ASSOCIATION BETWEEN WORKING CONDITION AND MUSCULOSKELETAL DISORDERS (MSDs) AMONG FEMALE GARMENT WORKERS IN KHAN MEAN CHEY, PHNOM PENH CITY, CAMBODIA

Miss Try Phally

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ความสัมพันธ์ระหว่างสภาพการทำงานและอาการผิดปกติของกล้ามเนื้อและโครงกระดูกในกลุ่มคนงานหญิงโรงงานตัดเย็บเสื้อผ้าในเขตคานเมียนเจย เมืองพนมเปญประเทศกัมพูชา

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วิทยานิพนธ์นี้เป็นส่วนหนึ่งของการศึกษาตามหลักสูตรปริญญาสาธารณสุขศาสตรมหาบัณฑิต
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Thesis Title	ASSOCIATION BETWEEN WORKING CONDITION AND MUSCULOSKELETAL DISORDERS (MSDs) AMONG FEMALE GARMENTWORKERS IN KHAN MEAN CHEY, PHNOM PENH CITY, CAMBODIA
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ไทล์ เพาลี่ : ความสัมพันธ์ระหว่างสภาพการทำงานและอาการผิดปกติของกล้ามเนื้อและโครงกระดูกในกลุ่มคนงานหญิงโรงงานตัดเย็บเสื้อผ้าในเขตคานเมียนเจย เมืองพนมเปญประเทศกัมพูชา. (ASSOCIATION BETWEEN WORKING CONDITION AND MUSCULOSKELETAL DISORDERS (MSDs) AMONG FEMALE GARMENTWORKERS IN KHAN MEAN CHEY, PHNOM PENH CITY, CAMBODIA) อ.ที่ปรึกษาหลัก : ไกรวุฒิ กัลวิชา, อ.ที่ปรึกษาร่วม : เอกราช สมบัติสวัสดิ์

ความผิดปกติของกระดูกและกล้ามเนื้อเป็นปัญหาด้านสาธารณสุขที่ร้ายแรงทั้งในประเทศอุตสาหกรรมและประเทศกำลังพัฒนา การศึกษานี้มีวัตถุประสงค์เพื่อศึกษาความชุกของโรคระบบกระดูกและกล้ามเนื้อและความสัมพันธ์ระหว่างสภาพการทำงานและความผิดปกติของกระดูกและกล้ามเนื้อในกลุ่มคนงานหญิงโรงงานตัดเย็บเสื้อผ้า ในเขตคานเมียนเจย เมืองพนมเปญ ประเทศกัมพูชา รูปแบบการวิจัยภาคตัดขวางได้ดำเนินการในกลุ่มคนงานหญิงโรงงานตัดเย็บเสื้อผ้าจำนวน 423 คน การเก็บรวบรวมข้อมูลเป็นการสุ่มตัวอย่างตามความสะดวกผ่านการสัมภาษณ์แบบตัวต่อตัวโดยใช้แบบสอบถามที่มีโครงสร้างประกอบด้วย ข้อมูลทางสังคมประชากร สภาพการทำงาน และแบบสอบถามมาตรฐานนอร์ดิกสำหรับการประเมินโรคระบบกระดูกและกล้ามเนื้อในช่วงระหว่างเดือนเมษายนถึงพฤษภาคม 2565 สถิติเชิงพรรณนาใช้เพื่อนำเสนอความชุกของความผิดปกติของกระดูกและกล้ามเนื้อ การทดสอบไคสแควร์และฟิชเชอร์ใช้เพื่อตรวจสอบความสัมพันธ์ระหว่างสภาพการทำงานและความผิดปกติของกระดูกและกล้ามเนื้อ ตัวแปรที่มีค่า p น้อยกว่า 0.05 ถือว่ามีนัยสำคัญทางสถิติ ผู้เข้าร่วมมีค่ามัธยฐานของอายุ (±ค่าส่วนเบี่ยงเบนมาตรฐาน) คือ 33 (±8.12) ปี ส่วนใหญ่จบการศึกษาระดับประถมศึกษา ร้อยละ 51.8 โดยมีดัชนีมวลกายปกติ (ร้อยละ 68.3) ผลการวิจัย พบว่า บริเวณที่ถูกรายงานว่าได้รับผลกระทบบ่อยที่สุดคือไหล่ รองลงมาคือคอและหลังส่วนล่าง ตามลำดับ ร้อยละ 70.7 ในกลุ่มคนงานหญิงโรงงานตัดเย็บเสื้อผ้าที่มีความผิดปกติของกล้ามเนื้อและกระดูกรายงานว่ามีอาการของกล้ามเนื้อและกระดูกอย่างน้อยหนึ่งอาการในช่วง 7 วันและ 12 เดือนที่ผ่านมา ในช่วง 7 วันที่ผ่านมาพบความสัมพันธ์อย่างมีนัยสำคัญระหว่างความผิดปกติของกระดูกและกล้ามเนื้อและการออกกำลังกาย (p=0.044) โรคประจำตัว (p=0.001) ตำแหน่งศีรษะขณะทำงาน (p=0.011) อุณหภูมิ (p=0.035) และงานหนัก (p=0.014) ในช่วง 12 เดือนที่ผ่านมา พบความสัมพันธ์อย่างมีนัยสำคัญระหว่างความผิดปกติของกระดูกและกล้ามเนื้อและอายุ (p=0.017) การดื่มเครื่องดื่มที่มีแอลกอฮอล์ (p=0.016) เก้าอี้ที่ไม่มีพนักพิง (p=0.042) อุณหภูมิ (p=0.019) เสียงรบกวน (p=0.003) การพักผ่อนที่ไม่เพียงพอ (p=0.046) และการได้รับแรงกดดันจากผู้จัดการ (p=0.004) ความผิดปกติของกระดูกและกล้ามเนื้อถูกรายงานโดยทั่วไปที่บริเวณไหล่ คอ และหลังส่วนล่าง และมีความสัมพันธ์อย่างมีนัยสำคัญทางสถิติกับสภาพการทำงาน การดำเนินการทางการยศาสตร์เป็นสิ่งจำเป็นเพื่อปรับปรุงการออกแบบสถานีงาน ท่าทางการทำงานที่เหมาะสม พฤติกรรมในสถานที่ทำงาน ความเครียดในการทำงาน วงจรการพักในการทำงาน และสภาพแวดล้อมการทำงานในกลุ่มคนงานหญิงในอุตสาหกรรมตัดเย็บเสื้อผ้า

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Try Phally : ASSOCIATION BETWEEN WORKING CONDITION AND MUSCULOSKELETAL DISORDERS (MSDs) AMONG FEMALE GARMENTWORKERS IN KHAN MEAN CHEY, PHNOM PENH CITY, CAMBODIA . Advisor: Dr. Asst. Prof. KRAIWUTH KALLAWICHA, Ph.D. Co-advisor: Ekarat Sombatsawat, Ph.D.

Musculoskeletal disorders (MSDs) are a serious public health issue in both industrialized and developing countries. This study aims to investigate the prevalence of musculoskeletal symptoms and the association between working conditions and MSDs among female garment workers in Khan Mean Chey, Phnom Penh city, Cambodia. A cross-sectional research design was conducted among 423 female garment workers. Data collection was convenient sampling through face-to-face interview using a structured questionnaire consisted of socio demographics, working conditions, and the Standardized Nordic Questionnaire for musculoskeletal symptoms assessment during the period between April and May 2022. Descriptive statistics was used to present the prevalence of MSDs. Chi-square and fisher exact test were used to examine the association between working conditions and MSDs. Variables with a p-value<0.05 was taken as statistically significant. Participants' median (±SD) age was 33 (±8.12) years. Most of them graduated primary school was 51.8% with normal BMI (68.3%). The findings revealed that the most frequently affected regions were reported in the shoulder, followed by neck, and lower back, respectively. Among 70.7% of female garment workers with MSDs reported at least one musculoskeletal symptom during the previous 7 days and 12 months. In the previous 7 days, there were significant association between MSDs and exercise (p=0.044), medical condition (p=0.001), head position during working (p=0.011), temperature (p=0.035), and work's heavy (p=0.014). In the previous 12 months, there were significant association between MSDs and age (p=0.017), alcohol drinking (p=0.016), chair without backrest (p=0.042), temperature (p=0.019), noise (p=0.003), not getting enough rest (p=0.046), and get pressure from manager (p=0.004). MSDs was commonly reported in shoulder, neck, and lower back, and was statistically significantly associated with working conditions. Ergonomic interventions are needed to improve workstation design, appropriate working posture, workplace behavior, work stress, work-rest cycle, and work environment among female workers in the garment industry.

Field of Study:	Public Health	Student's Signature .....
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CHAPTER 1
INTRODUCTION

1.1 Background

The musculoskeletal system permits the human body to move freely, musculoskeletal disorders (MSDs) harm body systems such as muscles, tendons, ligaments, cartilage, bones, joints, and/or nerves, affecting employee quality of life and performance losses (Smith et al., 2020). MSDs account for 40% of all injuries in the United States, with an annual cost of USD 45-54 billion, such diseases are more severe and acute in underdeveloped nations (Kang et al., 2014). MSDs are a serious public health issue in both industrialized and developing countries (Scientific, 2003). Therefore, contacting to MSDs is considered the foundation of many risks assessment approaches.

The prevalence of MSDs among garment workers have been studied in Kandal province in Cambodia in 2016, among 714 workers, the response rate was 98.3% (702/714) and the majority (89.3%) were female, In the previous twelve months, 92% of workers complaints in at least one body location, and, 89% of the workers reported similar symptoms in the previous seven days. The most affected body parts were the neck, shoulder, and lower back. In conclusion, Cambodian garment workers reported a high prevalence of musculoskeletal problems in the upper body, and their workplaces were ergonomically categorized as high risk (Van et al., 2016).

Many researchers have attempted to comprehend the impact of various risks of MSDs problems. Some researchers concluded that the factors that increase the risk of MSD can be grouped into two types, i.e. those based on physical aspects of the work (loads, bad postures, repetitive movements, physical exertion, mechanical pressure on bodily tissues, cold working conditions, body vibrations) and those based on the work environment and work organization (pace of work, repetition of tasks, work timetable, remuneration systems, job monotony, fatigue, worker perception of job organization, and psychosocial factors) (Larsman & Hanse, 2009). Workplace activities such as carrying large loads, repetitive tasks, and uncomfortable postures were identified as risk

factors for MSDs by certain investigation (Salmani Nodooshan et al., 2016). However, in recent years, researchers have started looking at the MSD issues linked to workplace ergonomic risk factors (Hosseini et al., 2019). In addition, a lack of activity was a contributing factor in the development of MSDs (Arya & Kwatra, 2020). Highly repetitive motions, physical job duties, and poorly built ergonomic workstations were also physical risk factors for MSD issues (Jaffar et al., 2011).

Since the late 1990s, Cambodia's garment industry has played a significant part in the country's economy. In 2010, this industry accounted for around 15% of the overall gross domestic product and 50% of manufacturing jobs. About 327,000 women amounts to 90% of the workers came from the clothing industry in rural area. In 2011, Cambodia earned US$4,047.05 million from exported garment product, comprising 58.9% of Cambodia’s total export value for the year (Asuyama & Neou, 2012). Garment industry making a lot of money for the country and lot of people working in these industries. In Cambodia, women make up the majority of garment workers. They come from countryside to work in Phnom Penh, Kampong Speu, and Kandal provinces. Phnom Penh and Kandal account for about 90% of all garment manufacturing in Cambodia. Garment workers typically labor in shifts and for lengthy periods of time.

To our knowledge, there is only one study related to the prevalence of musculoskeletal symptom among garment worker in Kandal province, Cambodia in 2016 that indicated 92% of workers complaint at least one body region. Therefore, comprehensive study should be conducted about risk factors for work-related MSDs. The objectives of this study were to determine the prevalence of musculoskeletal symptoms and to investigate the association between working conditions and musculoskeletal symptoms among garment worker in Khan Mean Chey, Phnom Penh city, Cambodia.

1.2 Research question

The research questions are as follow:

1. What is the prevalence of musculoskeletal symptoms among the garment workers in Khan Mean Chey, Phnom Penh city?

2. Are there association between working conditions and musculoskeletal symptoms among garment workers in Khan Mean Chey, Phnom Penh city?

1.3 Research objective

General objectives

To obtain the prevalence of musculoskeletal symptoms among garment workers in Khan Mean Chey, Phnom Penh city, Cambodia.

