงโดยเร็ว
เรื่องที่ควรปรับปรุง
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28. มีการจัดแบ่งหน้าที่ความรับผิดชอบให้คนทำงานแต่ละทีม เพื่อตัดสินใจว่าจะทำงานร่วมกันอย่างไร
ท่านมีข้อเสนอแนะเพื่อปรับปรุงหรือไม่
O ไม่มี O มี
O ควรปรับปรุงโดยเร็ว
เรื่องที่ควรปรับปรุง
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29. จัดตารางการทำงานโดยหลีกเลี่ยงไม่ให้ใครคนใดคนหนึ่งมีภาระงานหนักมากเกินไป
ท่านมีข้อเสนอแนะเพื่อปรับปรุงหรือไม่
O ไม่มี O มี
O ควรปรับปรุงโดยเร็ว
เรื่องที่ควรปรับปรุง
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30. เพิ่มทักษะการทำงานและส่งเสริมให้คนทำงานเกิดความรู้สึกอยากทำงานให้บรรลุเป้าหมายร่วมกัน

ท่านมีข้อเสนอแนะเพื่อปรับปรุงหรือไม่

O ไม่มี O มี

O ควรปรับปรุงโดยเร็ว

เรื่องที่ควรปรับปรุง

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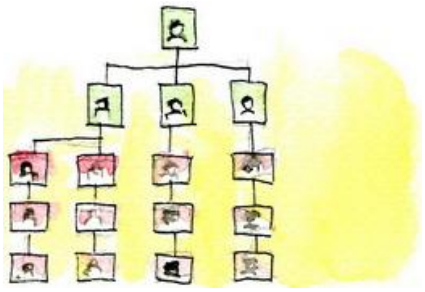
31. ใช้บอร์ด/ป้ายประกาศ เพื่อแจ้งให้คนทำงานได้รับรู้หน้าที่ของตนอย่างถูกต้อง



ท่านมีข้อเสนอแนะเพื่อปรับปรุงหรือไม่

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O ควรปรับปรุงโดยเร็ว

เรื่องที่ควรปรับปรุง

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32. มีการวางแผนปรับเปลี่ยนการทำงานล่วงหน้าและมีการแจ้งให้คนทำงานทุกคนทราบ

ท่านมีข้อเสนอแนะเพื่อปรับปรุงหรือไม่

O ไม่มี O มี

O ควรปรับปรุงโดยเร็ว

เรื่องที่ควรปรับปรุง

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33. จัดเวลาการทำงานอย่างเหมาะสมเพื่อลดการทำงานล่วงเวลาที่มากเกินไป

ท่านมีข้อเสนอแนะเพื่อปรับปรุงหรือไม่

O ไม่มี O มี

O ควรปรับปรุงโดยเร็ว

เรื่องที่ควรปรับปรุง

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34. ลดการทำงานซ้ำซาก โดยการผลัดเปลี่ยนหมุนเวียนคนทำงาน

ท่านมีข้อเสนอแนะเพื่อปรับปรุงหรือไม่

O ไม่มี O มี

O ควรปรับปรุงโดยเร็ว

เรื่องที่ควรปรับปรุง

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35. จัดให้คนทำงานทุกคนมีช่วงเวลาหยุดพักผ่อนยาว ในแต่ละปีได้อย่างเต็มที่

ท่านมีข้อเสนอแนะเพื่อปรับปรุงหรือไม่

O ไม่มี O มี

O ควรปรับปรุงโดยเร็ว

เรื่องที่ควรปรับปรุง

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6) การสนับสนุนให้กำลังใจในงาน

36. ทำให้คนทำงานมั่นใจว่าสามารถที่จะพูดคุยกับหัวหน้าเกี่ยวกับปัญหาการทำงานได้อย่างสะดวกใจ

ท่านมีข้อเสนอแนะเพื่อปรับปรุงหรือไม่

O ไม่มี O มี

O ควรปรับปรุงโดยเร็ว

เรื่องที่ควรปรับปรุง

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37. ส่งเสริมให้เกิดบรรยากาศการทำงานที่คนทำงานสามารถปรึกษาหรือให้กำลังใจกันและกันได้