Specific objective

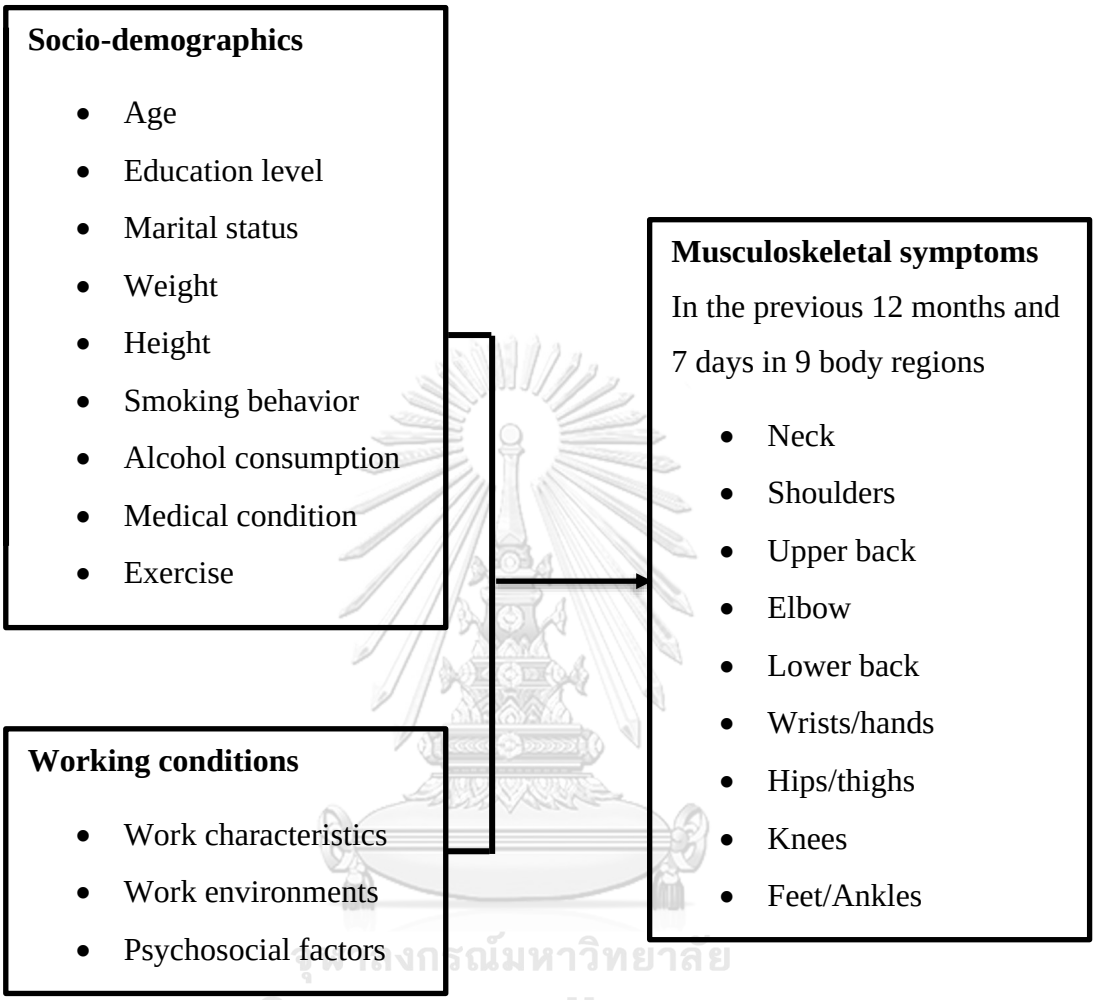
To investigate the association between working conditions and musculoskeletal symptoms among garment workers in Phnom Penh city, Cambodia

1.4 Research hypothesis

Ho: There are no association between working conditions and musculoskeletal symptoms.

Ha: There are association between working conditions and musculoskeletal symptoms.

1.5 Conceptual framework



1.6 Operational definition

- Musculoskeletal symptoms refer to subjective perception of ache, pain, discomfort condition in neck, shoulders, elbows, wrist/hand, upper back, lower back, one or both knees, and one or both ankles/feet which were reported by garment workers.
- Prevalence of musculoskeletal symptoms refers to the proportion derived from number of garment workers with at least one musculoskeletal symptom within 9 body regions during past 12 months with total respondents.
- Garment worker refers to a person who works in sewing section, ironing section, cutting section, buttoning section.
- Medical condition refers to the presence of congenital disease of worker before study, no need diagnosis from physician.
- Exercise refers to the physical activity from any body movement produced by skeletal muscles at least 30 minutes.
- Working condition refers to the risk factor under which the work of a worker is performed, including work characteristics, work environment, and psychosocial factors.
    - Work characteristics consisted of section of garment worker do, working time, working experience, and twisting activities while working.
    - Work environment consisted of level of chair, temperature, air ventilated, light, and noise.
    - Psychosocial factors consisted of the psychology and social effects that cause the stress to worker in the workplace.

CHAPTER 2
LITERATURE REVIEW

1.1 Garment factory characteristic

Sewing and repairing various of clothing, textiles, blankets, and other cloth-made goods are all part of the process. Sewing machine operators frequently use their hands to manipulate and handle the equipment and gadgets. Garment workers perform the repetitive actions over lengthy periods of time. Some prominent indicators of these activities are static sitting postures including forward head, back bending, and over flexion of ankles and knees. Furthermore, they also have awkward postures incorporate synchronous arm and leg actions while cycling such as visual control, material leading, and work tempo controlled by the feet. Musculoskeletal pains of the upper limb are caused by improper postures and repetitive uninteresting occupations (Mehta et al., 2020).

2.2 Definition of musculoskeletal disorders

Musculoskeletal disorders impact wide range of systems, including tendons, muscles, joints, nerves, and the vascular system. It is dependent on the structure affected and the type of affliction, the ailment would be referred to as tendinitis, tenosynovitis, bursitis, and carpal tunnel syndrome. In a work-related situation, any problem can arise (Simoneau et al., 2003).

Bernadini Ramazzini, an Italian physician and the pioneer of occupational medicine, was the first to notice work-related musculoskeletal disorders in the 18th century. He also explained the link between musculoskeletal complaints and postures, repetition of motions, weightlifting, and muscle stress. Certain diseases aided him describing the anatomical location of problems as week as determining the severity and duration of the risk factor. He discovered particular ergonomic issues related to diverse clinical pictures with job analysis such as abnormal posture can cause of numbness in the legs, lameness, and sciatica. (Franco & Fusetti, 2004).

Tendinitis is an inflammation of a tendon. Tendons are connective tissues between muscles and the skeletons. This muscle pushes on the tendon and creates the forearm bend resulting in the muscle and the tendon contracts. When a muscle is overworked, the tendon may become overworked. The overuse persists, the tendon will become increasingly overloaded, resulting in tendonitis. The tendon is wounded due to a build-up of tiny injuries, the body may try to heal itself through inflammation which manifests as swelling. When a muscle is overworked, the tendon may become overworked. The overuse persists, the tendon will become increasingly overloaded, resulting in tendonitis. The tendon is wounded due to a build-up of tiny injuries, the body may try to heal itself through inflammation which manifests as swelling. (Simoneau et al., 2003).

The bursa is a synovial fluid that sits between the tendon and the bone, allowing the tendon to glide over the bone with minimal friction. Bursitis occurs when the bursa or fluid-filled sacs that cushion your joints become inflamed. When the bursa is moved, it loses its slickness and gets increasingly irritating. Bursitis usually occurs after tendonitis, and it is no longer crushed between two bones. (Simoneau et al., 2003)

Carpal tunnel syndrome is a condition in which nerves are crushed in a small region called the carpal tunnel, usually due to swelling of tendons passing nearby. Carpal tunnel syndrome is a painful disorder that affects the wrist, hand, and arm over time. Tendons, nerves, and blood arteries run via the wrist joint, which is made up of multiple carpus bones. The carpal tunnel is a space formed by these bones. It was more frequent in those who had a habit of doing repeated wrist and hand motions. Numbness and muscular weakness are symptoms of nerve damage. The carpal tunnel syndrome is usually maximum swelling at night that produces agony to the patient. According to research findings, carpal tunnel syndrome is normally happened at the hands and wrists due to a carpal tunnel anatomy. (Kamolz et al., 2004).

2.3 Anatomy of human body

The musculoskeletal system of human is an organ system that helps humans the ability to stand, sit, walk, run and move. In the adult skeleton, there are 206 bones and more than 600 muscles, connected by ligaments, tendons and soft tissues. Even through

male and female skeletons are almost the same, the female skeleton has a broader pelvis to accommodate childbirth and the male skeleton is typically taller with greater bone density (Walker, 2020). There are five general classifications of bones including long bones, short bones, flat bones, irregular bones, and sesamoid bones. The important of human skeletal is showed in Figure 1 such as cranium, vertebra, scapular, ribs, sternum, humerus, radius, ulna, pelvis, femur, patella, tibia, fibula, and talus.

The majority of human muscles comprises of anterior and posterior views. There are three types of muscles and cardiac, skeletal, and smooth. Smooth muscles are used to control the flow of substances within the lumens of hollow organs, and are not consciously controlled. Skeletal and cardiac muscles have striations that are visible under a microscope due to the components within their cells. Only skeletal and smooth muscles are part of the musculoskeletal system and only the muscles can move the body.

Skeletal muscles are working in opposition to each other to create movement. When skeletal muscle receives a signal from the somatic (motor) nerve, it shortens, pulling one bone towards the other (Walker, 2020). In the process of muscle reverse, one muscle in the pair is contracts; on the other hand, the other muscle is relaxes to straighten the bone joint. The function of muscle movement, the neuromuscular junction is the chemical synapse formed between the nerve fiber and the muscle fiber. The nerve into the synapse between the muscle and the nerve fiber releases acetylcholine, which acts as a chemical neurotransmitter to convey the electrical impulse from the nerve to the receptors in the muscle while moving (Drake et al, 2020), presented in Figure 2.

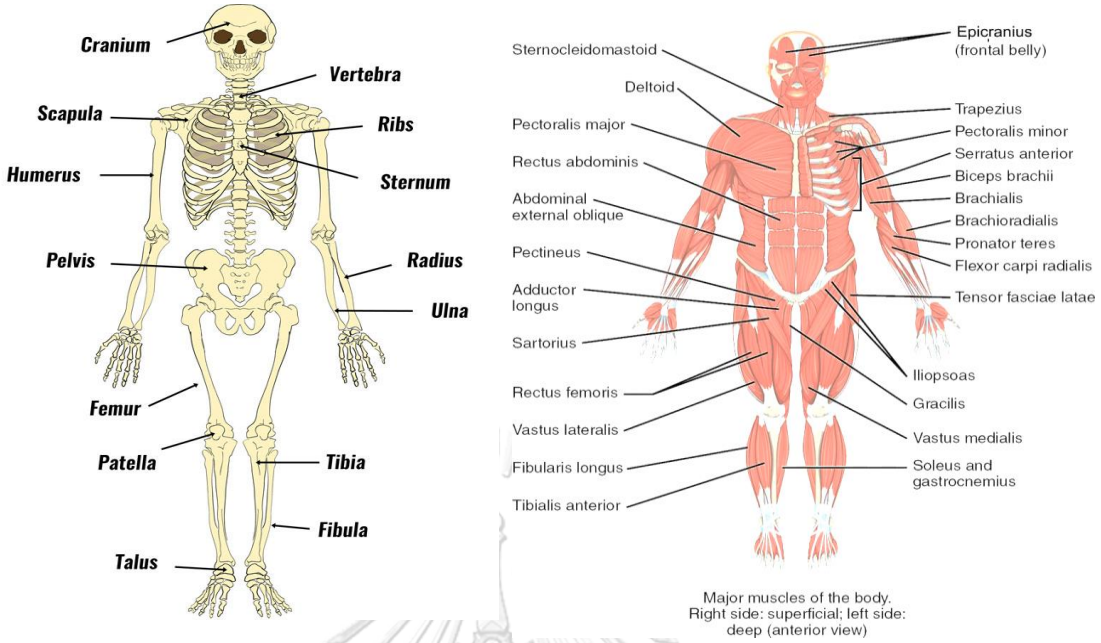


Figure 1: Human bone anatomy

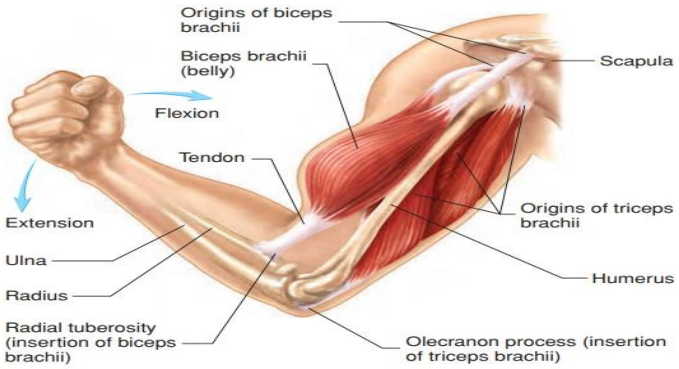


Figure 2: Skeletal Muscle Anatomy

2.4 Epidemiology of musculoskeletal disorders

In various industrial sectors such as automotive, furniture, appliances, electrical and electronic items, textiles, apparels, shoes, and foods, workers are affected by specific musculoskeletal problems. (Bernard & Putz-Anderson, 1997). Moreover, the certain occupations of clerical work, postal service, cleaner, industrial inspection and

packaging, truck driver, airplane baggage handler, construction, nurse and other patient care, and crane and other large vehicle operator have reported a high prevalence of musculoskeletal disorders (Punnett & Wegman, 2004).

Previous study of epidemiology of chronic back pain among adults and elderly found that the prevalence of chronic back pain was 20.7% among the 1,300 study participants, the factors associated with chronic back pain were women, elderly, smokers, obesity, and sleeping fewer hours pre might, as well as those with higher mental stress levels, history of fracture, arthritis/rheumatism, and work-related musculoskeletal disorder/repetitive strain injury. One-third of those with chronic back pain missed work (31%) and 68% visited the physician over a 12-month period (Saes-Silva et al., 2021). The most prevalent site for injury was back (42.5%), followed by knee (28.30%), and ankle (18.64%). Among all the injuries occurring in dancers 60, 80% injuries are of low back pain, 17% - 30% injuries are of spine, upper back injuries are 38%. Complaints related to hips was 54%, complaints for the thighs and knees were 48% whereas complaints for ankle and feet were 45% (Masal & Borkar, 2021). Results indicated that the prevalence of MSD pain was 41.9% where shoulder, neck, and lower back were the more prevalent site of MSD pain. A fair number of participants reported present job stress; moreover, there was a significant relation between MSD pain with sitting time and job stress (Bayzid et al., 2019). Most of the workers were aged below 35 years (88%) and females (82.9%) and the majority had only primary education (74.6%). The prevalence of MSD pain within 7 days of the interview was 77.1% much higher than in the general population. The most affected sites were shoulder (17.9%), lower back (15.2%), neck (13.8%) and knee (10.8%) (Shazzad et al., 2018).

2.5 Ergonomics in workplace

The term ergonomics come from Greek word means arrangement or management, and the concepts of ergonomics were introduced by Bernardini Ramazzini in the book called “The disease of occupational” (Taylor, 2004). Ergonomics is a disciplinary topic of science that deals with human posture at work, how they deal with working conditions, communicate with machines; in addition, is concerned with the study of human body size (anthropometry), the reaction of the body to internal and external

influences (biomechanics), work and environmental physiology, work-related behavior in humans, and adapting equipment and devices for human use (Scheer & Mital, 1997). Ergonomists around the world apply human-system interface technology (HSIT) to the design systems in order to improve safety, health, comfort, and performance, as well as productivity and quality (Hendrick, 2008). In this application, ergonomics was classified into three groups. Firstly, physical ergonomics is concerned with human anatomical, anthropometric, physiological, and biomechanical characteristics as they relate to physical activity. Working postures, materials handling, repetitive motions, work-related musculoskeletal problems, workplace layout, safety, and health are all essential concerns. Secondly, cognitive ergonomics is relevant to the mentality such as perception, memory, thinking and mobility. The relevant topics include metal workload, skilled performance, work stress and training as these may relate to human system design. Finally, organizational ergonomics is concerned with the optimization of sociotechnical systems, including their organizational structures, policies, and processes such as communication, work design, design of working times, cooperative work, new work paradigms, virtual organizations, telework, and quality management (International Ergonomic Association.2013)

2.6 Pathomechanisms possibly relevant to MSDs

Postural induced muscular imbalance

According to Mackinnon and his colleagues, maintaining a static posture caused muscular imbalance, with certain muscles being overworked and others being neglected. Hypertrophy occurs in the overworked group, whereas the underused group gets weaker as a result lack of usage. Maintaining an incorrect of prolonged static posture can raise pressure around peripheral nerves or stretch them, resulting in increased nerve tension and nerve compression (Mackinnon & Novak, 1994)

Neural pathomechanisms

The neutral posture is the ergonomic standard for body position while working, which support the natural curves of the spine and maintain the body in good alignment. Secondary sequelae of compressive force when maintaining an improper or prolonged static posture include neural processes, the peripheral nerve trunks are strongly

vascularized and compression occurred may induce an inflammatory reaction around the nerve trunks and edema and a reduction in vascular supply. This pathomechanism stimulates fibroblast invasion in the nerves (Lundberg et al., 1994).

2.7 Main factors related to MSDs

a. Repetitive and rapid motions: Musculoskeletal discomfort can be caused by repetitive or quick movements that must be done regularly over a lengthy period of time. Tasks requiring repetitive movements always involve other risk factors for MSDs such as fixed body position and force, in order to perform the task, has to maintain the shoulder and neck in a fixed position to exert some force. As a result of overload injured tissues and primarily in the upper limbs studies, work related upper limb disorders are the name for these illnesses and problems (Ringelberg & Koukoulaki, 2002). However, there are no rules to judge movements as either high or low in repetition. Even no exactly evidence confirms that what is the point of MSDs may develop, workers performing repetitive tasks are at risk for MSDs. The high-risk repetition rates by different body parts is showed in Table 1.

Table 1: High risk repetition rates by different body parts

Body part	Repetitive per minute
Shoulder	More than 2.5
Upper arm/Elbow	More than 10
Forearm/Wrist	More than 10
Finger	More than 200

b. Vibration is a mechanical phenomenon whereby oscillations occur about an equilibrium point. However, sound is also produced the vibration that makes particles in the air form sound waves. Long-term vibration exposure probably leads to muscle pains, especially on hand and arm. Over the less, significant symptoms are vibration white fingers (VWF) and neurosensory symptoms and signs in the hands, such as numbness, tingling, reduced grip strength and decreased manual dexterity. Workers who use electric or pneumatic tools experiences vibration. It constitutes a musculoskeletal disorder risk for upper limbs like vascular disorders (white fingers

syndrome), neurological problem (carpal tunnel syndrome) and joint disorders of the wrist, elbow, and shoulder (osteoarthritis). (osteoarthritis) (Simoneau et al., 2003)

c. Awkward posture refers to positions of the body that deviate significantly from the neutral position while performing work activities such as twisting, bending, exerting, reaching, pulling, or lifting. When workers are in an awkward posture, muscles operate less efficiently and you expend more force to complete the task. Awkward posture is generally a long way from the joint's range of motion limitations as showed in Figure 3 and 4. There are three reasons why the posture may be insufficient while working. For starters, it is excessive if it's near the joint's range of motion limit. The wrist can either be completely flexed or fully extended. Secondly, posture can be difficult to maintain if it only possible to do so by resisting gravity. Finally, certain postures are dangerous because they put the anatomical structures in a position where they cannot function properly. Examples of awkward postures are working with hands above your head, elbows above shoulders, working with neck or back bent over 30 degrees angle without support and without the ability to vary posture. For application, maintaining the arm above the shoulder, for example, restricts blood flow, lowering muscular capacity. As a result, the amount of discomfort induced by a posture will depend on how far it is from a relaxed position, how often it is adopted, and how long it is maintained (Simoneau et al., 2003)

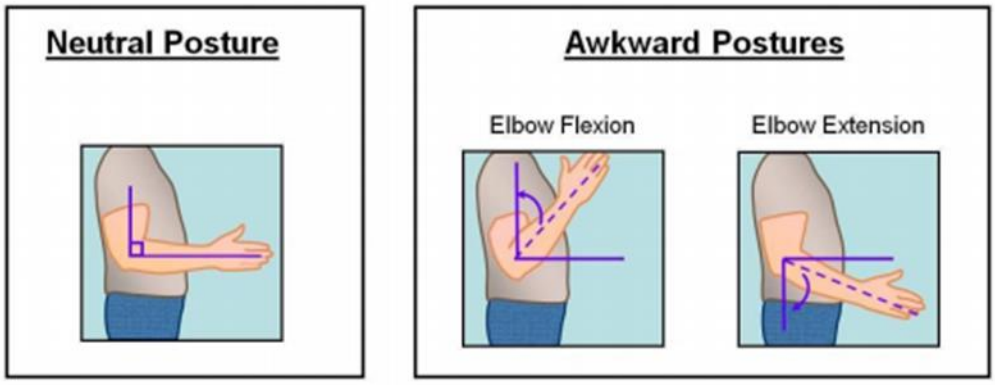


Figure 3: Neutral and awkward elbow postures

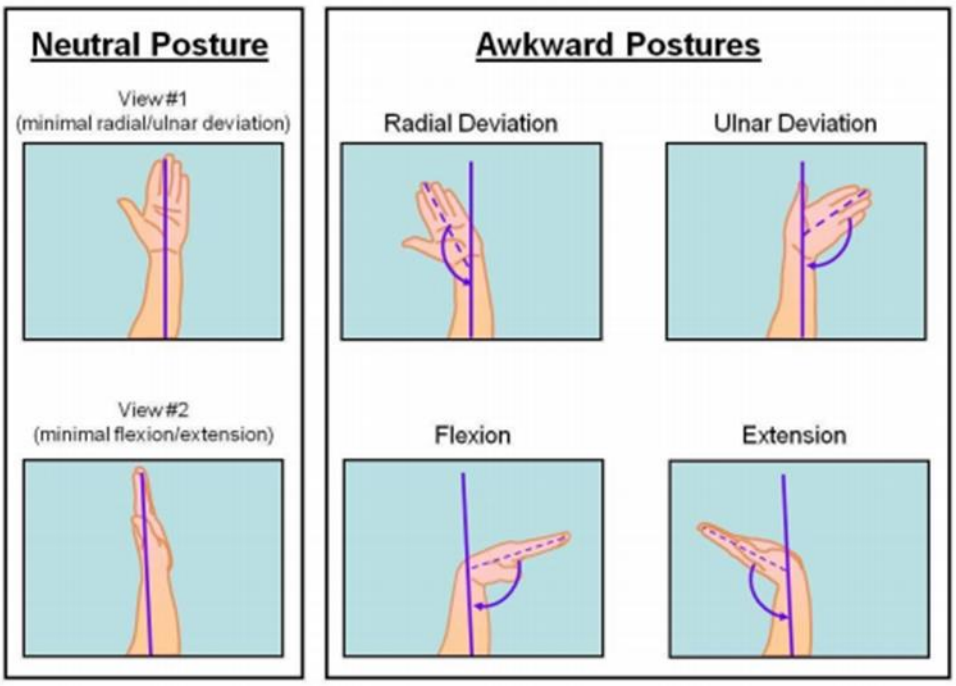


Figure 4: Neutral and awkward wrist postures

d. Forceful exertion is a simple cause of injury among workers in industrial sectors. Lifting, pulling, pushing, carrying, and dumping the products normally result in muscle injuries or other types of musculoskeletal disorders. This relates to the effort's intensity as well as its endurance. Larger forces result in higher stresses on the muscles, tendons, and joints, which can lead to muscle fatigue fast. Musculoskeletal disorders can be caused by both the initial forces to be given and the frequency of muscular force exertion (Ringelberg & Koukoulaki, 2002)

e. Psychosocial factors

Psychosocial pathways to musculoskeletal pain evokes an increased perceived work-related stress, and exposure to psychosocial factors in the workplace leads to psychological stress. Psychosocial factors such as feeling of tension, social help, low job control, work fulfillment, repetitive work which might related to MSDs. This may increase of muscle activity, secretion of cortisol, and catecholamines that can develop musculoskeletal symptoms (Bongers et al., 1993). In addition, accumulated stress may be involved in the development of musculoskeletal pain due to increased and sustained stress induced muscle tension and lack of muscle rest (Larsman & Hanse, 2009).

2.8 Related research

Study in Sri Lanka of 164 (15.5%) workers reported that musculoskeletal symptoms occurring more than 3 times or lasting a week or more during the previous 12-month period. Back (57.3%) and knee (31.7%) were the most common sites of pain. Prevalence of MSDs correlated positively with increased age and industry tenure of less than 12 months. Over the less, job type, body mass index, and education were not significant predictors of musculoskeletal symptoms (Lombardo et al., 2012).

In Bangladesh study of 401 garment workers in manufacturing industry, the prevalence of lower back pain was highest at 41% and followed by pain in the knees at 33%. The risk factor of developing MSD was significantly higher for age group between 25 and 30 years and age group over 31 years (Nabi et al., 2021b).

The prevalence of moderate to severe musculoskeletal pain in the neck and shoulder region was 24% and distal upper extremity was 16% among sewing machine operators in Los Angeles, the US. Elevated prevalence of upper body pain was associated with age less than 30 years, female gender, working more than 10 years as a sewing machine operator, using a single sewing machine, high physical exertion, high job demand, and low job satisfaction (Wang et al., 2007).