ท่านมีข้อเสนอแนะเพื่อปรับปรุงหรือไม่

O ไม่มี O มี

O ควรปรับปรุงโดยเร็ว

เรื่องที่ควรปรับปรุง

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38. จัดวาระการพบปะสังสรรค์แบบไม่เป็นทางการหรือมีกิจกรรมสันทนาการร่วมกันบ่อยๆ

ท่านมีข้อเสนอแนะเพื่อปรับปรุงหรือไม่

O ไม่มี O มี

O ควรปรับปรุงโดยเร็ว

เรื่องที่ควรปรับปรุง

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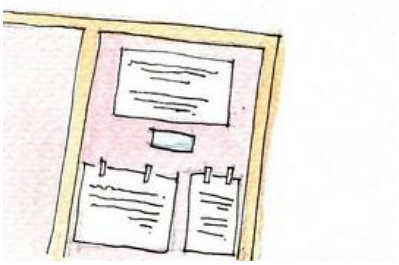
39. ใช้จดหมาย หนังสือเวียน หรือกระดานประกาศเพื่อแลกเปลี่ยนข้อมูลข่าวสารระหว่างหน่วยงาน



ท่านมีข้อเสนอแนะเพื่อปรับปรุงหรือไม่

O ไม่มี O มี

O ควรปรับปรุงโดยเร็ว

เรื่องที่ควรปรับปรุง

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40. แจ้งให้คนทำงานทราบถึงโอกาสความก้าวหน้าในงานและสิ่งที่จะต้องทำเพื่อให้ได้รับโอกาสนั้น

ท่านมีข้อเสนอแนะเพื่อปรับปรุงหรือไม่

O ไม่มี O มี

O ควรปรับปรุงโดยเร็ว

เรื่องที่ควรปรับปรุง

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41. มีการให้รางวัลหรือคำชมเชยให้กับคนที่ช่วยพัฒนาคุณภาพของการพยาบาล

ท่านมีข้อเสนอแนะเพื่อปรับปรุงหรือไม่

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O ควรปรับปรุงโดยเร็ว

เรื่องที่ควรปรับปรุง

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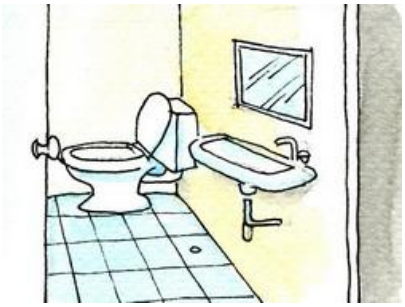
7) สวัสดิการและสิ่งอำนวยความสะดวก

42. มีห้องน้ำและสถานที่ล้างมือที่สะอาด



ท่านมีข้อเสนอแนะเพื่อปรับปรุงหรือไม่

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เรื่องที่ควรปรับปรุง

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43. มีห้องสำหรับพักผ่อนและแลกเปลี่ยนเรียนรู้

ท่านมีข้อเสนอแนะเพื่อปรับปรุงหรือไม่

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O ควรปรับปรุงโดยเร็ว

เรื่องที่ควรปรับปรุง

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44. มีเวลาหยุดพักในระหว่างช่วงเวลาทำงานอย่างเพียงพอ

ท่านมีข้อเสนอแนะเพื่อปรับปรุงหรือไม่

O ไม่มี O มี

O ควรปรับปรุงโดยเร็ว

เรื่องที่ควรปรับปรุง

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45. มีนโยบายด้านอาชีวอนามัยและความปลอดภัยที่เป็นลายลักษณ์อักษรชัดเจน
ท่านมีข้อเสนอแนะเพื่อปรับปรุงหรือไม่
O ไม่มี O มี
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เรื่องที่ควรปรับปรุง
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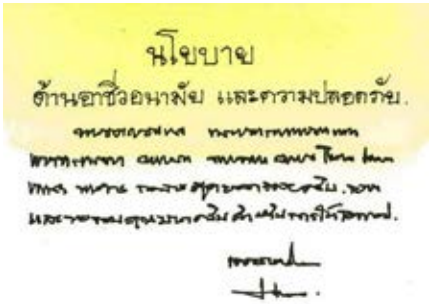

46. มีการมอบหมายบุคลากรให้เป็นผู้นำในการดูแลด้านอาชีวอนามัยและความปลอดภัย
ท่านมีข้อเสนอแนะเพื่อปรับปรุงหรือไม่
O ไม่มี O มี
O ควรปรับปรุงโดยเร็ว
เรื่องที่ควรปรับปรุง
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47. จัดให้มีการอบรมหรือจัดชั่วโมงการเรียนรู้เกี่ยวกับการลดความเครียดจากการทำงาน
ท่านมีข้อเสนอแนะเพื่อปรับปรุงหรือไม่
O ไม่มี O มี
O ควรปรับปรุงโดยเร็ว
เรื่องที่ควรปรับปรุง
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48. จัดให้มีจุดให้คำปรึกษาเกี่ยวกับปัญหาสุขภาพและการทำงานที่มีความเป็นส่วนตัว
ท่านมีข้อเสนอแนะเพื่อปรับปรุงหรือไม่
O ไม่มี O มี
O ควรปรับปรุงโดยเร็ว
เรื่องที่ควรปรับปรุง
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49. มีการอบรมหรือให้คำแนะนำการป้องกันอาการบาดเจ็บในระบบกระดูกและกล้ามเนื้อให้กับบุคลากรที่เข้าทำงานใหม่
ท่านมีข้อเสนอแนะเพื่อปรับปรุงหรือไม่
O ไม่มี O มี
O ควรปรับปรุงโดยเร็ว
เรื่องที่ควรปรับปรุง
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50. มีการสอนการยืดเหยียดกล้ามเนื้อเพื่อป้องกันความเมื่อยล้าจากการทำงาน

ท่านมีข้อเสนอแนะเพื่อปรับปรุงหรือไม่

O ไม่มี O มี

O ควรปรับปรุงโดยเร็ว

เรื่องที่ควรปรับปรุง

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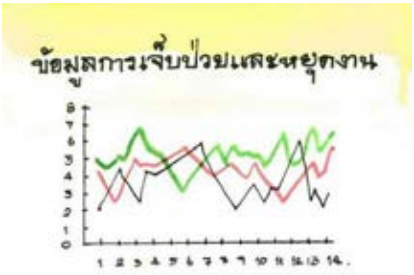
51. มีการจัดเก็บข้อมูลการเกิดอาการผิดปกติในระบบโครงร่างกล้ามเนื้อและข้อมูลการหยุดงาน



ท่านมีข้อเสนอแนะเพื่อปรับปรุงหรือไม่

O ไม่มี O มี

O ควรปรับปรุงโดยเร็ว

เรื่องที่ควรปรับปรุง

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52. จัดให้มีการรักษาและติดตามผลการรักษาเมื่อเกิดอาการผิดปกติในระบบโครงร่างกล้ามเนื้อในบุคลากรพยาบาล