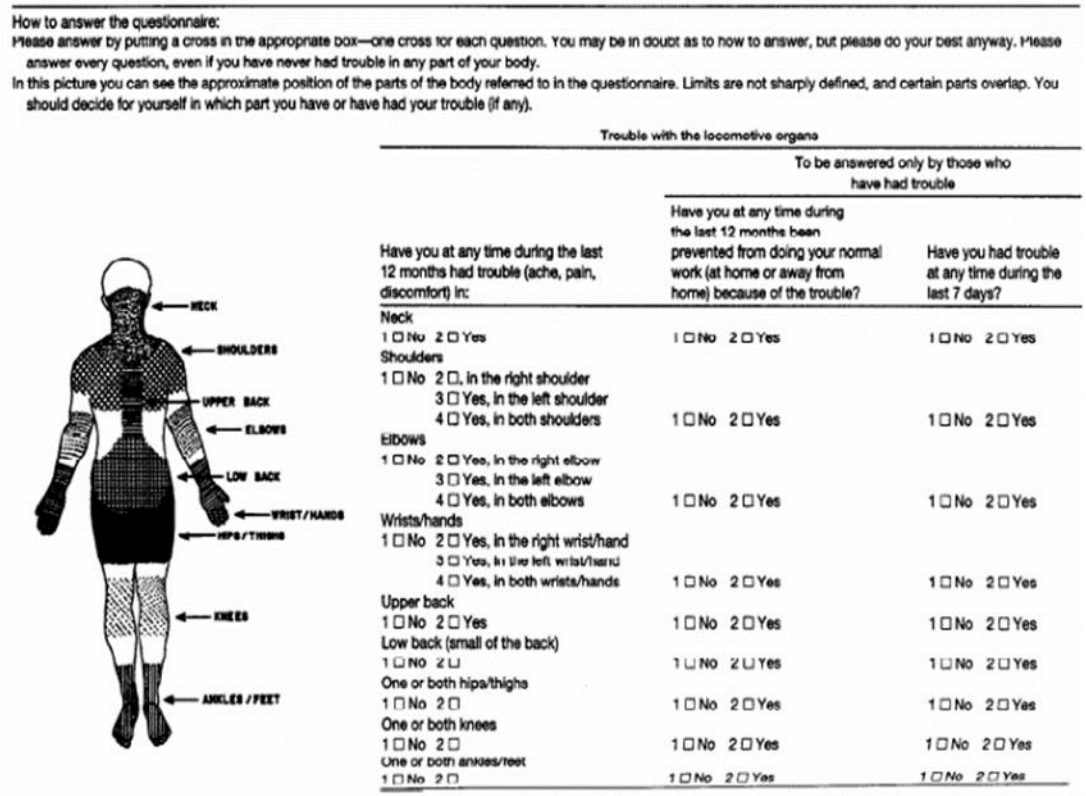
A cross-sectional study of 1439 among Iranian steel workers, they aged average (SD) was 37.23±8.74 years. About 46.3% in the past week and 61% in the last year claimed one of MSDs in their bodies. Lumbar, knee(s) and neck areas had the most common musculoskeletal disorders. Moreover, the job time of work and BMI were significant association with MSDs (M. Aghilinejad et al., 2012)

In 2021, an investigation to identify the causes of low back pains among 151 garment workers in Bangladesh revealed that 70.86% of garment workers suffered from low back pain, 71.42% of them having LBP are overweight, 78% of the interviewed smoking workers have LBP, and all of them used non-adjustable chair. The recommendation includes ensuring appropriate working postures and providing ergonomically designed chairs (Iqbal et al., 2021).

2.9 Assessment tools for MSD

Standardized Nordic Questionnaire (SNQ)

SNQ was founded by the Nordic Council of Ministers. The following questions of NSQ included nine body regions in total consisted of neck, shoulders, elbows, wrists, hands, upper back, lower back, hip, thighs, knee, ankle, and feet. The responders just select a response “yes” or “no” in each question during 12 months and 7 days with the picture showing the body areas. In this study use of SNQ to detect musculoskeletal symptoms in an ergonomic or occupational health environment is well known (Kuorinka et al., 1987) as shows in Figure 5. SNQ has been widely used to screen for musculoskeletal symptoms among sewing machine operators in Turkey (Öztürk & Esin, 2011), forest workers in Greece (Gallis, 2006), Chinese foundry worker (Lei et al., 2005), and sugarcane farmer in Northeast Thailand (Phajan et al., 2014).



How to answer the questionnaire:

Please answer by putting a cross in the appropriate box—one cross for each question. You may be in doubt as to how to answer, but please do your best anyway. Please answer every question, even if you have never had trouble in any part of your body.

In this picture you can see the approximate position of the parts of the body referred to in the questionnaire. Limits are not sharply defined, and certain parts overlap. You should decide for yourself in which part you have or have had your trouble (if any).

Trouble with the locomotive organs	To be answered only by those who have had trouble	
Have you at any time during the last 12 months had trouble (ache, pain, discomfort) in:	Have you at any time during the last 12 months been prevented from doing your normal work (at home or away from home) because of the trouble?	Have you had trouble at any time during the last 7 days?
Neck 1 ☐ No 2 ☐ Yes	1 ☐ No 2 ☐ Yes	1 ☐ No 2 ☐ Yes
Shoulders 1 ☐ No 2 ☐, in the right shoulder 3 ☐ Yes, in the left shoulder 4 ☐ Yes, in both shoulders	1 ☐ No 2 ☐ Yes	1 ☐ No 2 ☐ Yes
Elbows 1 ☐ No 2 ☐ Yes, in the right elbow 3 ☐ Yes, in the left elbow 4 ☐ Yes, in both elbows	1 ☐ No 2 ☐ Yes	1 ☐ No 2 ☐ Yes
Wrists/hands 1 ☐ No 2 ☐ Yes, in the right wrist/hand 3 ☐ Yes, in the left wrist/hand 4 ☐ Yes, in both wrists/hands	1 ☐ No 2 ☐ Yes	1 ☐ No 2 ☐ Yes
Upper back 1 ☐ No 2 ☐ Yes	1 ☐ No 2 ☐ Yes	1 ☐ No 2 ☐ Yes
Low back (small of the back) 1 ☐ No 2 ☐	1 ☐ No 2 ☐ Yes	1 ☐ No 2 ☐ Yes
One or both hips/thighs 1 ☐ No 2 ☐	1 ☐ No 2 ☐ Yes	1 ☐ No 2 ☐ Yes
One or both knees 1 ☐ No 2 ☐	1 ☐ No 2 ☐ Yes	1 ☐ No 2 ☐ Yes
One or both ankles/feet 1 ☐ No 2 ☐	1 ☐ No 2 ☐ Yes	1 ☐ No 2 ☐ Yes

Figure 5:Nordic Standardized Questionnaire

CHAPTER 3
METHODOLOGY

3.1 Study Design

A cross-sectional research design was conducted to study the association between working condition and musculoskeletal symptoms among garment worker in Khan Mean Chey, Phnom Penh city, Cambodia during the April 2022 to May 2022.

3.2 Study Area

Phnom Penh is the capital of Cambodia, surrounded by Kandal province which has total area 676 km2. It has become the national economic, industrial, and cultural center. According to General Population Census of the Kingdom of Cambodia 2019 were 2.282 million people approximately 14% of the Cambodian people that most of them come from another province to find a job especially in garment factory. Khan (district) Mean Chey is located in the southeastern part of Phnom Penh. In 2020 Khan Mean Chey is subdivided in to seven communes and 59 villages.

3.3 Study Population

There are 24 factories with 30257 garment workers in Khan Mean Chey according to Garment Manufacturers Association in Cambodia, following the inclusion and exclusion criteria in the study:

Inclusion Criteria

- Female workers≥18 years old.
- Work in sewing, cutting, buttoning, and ironing sections
- Willing to participate in the study

Exclusion Criteria

- Illiterate in Khmer

- Pregnancy
- History of bone fracture
- Having arthritis, rheumatoid arthritis, gout and take medication prescript from doctor.

3.4 Sample size

The sample size is calculated by Formula (Yamane, 1967)

$$n = \frac{N}{1 + Ne^2}$$

n= sample size

N= population=30257

e= level of precision (0.05)

n=394

Assume the loss of response 5%=19

Therefore, the total sample size is 423

Table 2: List of garment factory's name and number of workers

Factory's name	Workers
1. Grand Textiles (Cambodia) Co., Ltd.	969
2. M & V International Manufacturing Ltd.	5534
3. Broadland Cambodia Garment Industries	503
4. W & D (Cambodia) Co., Ltd.	841
5. Great Union (Cambodia) Garment Co., Ltd.	1050
6. Makalot Garments (Cambodia) Co., Ltd.	5157
7. Hoyear (Cambodia) Garment limited	1052
8. Shen Zhou (Cambodia) Co., Ltd	2050
9. Star Sportwear Ltd.	981
10. Seeds Garment (Cambodia) Co., Ltd.	1350
11. New Rainbow (Cambodia) Co., Ltd.	316
12.CG Glory (Cambodia) Manufacturing Limited	1017
13. SEIL (Cambodia) Co., Ltd.	350
14. Kang Da Garment Co., Ltd.	490
15. Cam Forever Co., Ltd.	1269
16. Kai Yue (Cambodia) Co., Ltd.	502
17. Din Han Enterprise Co., Ltd.	2855
18. Star Fuyu Garment Company Limited	652
19. Soo Apparel (Cambodia) Co., Ltd.	399
20. Choung Hao Garment Co., Ltd.	1000
21. Nasmi Industry Co., Ltd.	332
22. S.L.J (Cambodia) Apparel Manufacturing Co., Ltd.	731
23. MT. Yeh's Garment (Cambodia) Co., Ltd.	337
24. Morica Industry Co., Ltd.	500

GMAC (Garment Manufactures Associations in Cambodia) 2022

3.5 Sampling strategy

In Phnom Penh city, there are many of Khan. Khan Mean Chey is purposively selected. The subjects were conveniently recruited from the eligible population according to inclusion and exclusion criteria. The subject recruitment date was set up for each area in this district and the information of the research was posted nearby living area of the garment workers. Thus, the garment workers who saw this announcement and meet the criteria feel free to participate in this research. In the subject recruitment day, researcher and research assistants went to that area and hand out the questionnaire to the garment worker who participated in this study.

3.6 Measurement

In this study the questionnaire includes 3 main parts

A. Socio demography: age, education, weight, height, smoking, alcohol consumption, health status, and exercise.

B. Working condition: divided into three parts

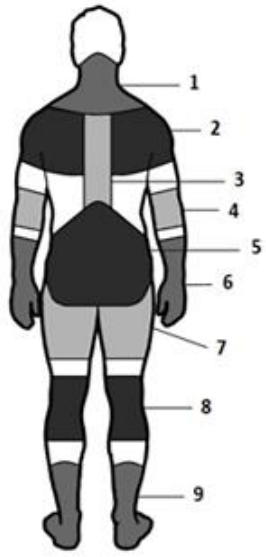
- Work characteristics: working section, daily working time, weekly working time, working experience, work repetitive, and twisting activities while working.
- Work environment: level of chair, head and back position while working, temperature, air ventilated, light, vibrate, and noise pollution.
- Psychosocial factors: feeling work continuously for a long time, getting enough rest during the workday, feeling that the work's heavy, and feeling stress at work.

This questionnaire was sent to 3 experts in this field to test its validity prior to the research study. The validity score for this questionnaire was 0.87.

C. Standardized Nordic Questionnaire: For symptom of musculoskeletal, there are 9 questions with “Yes” and “No” answers. If “Yes” means present the symptom of musculoskeletal disorders.

According to the SNQ, the pain was divided in two phases consisted of the pain from within 7 days as acute phase and the pain from the previous 12 months as chronic phase.

Table 3: Standardize Nordic Questionnaire (SNQ)

Body map	Body parts	Have you had trouble (ache, pain, discomfort) at any time during the last 12 months?		Have you had trouble (ache, pain, discomfort) at any time during the last 7 days?	
	1. Neck	☐ Yes	☐ No	☐ Yes	☐ No
	2. Shoulders	☐ Yes	☐ No	☐ Yes	☐ No
	3. Upper back	☐ Yes	☐ No	☐ Yes	☐ No
	4. Elbows	☐ Yes	☐ No	☐ Yes	☐ No
	5. Lower back	☐ Yes	☐ No	☐ Yes	☐ No
	6. Wrists/hands	☐ Yes	☐ No	☐ Yes	☐ No
	7. Hips/thighs	☐ Yes	☐ No	☐ Yes	☐ No
	8. Knees	☐ Yes	☐ No	☐ Yes	☐ No
	9. Ankles/feet	☐ Yes	☐ No	☐ Yes	☐ No

3.7 Data Collection

First, Khan Mean Chey was chosen as a study area. Address of each factory was in the Garment Manufacturers Association in Cambodia (GMAC). Then, researcher went to every area of Khan Mean Chey to post an announcement for two days before data collection. Prior to conduct the study, the research assistant was trained to help to interview of participants. Two days later, researcher and researcher assistants went to collect data by face-to-face interview. All participant responses were filled-in by researcher and research assistant without show identification of the participants and took around 5 to 10 minutes per person.

3.8 Data analysis strategy

The questionnaire used to collect information on the following variables: socio demographic, working condition, and presence or absence of musculoskeletal symptoms in the previous 12 months and the previous 7 days (dependent variables). According to the MSDs, participants were requested to report in the form of yes or no answers. If they had any trouble in various parts of the body including neck, shoulder, upper back, elbow, lower back, hand, hip, knee, and angle during the last 7 days and 12 months.

In statistical applications, data analysis used both descriptive and analytical statistics. Descriptive statistic used to investigations of the socio demographics and working conditions, and musculoskeletal symptoms. The analytical statistic, either chi-square test or fisher-exact test was used to assess the relationships between musculoskeletal symptom prevalence and above independent variables. Data analysis was conducted using the IBM statistical package for the social sciences (SPSS) version 22. The significance level was set at p-value less than 0.05.