ท่านมีข้อเสนอแนะเพื่อปรับปรุงหรือไม่

O ไม่มี O มี

O ควรปรับปรุงโดยเร็ว

เรื่องที่ควรปรับปรุง

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APPENDIX E
WORKPLACE IMPROVEMENT ACHIEVEMENT PHOTOS

Figure E.1 Apply lifting team to move and transfer a patient to or from the bed

Figure E.2 Clean the rolling wheels of the medical equipment

Figure E.3 Use a step or ladder to address height difficulties

Before **After**

Figure E.4 Reorganize the stuffs for easy access

Before

After

Figure E.5 Reorganize and redecorate resting room

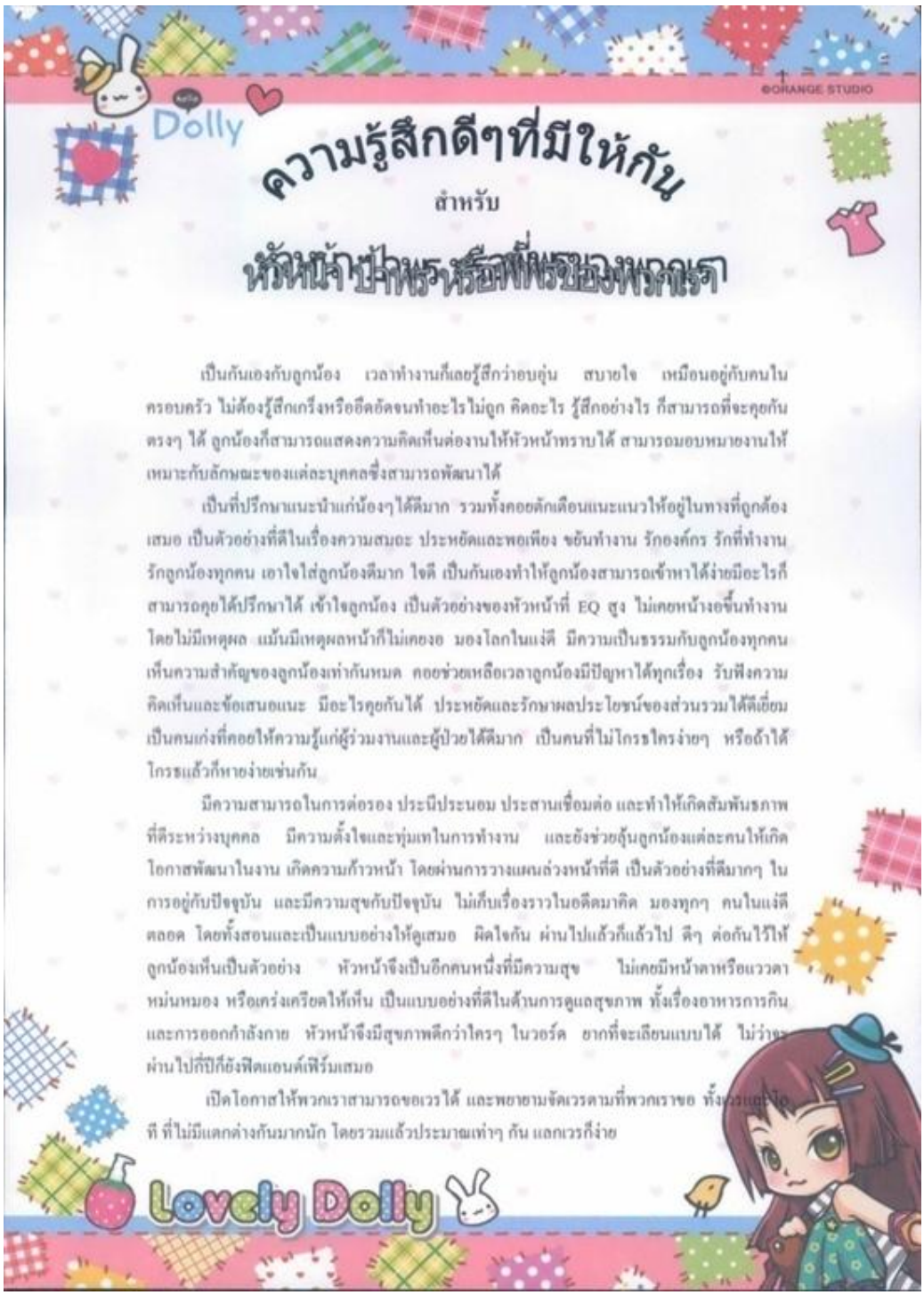

Figure E.6 Promote the healthier climate where worker can discuss or encourage each other

BIOGRAPHY

Name	Ms.Wanpen Songkham
Date of Birth	14th September 1971
Place of Birth	Chiang Mai, Thailand
Educational Achievements	Bachelor of Nursing Science Chiang Mai University, Chiang Mai, Thailand Master of Sciences (Industrial Hygiene and Safety) Mahidol University, Bangkok, Thailand
Occupation	Lecturer Faculty of Nursing, Chiang Mai University Chiang Mai, Thailand