3.9 Ethical issue

The study protocol was approved by the National Ethic Committee for Health Research (NECHR) of Ministry of Health in Cambodia No 149 NECHR.

CHAPTER 4
RESULTS

This chapter presents detailed results of the study on association between working condition and musculoskeletal symptoms among female garment workers.
The results including:

- Socio-demographic information
- Work condition of respondents
- 12-month and 7-day prevalence of musculoskeletal symptoms among 9 body regions of respondents
- Association between MSDs, and socio demographics and working conditions (work characteristic, work environment and psychosocial factor).

4.1 Socio demographic of participants

In the sociodemographic characteristic of participants in Table 4, the median age of participants was 33 years with minimum of 18 years and maximum of 58 years. Approximately three-quarter (74.5%) of garment workers were married and around half of them (51.8%) graduated from primary school. For the body mass index, 68.3% of participants were in the range of normal weight, followed by 21.3% were in the range of overweight, and 10.4% were in the range of underweight. Majority of participants had never done physical exercise (63.1%) without medical condition (73%). Only few of participants currently drink alcohol was 9.9%. Of all garment workers, more than one-half (52.2%) of them got income between 200-300 USD per month.

Table 4: Socio demographic

Sociodemographic	Number	Percentage
Age(years)		
<30	168	39.7
31-40	177	41.8
41-50	68	16.1
>50	10	2.4
Median=33 and range (minimum-maximum)=18-58		
Marital status		
Single	82	19.4
Married	315	74.5
Widow	26	6.1
Education level		
Primary school	219	51.8
Secondary school	171	40.4
High school	29	6.9
Above high school	4	.9
BMI		
Under weigh <18.5 kg/m2)	44	10.4
Normal (≥18.5 and <25 kg/m2)	289	68.3
Overweight (≥25 kg/m2)	90	21.3
Exercise		
Never	267	63.1
≤3 times/week	127	30.0
>3 times/week	29	6.9
Alcohol		
Never	343	81.1
Drunk in the past	38	9.0
Current drinking	42	9.9
Medical condition		
No	309	73.0
Yes	114	27.0
Income (1USD=115.9 Reil)*		
<200 USD	172	40.7
200-300 USD	221	52.2
>300 USD	30	7.1

* minimum wages in Cambodia = 194 USD

4.2 Working condition

In various types of work such as sewing, cutting, buttoning, and ironing, the majority of respondents 73.8% were sewing machine operators, working for eight hours per day in official work hour and 95.5% of respondents did overtime. About the duration of employment in garment industry, more than half of respondents reported that they had worked less than 3 years. Respondents self-reported exposure to repetitive movement 81.6%, sitting on chair without backrest 38.3%.

Table 5: Work characteristic

Work characteristic	Number	Percentage
Work section		
Sewing	312	73.8
Cutting	25	5.9
Buttoning	11	2.6
Ironing	75	17.7
Working hour per day		
8 h (official)	423	100
Over time		
Never	19	4.5
≤2 h	224	53.0
>2 h	180	42.5
Duration of employment		
<3 years	240	56.8
3-6 years	83	19.6
>6 years	100	23.6
Media =3		
Range (1-20)		
Repetitive movement		
No	78	18.4
Yes	345	81.6
Chair with backrest		
No	261	61.7
Yes	162	38.3
Adjustable chair		
No	419	99.1
Yes	4	0.9
Table height		
Elbow level	328	77.5
Above or below elbow level	95	22.5
Feet can step on the floor during working		
No	34	8.0
Yes	389	92.0
Head position during working		
Straight	161	38.1
Either backward or forward	262	61.9
Temperature		
Too cool	3	0.7
Moderate	348	82.3
Too hot	72	17.0
Noisy		
Too noisy	33	7.8
Noisy but acceptable	390	92.2

4.3 Psychosocial factors

The percentage of psychosocial factors regroup in yes (strongly agree and agree), neutral and no (strongly disagree and disagree) presented in table 6. For the content we find out they feel uninteresting 5.2% and 12% of them not get enough rest. There was

only 8.5% of them, feel that this work is heavy, and 20.3% of them they feel stress at work place, 26% no encourage and 18.7% of them feel they get pressure from the manager.

Table 6: Psychosocial factor

Psychosocial factor	Yes	Neutral	No
	n (%)	n (%)	n (%)
1. Do you think that your job is an uninteresting job?	363 (85.8)	38 (9)	22 (5.2)
2. Do you think that you get enough rest during the workday?	326 (77.1)	46 (10.9)	51 (12)
3. Do you feel that your work is heavy?	36 (8.5)	90 (21.3)	297 (70.2)
4. Do you feel that your work is stressful?	86 (20.3)	114 (27)	223 (52.7)
5. Do you feel that no encouraging at your workplace?	295 (69.7)	41 (9.7)	87 (20.6)
6. Do you think that you get pressure from your boss?	79 (18.7)	70 (16.5)	274 (64.8)

4.4 The prevalence of MSDs in the past 7 days and in the past 12 months

All participants in this study were asked about their troubles (discomfort, ache, and pain) in 9 body regions in the last 7 days and last 12 months. In Figure 6, the top three highest prevalence of MSDs in the last 7 days were neck (14.9%), shoulder (11.9%), and lower back (11.6%), and in the past 12 months were shoulder (21.0%), neck (18.4%), and lower back (15.3%).

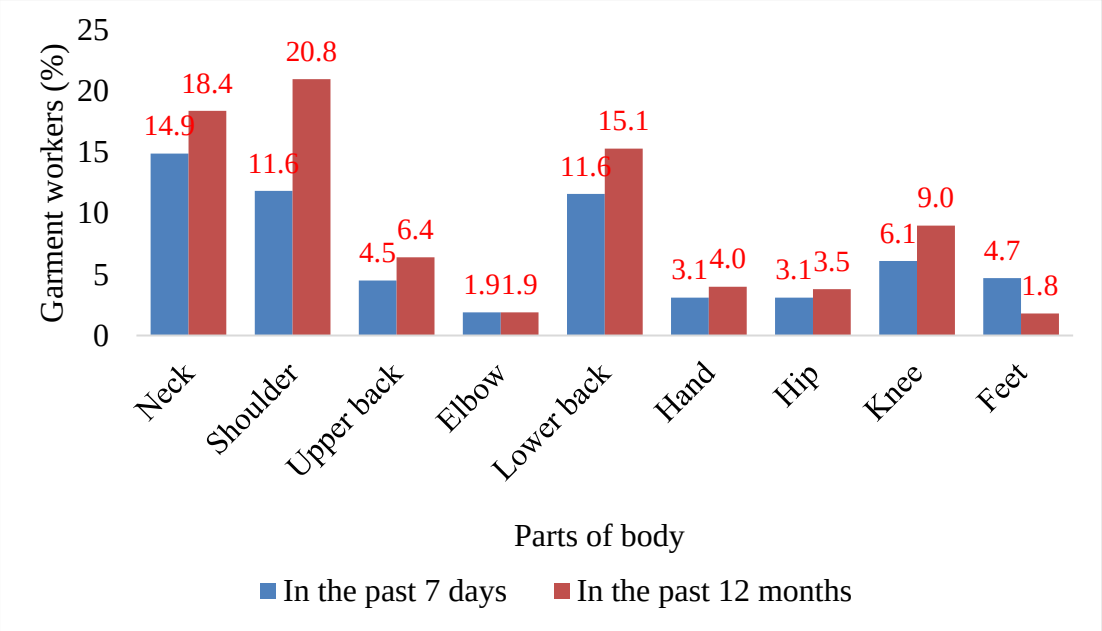


Figure 6: Prevalence of MSDs

4.5 Association between socio demographic and MSDs in the past 7days

Table 5 showed the association between socio-demographic and MSDs in past 7 days. Participants reported the body pain at least one region classified into "yes (with MSDs)", and who not reported the body pain classified into "no (without MSDs)". There was significant association between MSDs and medical condition ($p<0.001$) and exercise ($p=0.044$). However, age, education level, BMI, and income were no significant associate with MSDs in past 7 days.

Table 7: Association between sociodemographic and MSDs in past 7 day

Sociodemographic	Total N(%)	MSDs in past 7 days Yes N(%)	No N(%)	*P*-value
Age(years)				
<30	168	80 (39.2%)	88 (40.2)	0.569
31-40	177	86 (42.2)	91 (41.6)	
41-50	68	31 (15.2)	37 (16.9)	
>50	10	7 (3.4)	3 (1.4)	
Median=33 and range (minimum-maximum)=18-58				
Marital status				
Single	82	33 (16.2)	49 (22.4)	0.207
Married	315	160 (78.4)	155 (70.8)	
Widow	26	11 (5.4)	15 (6.8)	
Education level				
Primary school	219	105 (51.5)	114 (52.1)	0.877
Secondary school	171	84 (41.2)	87 (39.7)	
High school	29	14 (6.9)	15 (6.8)	
Above high school	4	1 (0.5)	3 (1.4)	
BMI				
Under weigh <18.5 kg/m2)	44	19 (9.3)	25 (11.4)	0.266
Normal (≥18.5 and <25 kg/m2)	289	135 (66.2)	154 (70.3)	
Overweight (≥25 kg/m2)	90	50 (24.5)	40 (18.3)	
Exercise				
Never	267	137 (67.2)	130 (59.4)	**0.044**
≤3 times/week	127	50 (24.5)	77 (35.2)	
>3 times/week	29	17 (8.3)	12 (5.5)	
Alcohol				
Never	343	163 (79.9)	180 (82.2)	0.451
Drunk in the past	38	17 (8.3)	21 (9.6)	
Current drinking	42	24 (11.8)	18 (8.2)	
Medical condition				
No	309	134 (65.7)	175 (79.9)	< **0.001**
Yes	114	70 (34.3)	44 (20.1)	
Income (1USD=115.9 Reil)				
<200 USD	172	73 (35.8)	99 (45.2)	0.052
200-300 USD	221	119 (58.3)	102 (46.6)	
>300 USD	30	12 (5.9)	18 (8.2)	

Note: significant at $p<0.05$, * Fisher exact test

Association between work characteristic and MSDs in the past 7 days demonstrated that head position during working, and temperature were significant associated with MSDs at p=0.011, and p=0.035, respectively. While, work section, working overtime, duration of employment in the garment factory were no significant associated with MSDs.

Table 8: Work characteristic associated with MSDs in the past 7 days

Work characteristic	Total n(%)	MSDs in past 7 days Yes n(%)	No n(%)	*P*-value
Work section				
Sewing	312	157 (77)	155 (70.8)	0.167
Cutting	25	7 (3.4)	18 (8.2)	
Buttoning	11	6 (2.9)	5 (2.3)	
Ironing	75	34 (16.7)	41 (18.7)	
Over time				
Never	19	11 (5.4)	8 (3.7)	0.633
≤2 h	224	105 (51.5)	119 (54.3)	
>2 h	180	88 (43.1)	92 (42)	
Duration of employment				
<3 years	240	112 (54.9)	128 (58.4)	0.669
3-6 years	83	40 (19.6)	43 (19.6)	
>6 years	100	52 (25.5)	48 (21.9)	
Media =3				
Range (1-20)				
Repetitive movement				
No	78	37 (18.1)	41 (18.7)	0.887
Yes	345	167 (81.9)	178 (81.3)	
Chair with backrest				
No	261	121 (59.3)	140 (63.9)	0.329
Yes	162	83 (40.7)	79 (36.1)	
Adjustable chair				
No	419	203 (99.5)	216 (98.6)	0.624
Yes	4	1 (0.5)	3 (1.4)	
Table height				
Elbow level	328	162 (79.4)	166 (75.8)	0.374
Above or below elbow level	95	42 (20.6)	53 (24.2)	
Feet can step on the floor during working				
No	34	17 (8.3)	17 (7.8)	0.829
Yes	389	187 (91.7)	202 (92.2)	
Head position during working				
Straight	161	65 (31.9)	96 (43.8)	**0.011**
Either backward or forward	262	139 (68.1)	123 (56.2)	
Temperature				
Too cool	3	3 (1.5)	0 (0)	**0.035***
Moderate	348	160 (78.4)	188 (85.8)	
Too hot	72	41 (20.1)	31 (14.2)	
Noise				
Too noisy	33	21 (10.3)	12 (5.5)	0.065
Noisy but acceptable	390	183 (89.7)	207 (94.5)	

Note: significant at p<0.05 ,* Fisher exact test

The association between psychosocial factor and MSDs in the past 7 days indicated that they felt the work is heavy was significantly associated with MSDs at p=0.044 and p=0.014, respectively. The finding is presented in the Table 7

Table 9: Psychosocial associated with MSDs in the past 7 days

Psychosocial factor	Total n(%)	MSDs in past 7 days Yes n(%)	No n(%)	P-value
Do you think that your job is an uninteresting job?				
Yes	363 (85.8)	174 (85.3)	189 (86.3)	0.957
Neutral	38 (9)	19 (9.3)	19 (8.7)	
No	22 (5.2)	11 (5.4)	11 (5)	
Do you think that you get enough rest during the workday?				
Yes	326 (77.1)	147 (72.1)	179 (81.7)	0.056
Neutral	46 (10.9)	26 (12.7)	20 (9.1)	
No	51 (12)	31 (15.2)	20 (9.1)	
Do you feel that your work is heavy?				
Yes	36 (8.5)	12 (5.9)	24 (11)	**0.014**
Neutral	90 (21.3)	54 (26.5)	36 (16.4)	
No	297 (70.2)	138 (67.6)	159 (72.6)	
Do you feel that your work is stressful?				
Yes	86 (20.3)	40 (19.6)	46 (21)	0.303
Neutral	114 (27)	62 (30.4)	52 (23.7)	
No	223 (52.7)	102 (50)	121 (55.3)	
Do you feel that no encouraging at your workplace?				
Yes	295 (69.7)	144 (70.6)	151 (68.9)	0.840
Neutral	41 (9.7)	18 (8.8)	23 (10.5)	
No	87 (20.6)	42 (20.6)	45 (20.5)	
Do you think that you get pressure from your boss?				
Yes	79 (18.7)	42 (20.6)	37 (16.9)	0.105
Neutral	70 (16.5)	40 (19.6)	30 (13.7)	
No	274 (64.8)	122 (59.8)	152 (69.4)	

Note: significant at $p<0.05$

4.6 Association between socio demographic and MSDs in the past 12 months

Table 10 showed the association between socio demographic and MSDs in the past 12 months. The results revealed that only age and alcohol consumption were significant associated with MSDs at p=0.017 and p=0.016, respectively.

Table 10: Socio demographic associated with MSDs in the past 12 months

Sociodemographic	Total N(%)	MSDs in past 12 months Yes N(%)	No N(%)	*P*-value
Age(years)				
<30	168	95 (37.1)	73 (43.7)	**0.017**
31-40	177	105 (41)	72 (43.1)	
41-50	68	46 (18)	22 (13.2)	
>50	10	10 (3.9)	0 (0)	
Median=33 and range (minimum-maximum)=18-58				
Marital status				
Single	82	45 (17.6)	37 (22.2)	0.472
Married	315	194 (75.8)	121 (72.5)	
Widow	26	17 (6.6)	9 (5.4)	
Education level				
Primary school	219	136 (53.1)	83 (49.7)	0.422
Secondary school	171	100 (39.1)	71 (42.5)	
High school	29	19 (7.4)	10 (6)	
Above high school	4	1 (0.4)	3 (1.8)	
BMI				
Under weigh <18.5 kg/m2)	44	22 (8.6)	22 (13.2)	0.319
Normal (≥18.5 and <25 kg/m2)	289	178 (69.5)	111 (66.5)	
Overweight (≥25 kg/m2)	90	56 (21.9)	34 (20.4)	
Exercise				
Never	267	156 (60.9)	111 (66.5)	0.308
≤3 times/week	127	79 (30.9)	48 (28.7)	
>3 times/week	29	21 (8.2)	8 (4.8)	
Alcohol				
Never	343	199 (77.7)	144 (86.2)	**0.016**
Drunk in the past	38	23 (9)	15 (9)	
Current drinking	42	34 (13.3)	8 (4.8)	
Medical condition				
No	309	184 (71.9)	125 (74.9)	0.500
Yes	114	72 (28.1)	42 (25.1)	
Income (1USD=115.9 Reil)				
<200 USD	172	102 (39.8)	70 (41.9)	0.889
200-300 USD	221	135 (52.7)	86 (51.5)	
>300 USD	30	19 (7.4)	11 (6.6	

Note: significant at p<0.05

Table 11: Work characteristic associated with MSDs in the past 12 months

Work characteristic	Total n(%)	MSDs in past 12 months Yes n(%)	No n(%)	*P*-value
Work section				
Sewing	312	202 (78.9)	110 (65.9)	**0.003***
Cutting	25	8 (3.1)	17 (10.2)	
Buttoning	11	4 (1.6)	7 (4.2)	
Ironing	75	42 (16.4)	33 (19.8)	
Over time				
Never	19	11 (4.3)	8 (4.8)	0.241
≤2 h	224	144 (56.3)	80 (47.9)	
>2 h	180	101 (39.5)	79 (47.3)	
Duration of employment				
<3 years	240	149 (58.2)	91 (54.5)	0.424
3-6 years	83	45 (17.6)	38 (22.8)	
>6 years	100	62 (24.2)	33 (22.8)	
Media =3				
Range (1-20)				
Repetitive movement				
No	78	41 (16)	37 (22.2)	0.111
Yes	345	215 (84)	130 (37.8)	
Chair with backrest				
No	261	148 (57.8)	113 (67.7)	**0.042**
Yes	162	108 (42.2)	54 (32.3)	
Adjustable chair				
No	419	254 (99.2)	165 (98.8)	0.665
Yes	4	2 (0.8)	2 (1.2)	
Table height				
Elbow level	328	199 (77.7)	129 (77.2)	0.906
Above or below elbow level	95	57 (22.3)	38 (22.8)	
Feet can step on the floor during working				
No	34	18 (7)	16 (9.6)	0.346
Yes	389	238 (93)	151 (90.4)	
Head position during working				
Straight	161	88 (34.4)	73 (43.7)	0.053
Either backward or forward	262	168 (65.6)	94 (56.3)	
Temperature				
Too cool	3	3 (1.2)	0 (0)	**0.019***
Moderate	348	201 (78.5)	147 (88)	
Too hot	72	52 (20.3)	20 (12)	
Noise				
Too noisy	33	28 (10.9)	5 (3)	**0.003**
Noisy but acceptable	390	228 (89.1	162 (97)	

Note: *=significant at p<0.05, *Fisher exact test

Table 12 showed the association between psychosocial factor and MSDs in the past 12 months. The finding revealed that they felt the they do not get enough rest during the workday and they felt get pressure from their manger were significantly associated with MSDs at p=0.046 and p=0.004, respectively

Table 12: Psychosocial factor associated with MSDs in the past 12 months

Psychosocial factor	Total n(%)	MSDs in past 7 days Yes n(%)	No n(%)	P-value
Do you think that your job is an uninteresting job?				
Yes	363 (85.8)	216 (84.4)	147 (88)	0.566
Neutral	38 (9)	25 (9.8)	13 (7.8)	
No	22 (5.2)	15 (5.9)	7 (4.2)	
Do you think that you get enough rest during the workday?				
Yes	326 (77.1)	190 (74.2)	136(81.4)	**0.046**
Neutral	46 (10.9)	27 (10.5)	19 (11.4)	
No	51 (12)	39 (15.2)	12 (7.2)	
Do you feel that your work is heavy?				
Yes	36 (8.5)	20 (7.8)	16 (9.6)	0.635
Neutral	90 (21.3)	52 (20.3)	38 (22.8)	
No	297 (70.2)	184 (71.9)	113 (67.7)	
Do you feel that your work is stressful?				
Yes	86 (20.3)	54 (21.1)	32 (19.2)	0.879
Neutral	114 (27)	69 (27)	45 (26.9)	
No	223 (52.7)	133 (52)	90 (53.9)	
Do you feel that no encouraging at your workplace?				
Yes	295 (69.7)	177 (69.1)	118 (70.7)	0.417
Neutral	41 (9.7)	22 (8.6)	19 (11.4)	
No	87 (20.6)	57 (22.3)	30 (18)	
Do you think that you get pressure from your boss?				
Yes	79 (18.7)	57 (22.3)	22 (13.2)	**0.004**
Neutral	70 (16.5)	49 (19.1)	21 (12.6)	
No	274 (64.8)	150 (58.6)	124 (74.3)	

Note: significant at p<0.05

CHAPTEE 5
DISSCUSSION

The aims of this study were to find the prevalence of MSDs among female garment workers and to find association between working conditions and MSDs. Face-to-face interview was applied in this cross-sectional study. Socio-demographic information, work conditions, and MSDs among nine body regions were obtained from the interview. The SNQ was used to obtain the information of musculoskeletal symptoms among respondents.

5.1 The prevalence of MSDs

The result of this study showed that the past 12 months were 60.6% and during the last 7 days were 48.3%. The most common site affected was shoulder, neck and lower back. Numerous studies worldwide have shown the inconsistent prevalence of MSDs in past 12-month period. This result was relatively similar to the other studies such as study among Portuguese Call Center Operators 65.2% Portugal (Moreira-Silva et al., 2022), among manual porcelain workers at different workstations 69.1% (Hong et al., 2022), among Iranian steel workers was 61% (M Aghilinejad et al., 2012). However, this result was lower than those observed among tea garden workers in Bangladesh 80.9% (Kairi & Dey, 2022), 92% New Zealand Electoral Roll (Widanarko et al., 2011). The prevalence of MSDs in past 7 days were 48.3% similar to the previous study among district hospital nurses in Haiphong city in Vietnam, last 7 days (41.1%) (Luan et al., 2018).

There could have been two factors causing these different: firstly, these study in different job that the nature of job could make different. Secondary, we used the Standardized Nordic Questionnaire with 3 references symptoms: ache, pain, and discomfort, participants answer's may be included others symptoms such as numbness, stiffness that make more the number of MSDs which appears in the assessment questionnaire.

In this study the most common pain sites were shoulder and neck in 21% and 18.4% of the participants, respectively. This result similar to a study in India among self-employed tailors of informal sectors in Ethiopia, the common pain in neck and shoulder (Mekonnen et al., 2020), 49.7% neck and 41.6% shoulder pain prevalence in tailors in Kermanshah, Iran (Kazemi et al., 2019), and in Bangladesh, 23.7% of pain in neck (Hossain et al., 2018). However, there were the different common pain site in other previous study such as studies in Sri Lanka Back (57.3%) and knee (31.7%) were the most common sites of pain (Lombardo et al., 2012), Bangladesh, in garment manufacturing industry among 401garment workers, the prevalence of lower back pain was highest (41%), knees (33%) (Nabi et al., 2021a). Study in Iranian, Lumbar, knee(s) and neck areas had the most common musculoskeletal disorders (Moreira-Silva et al., 2022). These differences could be due to different work task such as sewing section and non-sewing section. For group sewing section which requires more sitting work posture using sewing machines. Machin operators always concentrated on the needle so their head were in flexion, which leaded to trouble in the neck. The trouble in lower back of them may be due to prolonged sitting. Musculoskeletal symptoms in the shoulder and upper back seemed to be caused by upper arm abduction or shoulder raised or overuse of muscle in both regions to control the movement of wrist/hand in the sewing process. Non-sewing group had high prevalence in the neck, shoulder, lower back and upper back as well. Noticeably, this group had prevalence in knee higher than others because workers in the group had prolonged standing.

5.2 Association between socio demographic and MSDs

Age group, exercise, and alcohol consumption were associated with MSDs. This finding is consistent with previous study which showed that there was a significant relationship between age groups and MSDs (Chinedu et al., 2020). Aging is one of the risk factors for MSDs because it causes degeneration of muscle cell as well as a decrease in their strength. It also causes a decrease in muscle mass through sarcopenia, which can lead to disability and complications in the future (Minetto et al., 2020). The majority of participant (79.9%) never had exercise was associated with MSDs. In the previous study found that physical activity has a beneficial effect on weight and may

further improve bone mass and muscle function, as well as improve general health (Niederstrasser & Attridge, 2022). Furthermore, physical activity may positively impact on pain by elevating mood (Leblanc et al., 2015), reducing stress (Mücke et al., 2018) and enhancing descending pain modulation (Naugle & RILEY 3rd, 2014). In this study most of participants did not have enough time to do physical activity and most of their work section is sewing that have to sit for long hours.

For alcohol consumption in this study indicated that there were associated with MSDs, however, have no association between alcohol consumption and pain (Kirsch Micheletti et al., 2019). In 2000, (Leboeuf-Yde, 2000) performed a systematic review assessing the association between alcohol consumption and the risk of developing a new episode of acute low back pain , the result indicated that alcohol consumption is not associated with low back pain. However, 2013 Ferreira et al (Ferreira et al., 2013) Twenty-six studies were included, and the that alcohol consumption was associated with low back pain (Leboeuf-Yde, 2000) but, this relation appears only to chronic low back pain and only generalizable to people with alcohol addiction.

5.3 Association between and working conditions and MSDs

Work characteristic

Work section and chair without backrest were associated with MSDs. Chairs must be designed with a back that can be adjusted otherwise our spine will not be supported that cause of MSDs (Aulianingrum & Hendra, 2022). Generally, the sewing of apparel is viewed as a feminine vocation generally in Cambodia. In this study we focused on sewing, cutting, buttoning and ironing section and most of them work in sewing section (73.8%) sitting on chair without backrest to support their back, consequently most of them had experience on shoulder pain in the past 12 months Sewing machine operators frequently use their hands to manipulate and handle the equipment and gadgets. This section are required sitting postures including forward head, back bending. Head position in backward or forward during working was associated with MSDs which consistent with literature review, when workers are in an awkward posture, muscles operate less efficiently, and worker expend more force to complete the task. Awkward posture is generally a long way from the joint’s range of motion limitations. There are

some reasons why the posture may be insufficient while working. For starters, it is excessive if it's near the joint's range of motion limit. Secondly, posture can be difficult to maintain if it only possible to do so by resisting gravity. Finally, certain postures are dangerous because they put the anatomical structures in a position where they cannot function properly. As a result, the amount of discomfort induced by a posture will depend on how far it is from a relaxed position, how often it is adopted, and how long it is maintained (Simoneau et al., 2003).

Psychosocial factor

There were association between MSDs and psychosocial factors. These factors include not getting enough rest, feel that work is heavy, and get pressure from manager. Poor psychosocial factors at work can also lead to an increase in the prevalence of MSDs. They are often caused by ineffective organization and management, which leads to inadequate social support, psychological aggression, conflicting demands, imbalances in work-family relationships, dissatisfaction, stress, and loss of motivation. A poor work environment, as well as the inability to adapt to these conditions, can lead to work-related stress. Enhancement of stress can increase the relationship between physical workload and musculoskeletal symptoms (AlOmar et al., 2021). It can also cause the release of norepinephrine and epinephrine, which leads to abnormal changes in heart rate and systolic blood pressure, thereby affecting muscle activity (Li et al., 2021). People with higher job stress tend to respond more to uncomfortable symptoms or pain. These factors also affect their workability and adaptability, thereby increasing the risk of MSDs (Van Eerd et al., 2016).

Strength and limitation of study

Strength

The SNQ included a body map that allowed responders to identify the body parts where symptoms were present and questionnaires were included psychosocial factors that the previous study did not include.

Limitation

There could have been a bias in reporting because the recall period for MSD experiences could have lasted up to 12 months. For instance, there could be different understandings and perceptions in people with chronic pain, who often report problems

with cognitive abilities, such as memory or attention. And other limitation is this study only focus on female so the result cannot represent the whole population in Khan Mean Chey.

Conclusion

The female garment workers in Khan Mean Chey had high prevalence of MSDs. Among 70.7% of female garment workers reported at least one musculoskeletal symptom. Prevalence of MSDs was high particularly in shoulder pain, neck pain and lower back pain. In the previous 7 days, there were significant association between MSDs and exercise, medical condition, head position during working, temperature, and work's heavy. In the previous 12 months, there were significant association between MSDs and age, alcohol drinking, chair without backrest, temperature, noise, not getting enough rest, and get pressure from manager.

Recommendation

Working condition improvement

1) Chairs should have padded backrests and adjustable seat heights to support the lower back.
2) Health promotion program should be implemented in clothing factories, such as the provision of brief rest periods for stretching exercises that help the body recover from exhaustion and lessen work-related stress.

REFERENCES

Aghilinejad, M., Choobineh, A., Sadeghi, Z., Nouri, M., & Ahmadi, A. B. (2012). Prevalence of musculoskeletal disorders among Iranian steel workers. *Iranian Red Crescent Medical Journal*, *14*(4), 198.

Aghilinejad, M., Choobineh, A. R., Sadeghi, Z., Nouri, M. K., & Bahrami Ahmadi, A. (2012). Prevalence of Musculoskeletal Disorders among Iranian Steel Workers. *Iran Red Crescent Med J*, *14*(4), 198-203.

AlOmar, R. S., AlShamlan, N. A., Alawashiz, S., Badawood, Y., Ghwoidi, B. A., & Abugad, H. (2021). Musculoskeletal symptoms and their associated risk factors among Saudi office workers: a cross-sectional study. *BMC Musculoskeletal Disorders*, *22*(1), 1-9.

Arya, N., & Kwatra, S. (2020). Workstation assessment and suggestions to optimize comfort level for banks employees in Udham Singh Nagar district. *Pharma Innov. J.*, *9*(8), 96-101.

Asuyama, Y., & Neou, S. (2012). How has the Cambodian garment industry evolved. *Dynamics of the garment industry in low-income countries: experience of Asia and Africa*.

Aulianingrum, P., & Hendra, H. (2022). Risk Factors of Musculoskeletal Disorders in Office Workers. *The Indonesian Journal of Occupational Safety and Health*, *11*(Special Issue).

Bayzid, B., Kamrujjaman, M., Hossain, A., & Musa, A. M. (2019). Prevalence and determinant factors OF musculoskeletal pain among female ready made garment workers residing IN northern Dhaka City: a cross-sectional study. *Prevalence*, *3*(2).

Bernard, B. P., & Putz-Anderson, V. (1997). Musculoskeletal disorders and workplace factors; a critical review of epidemiologic evidence for work-related musculoskeletal disorders of the neck, upper extremity, and low back.

Bongers, P. M., de Winter, C. R., Kompier, M. A., & Hildebrandt, V. H. (1993). Psychosocial factors at work and musculoskeletal disease. *Scandinavian journal of work, environment & health*, 297-312.

Chinedu, O. O., Henry, A. T., Nene, J. J., & Okwudili, J. D. (2020). Work-related musculoskeletal disorders among office workers in higher education institutions: A cross-sectional study. *Ethiopian Journal of Health Sciences*, *30*(5).

Ferreira, P. H., Pinheiro, M. B., Machado, G. C., & Ferreira, M. L. (2013). Is alcohol intake associated with low back pain? A systematic review of observational studies. *Manual therapy*, *18*(3), 183-190.

Franco, G., & Fusetti, L. (2004). Bernardino Ramazzini's early observations of the link between musculoskeletal disorders and ergonomic factors. *Applied ergonomics*, *35*(1), 67-70.

Gallis, C. (2006). Work-related prevalence of musculoskeletal symptoms among Greek forest workers. *International Journal of Industrial Ergonomics*, *36*, 731-736. https://doi.org/10.1016/j.ergon.2006.05.007

Hendrick, H. W. (2008). Applying ergonomics to systems: some documented "lessons learned". *Appl Ergon*, *39*(4), 418-426. https://doi.org/10.1016/j.apergo.2008.02.006

Hong, X., Lee, Y.-C., & Zhou, S. (2022). Musculoskeletal symptoms and associated factors among manual porcelain workers at different workstations: a cross-

sectional study. *International Archives of Occupational and Environmental Health*. https://doi.org/10.1007/s00420-022-01879-z

Hossain, M. D., Aftab, A., Al Imam, M. H., Mahmud, I., Chowdhury, I. A., Kabir, R. I., & Sarker, M. (2018). Prevalence of work related musculoskeletal disorders (WMSDs) and ergonomic risk assessment among readymade garment workers of Bangladesh: A cross sectional study. *PloS one*, *13*(7), e0200122.

Hosseini, A., Choobineh, A., Razeghi, M., Pakshir, H. R., Ghaem, H., & Vojud, M. (2019). Ergonomic Assessment of Exposure to Musculoskeletal Disorders Risk Factors among Dentists of Shiraz, Iran. *Journal of dentistry (Shiraz, Iran)*, *20*(1), 53-60. https://doi.org/10.30476/DENTJODS.2019.44564

Iqbal, M., Dipu, M., Masfiq, M., & Rashid, A. (2021). Investigation to identify the causes of low back pains among garment workers of a selected garment factory in Bangladesh. *Advances in Materials and Processing Technologies*, 1-16. https://doi.org/10.1080/2374068X.2021.1948699

Jaffar, N., Abdul-Tharim, A. H., Mohd-Kamar, I. F., & Lop, N. S. (2011). A Literature Review of Ergonomics Risk Factors in Construction Industry. *Procedia Engineering*, *20*, 89-97. https://doi.org/https://doi.org/10.1016/j.proeng.2011.11.142

Kairi, T. K., & Dey, S. (2022). Prevalence of work-related musculoskeletal symptoms among tea garden workers in Bangladesh: a cross-sectional study. *BMJ open*, *12*(5), e061305.

Kamolz, L.-P., Beck, H., Haslik, W., Högler, R., Rab, M., Schrögendorfer, K., & Frey, M. (2004). Carpal tunnel syndrome: a question of hand and wrist configurations? *Journal of hand surgery*, *29*(4), 321-324.

Kang, D., Kim, Y.-K., Kim, E.-A., Kim, D. H., Kim, I., Kim, H.-R., Min, K.-B., Jung-Choi, K., Oh, S.-S., & Koh, S.-B. (2014). Prevention of Work-Related Musculoskeletal Disorders. *Annals of Occupational and Environmental Medicine*, *26*(1), 14. https://doi.org/10.1186/2052-4374-26-14

Kazemi, S., Asgari, A., Khatib, M., Poyafar, L., & Mohammadi, M. (2019). Determining the prevalence of musculoskeletal disorders in tailors in Kermanshah, Iran using the Nordic questionnaire (2018). *International Journal of Health and Life Sciences*, *5*(1).

Kirsch Micheletti, J., Bláfoss, R., Sundstrup, E., Bay, H., Pastre, C. M., & Andersen, L. L. (2019). Association between lifestyle and musculoskeletal pain: cross-sectional study among 10,000 adults from the general working population. *BMC Musculoskeletal Disorders*, *20*(1), 609. https://doi.org/10.1186/s12891-019-3002-5

Kuorinka, I., Jonsson, B., Kilbom, A., Vinterberg, H., Biering-Sørensen, F., Andersson, G., & Jørgensen, K. (1987). Standardised Nordic questionnaires for the analysis of musculoskeletal symptoms. *Applied Ergonomics*, *18*(3), 233-237. https://doi.org/https://doi.org/10.1016/0003-6870(87)90010-X

Larsman, P., & Hanse, J. J. (2009). The impact of decision latitude, psychological load and social support at work on the development of neck, shoulder and low back symptoms among female human service organization workers. *International Journal of Industrial Ergonomics*, *39*(2), 442-446.

Leblanc, A., Taylor, B. A., Thompson, P. D., Capizzi, J. A., Clarkson, P. M., Michael White, C., & Pescatello, L. S. (2015). Relationships between physical activity

and muscular strength among healthy adults across the lifespan. *Springerplus*, *4*(1), 1-10.

Leboeuf-Yde, C. (2000). Alcohol and low-back pain: a systematic literature review. *Journal of Manipulative and Physiological Therapeutics*, *23*(5), 343-346.

Lei, L., Dempsey, P. G., Xu, J.-g., Ge, L.-n., & Liang, Y.-x. (2005). Risk factors for the prevalence of musculoskeletal disorders among chinese foundry workers. *International Journal of Industrial Ergonomics*, *35*(3), 197-204. https://doi.org/https://doi.org/10.1016/j.ergon.2004.08.007

Li, X., Yang, X., Sun, X., Xue, Q., Ma, X., & Liu, J. (2021). Associations of musculoskeletal disorders with occupational stress and mental health among coal miners in Xinjiang, China: a cross-sectional study. *BMC Public Health*, *21*(1), 1327. https://doi.org/10.1186/s12889-021-11379-3

Lombardo, S. R., Vijitha de Silva, P., Lipscomb, H. J., & Østbye, T. (2012). Musculoskeletal symptoms among female garment factory workers in Sri Lanka. *International journal of occupational and environmental health*, *18*(3), 210-219.

Luan, H. D., Hai, N. T., Xanh, P. T., Giang, H. T., Van Thuc, P., Hong, N. M., & Khue, P. M. (2018). Musculoskeletal Disorders: Prevalence and Associated Factors among District Hospital Nurses in Haiphong, Vietnam. *BioMed Research International*, *2018*, 3162564. https://doi.org/10.1155/2018/3162564

Lundberg, U., Kadefors, R., Melin, B., Palmerud, G., Hassmén, P., Engström, M., & Elfsberg Dohns, I. (1994). Psychophysiological stress and emg activity of the trapezius muscle. *International Journal of Behavioral Medicine*, *1*(4), 354-370. https://doi.org/10.1207/s15327558ijbm0104_5

Mackinnon, S. E., & Novak, C. B. (1994). Pathogenesis of cumulative trauma disorder. *The Journal of Hand Surgery*, *19*(5), 873-883. https://doi.org/https://doi.org/10.1016/0363-5023(94)90205-4

Masal, S., & Borkar, P. (2021). Epidemiology of musculoskeletal injuries in Indian classical dancers: A systematic review. *International Journal of Physical Education, Sports and Health*, *8*(3), 310-319.

Mehta, E., Mehta, M., & Sharma, P. K. (2020). A study on work-related musculoskeletal disorders among sewing machine operators. *Indian Journal of Health & Wellbeing*, *11*.

Mekonnen, T. H., Yenealem, D. G., & Geberu, D. M. (2020). Physical environmental and occupational factors inducing work-related neck and shoulder pains among self-employed tailors of informal sectors in Ethiopia, 2019: results from a community based cross-sectional study. *BMC Public Health*, *20*(1), 1265. https://doi.org/10.1186/s12889-020-09351-8

Minetto, M. A., Giannini, A., McConnell, R., Busso, C., Torre, G., & Massazza, G. (2020). Common Musculoskeletal Disorders in the Elderly: The Star Triad. *Journal of Clinical Medicine*, *9*(4), 1216. https://www.mdpi.com/2077-0383/9/4/1216

Moreira-Silva, I., Queirós, R., Seixas, A., Cardoso, R., Ventura, N., & Azevedo, J. (2022). Prevalence of Musculoskeletal Symptoms Among Portuguese Call Center Operators: Associations with Gender, Body Mass Index and Hours of Work. In P. M. Arezes, J. S. Baptista, P. Carneiro, J. Castelo Branco, N. Costa, J. Duarte, J. C. Guedes, R. B. Melo, A. S. Miguel, & G. Perestrelo (Eds.),

Occupational and Environmental Safety and Health III (pp. 207-214). Springer International Publishing. https://doi.org/10.1007/978-3-030-89617-1_19

Mücke, M., Ludyga, S., Colledge, F., & Gerber, M. (2018). Influence of regular physical activity and fitness on stress reactivity as measured with the trier social stress test protocol: A systematic review. *Sports Medicine*, *48*(11), 2607-2622.

Nabi, M. H., Kongtip, P., Woskie, S., Nankongnab, N., Sujirarat, D., & Chantanakul, S. (2021a). Factors associated with musculoskeletal disorders among female readymade garment workers in Bangladesh: a comparative study between OSH compliant and non-compliant factories. *Risk management and healthcare policy*, *14*, 1119.

Nabi, M. H., Kongtip, P., Woskie, S., Nankongnab, N., Sujirarat, D., & Chantanakul, S. (2021b). Factors Associated with Musculoskeletal Disorders Among Female Readymade Garment Workers in Bangladesh: A Comparative Study Between OSH Compliant and Non-Compliant Factories. *Risk management and healthcare policy*, *14*, 1119-1127. https://doi.org/10.2147/RMHP.S297228

Naugle, K. M., & RILEY 3rd, J. L. (2014). Self-reported physical activity predicts pain inhibitory and facilitatory function. *Medicine and science in sports and exercise*, *46*(3), 622.

Niederstrasser, N. G., & Attridge, N. (2022). Associations between pain and physical activity among older adults. *PloS one*, *17*(1), e0263356.

Öztürk, N., & Esin, M. N. (2011). Investigation of musculoskeletal symptoms and ergonomic risk factors among female sewing machine operators in Turkey. *International Journal of Industrial Ergonomics*, *41*(6), 585-591. https://doi.org/https://doi.org/10.1016/j.ergon.2011.07.001

Phajan, T., Nilvarangkul, K., Settheetham, D., & Laohasiriwong, W. (2014). Work-related musculoskeletal disorders among sugarcane farmers in north-eastern Thailand. *Asia Pac J Public Health*, *26*(3), 320-327. https://doi.org/10.1177/1010539514528026

Punnett, L., & Wegman, D. H. (2004). Work-related musculoskeletal disorders: the epidemiologic evidence and the debate. *Journal of electromyography and kinesiology*, *14*(1), 13-23.

Ringelberg, J. A., & Koukoulaki, T. (2002). *Risk Estimation for Musculoskeletal Disorders in Machinery Design-Integrating a User Perspective*. European Trade Union Technical Bureau for Health and Safety.

Saes-Silva, E., Vieira, Y. P., Saes, M. d. O., Meucci, R. D., Aikawa, P., Cousin, E., Silva, L. M. A. d., & Dumith, S. C. (2021). Epidemiology of chronic back pain among adults and elderly from Southern Brazil: a cross-sectional study. *Brazilian Journal of Physical Therapy*, *25*(3), 344-351. https://doi.org/https://doi.org/10.1016/j.bjpt.2020.12.005

Salmani Nodooshan, H., Koohi Booshehri, S., Daneshmandi, H., & Choobineh, A. R. (2016). Ergonomic workplace assessment in orthotic and prosthetic workshops. *Work*, *55*, 463-470. https://doi.org/10.3233/WOR-162401

Scheer, S. J., & Mital, A. (1997). Ergonomics. *Arch Phys Med Rehabil*, *78*(3 Suppl), S36-45. https://doi.org/10.1016/s0003-9993(97)90406-8

Scientific, W. (2003). Group on the Burden of Musculoskeletal Conditions at the Start of the New Millennium. The burden of musculoskeletal conditions at the start of the new millennium. *World Health Organ Tech Rep Ser*, *919*, i.

Shazzad, M. N., Ahmed, S., Haq, S. A., Islam, M. N., Abu Shahin, M., Choudhury, M. R., Hasan, A. T. M. T., Abdal, S. J., & Rasker, J. J. (2018). Musculoskeletal symptoms and disorders among 350 garment workers in Bangladesh: A cross-sectional pilot study. *International journal of rheumatic diseases*, *21*(12), 2063-2070.

Simoneau, S., St-Vincent, M., & Chicoine, D. (2003). Work-related musculoskeletal disorders (WMSDs)–a better understanding for more effective prevention. In: Technical Guide RG-126-ang. Association paritaire pour la santé et la ….

Smith, P., LaMontagne, A. D., Lilley, R., Hogg-Johnson, S., & Sim, M. (2020). Are there differences in the return to work process for work-related psychological and musculoskeletal injuries? A longitudinal path analysis [Article]. *Social Psychiatry & Psychiatric Epidemiology*, *55*(8), 1041-1051. https://doi.org/10.1007/s00127-020-01839-3

Taylor, G. E. K. H. R. (2004). Enhancing occupational safety and health. http://search.ebscohost.com/login.aspx?direct=true&scope=site&db=nlebk&db=nlabk&AN=117157

Van Eerd, D., Munhall, C., Irvin, E., Rempel, D., Brewer, S., van der Beek, A. J., Dennerlein, J. T., Tullar, J., Skivington, K., Pinion, C., & Amick, B. (2016). Effectiveness of workplace interventions in the prevention of upper extremity musculoskeletal disorders and symptoms: an update of the evidence. *Occup Environ Med*, *73*(1), 62-70. https://doi.org/10.1136/oemed-2015-102992

Van, L., Chaiear, N., Sumananont, C., & Kannarath, C. (2016). Prevalence of musculoskeletal symptoms among garment workers in Kandal province, Cambodia. *Journal of occupational health*, *58*(1), 107-117.

Wang, P. C., Rempel, D. M., Harrison, R. J., Chan, J., & Ritz, B. R. (2007). Work-organisational and personal factors associated with upper body musculoskeletal disorders among sewing machine operators. *Occup Environ Med*, *64*(12), 806-813. https://doi.org/10.1136/oem.2006.029140

Widanarko, B., Legg, S., Stevenson, M., Devereux, J., Eng, A., Mannetje, A. t., Cheng, S., Douwes, J., Ellison-Loschmann, L., McLean, D., & Pearce, N. (2011). Prevalence of musculoskeletal symptoms in relation to gender, age, and occupational/industrial group. *International Journal of Industrial Ergonomics*, *41*(5), 561-572. https://doi.org/https://doi.org/10.1016/j.ergon.2011.06.002

APPENDIX A QUESTIONNAIRE (English version)

These questionnaires for study about the association between working condition and musculoskeletal symptom. The questionnaire consists of 3 parts: socio demographique, working condition(work characteristic, work environment, psychological factors), and SNQ.

Part 1: Socio demographique

1. Age…….years
2. Weight……..kg
3. Height……...cm
4. Marital status
   - ☐ Single ☐ Married
   - ☐ Widow
5. Education background
   - ☐ Illiterate ☐ Primary school
   - ☐ Secondary school ☐ High school
   - ☐ Above the high school
6. How often do you exercise per week?
   - ☐ ≤3 times/week ☐>3times/week
7. Have you ever been drink alcohol?
   - ☐ Never drink ☐ Drunk in the past ☐ Current drinking
8. Have you ever smoked cigarette?
   - ☐ Never smoked ☐ Smoked in the past ☐ Current smoking
9. Do you have any medical problem
   - ☐No ☐ Yes, (please, specify)……
10. Personal monthly income
    - ☐ <200 USD
    - ☐ 200 – 300 USD
    - ☐ >300 USD

Part 2: Working condition

Ⅰ. Work characteristic

1. Which section do you work in this garment factory?

   ☐ Sewing ☐ Cutting

   ☐ Buttoning ☐ Ironing

2. How many hours do you work per day?

   ☐ <8 hours ☐ 8 - 10 hours ☐ >10 hours

3. How many hours do you work over time per day?

   ☐ <2 hours ☐ >2 hours

4. How long have you been in this factory?

   ……year.

5. Is your work repetitive movement?

   ☐Yes ☐No

Ⅱ. Work environment

1. Chair with backrest

   ☐Yes ☐No

2. Chair height adjustable

   ☐Yes ☐No

3. Table height compare to elbow while working

   ☐Elbow level ☐ Below above elbow level

4. Feet can step on the floor while working

   ☐Yes ☐No

5. Head position while working

   ☐ Straight ☐ Either forward or backward

6. Back position while working

   ☐ Straight ☐ Either forward or backward

7. How do you feel about the temperature at work-station?

   ☐ Too cold ☐ Moderate ☐ Too hot

8. How do you feel about the light at work-station?

   ☐ Too dark ☐ Neither too dark nor too bright ☐ Too bright

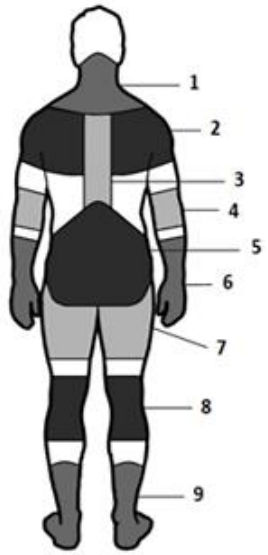
9. How do you feel about the noise at work-station?

   ☐ Too noisy ☐ Neither too noisy nor too quiet ☐ Too quiet

Ⅲ. Psychological factors

Questions	Strongly agree	Agree	Neutral	Disagree	Strongly disagree
1. Do you think that your job is an uninteresting job?					
2. Do you think that you get enough rest during the workday?					
3. Do you feel that your work is heavy?					
4. Do you feel that your work is stressful?					
5. Do you feel that no encouraging at your workplace?					
6. Do you think that you get pressure from your boss?					

Part 3 : Nordic Standardized Questionnaire

Body map	Body parts	Have you had trouble (ache, pain, discomfort) at any time during the last 12 months?	Have you had trouble (ache, pain, discomfort) at any time during the last 7 days?
	1. Neck	☐ Yes ☐ No	☐ Yes ☐ No
	2. Shoulders	☐ Yes ☐ No	☐ Yes ☐ No
	3. Upper back	☐ Yes ☐ No	☐ Yes ☐ No
	4. Elbows	☐ Yes ☐ No	☐ Yes ☐ No
	5. Lower back	☐ Yes ☐ No	☐ Yes ☐ No
	6. Wrists/hands	☐ Yes ☐ No	☐ Yes ☐ No
	7. Hips/thighs	☐ Yes ☐ No	☐ Yes ☐ No
	8. Knees	☐ Yes ☐ No	☐ Yes ☐ No
	9. Ankles/feet	☐ Yes ☐ No	☐ Yes ☐ No

APPENDIX B QUESTIONNAIRE (Khmer version)

ផ្នែកទី១ សង្គមប្រជាសាស្ត្រ

1. អាយុ.....ឆ្នាំ
2. ទំងន់.....គីឡូក្រាម
3. កំពស់.....សង់ទីម៉ែត្រ
4. ចូរជ្រើសរើសស្ថានភាពគ្រួសារដែលត្រូវជាមួយអ្នក

☐ នៅលីវ ☐រៀបការ ☐ ម៉ែម៉ាយ ☐ លែងលះ

5. ចូរអ្នកជ្រើរើសកំរិតវប្បធម៌នៃការសិក្សារបស់អ្នកដូចខាងក្រោម

☐ អក្ខរកម្ម ☐ បឋមសិក្សា ☐ អនុវិទ្យាល័យ ☐ វិទ្យាល័យ
☐ មហាវិទ្យាល័យ

6. តើអ្នកហាត់ប្រាណប៉ុន្មានដងក្នុងមួយសប្តាហ៍?

☐ ≤៣ដងក្នុងមួយសប្តាហ៍ ☐ >៣ដងក្នុងមួយសប្តាហ៍

7. តើអ្នកពិសារស្រាឬទេ?

☐មិនដែលផឹកទេ ☐ផឹកកាលពីមុន ☐ផឹកជាប្រចាំ

8. តើអ្នកពិសារបារីឬទេ?

☐មិនដែលជក់ទេ ☐ជក់កាលពីមុន ☐ជក់ជាប្រចាំ

9. តើអ្នកមានជំងឺប្រចាំកាយទេ?

☐ទេ ☐បាទ /ចាស បញ្ជាក់.....

10. ប្រាក់ចំនូលប្រចាំខែ

☐<100ដុល្លា ☐100ដុល្លា-150ដុល្លា
☐151ដុល្លា-200ដុល្លា ☐201,ដុល្លា-250ដុល្លា
☐251ដុល្លា-300ដុល្លា ☐>300ដុល្លា

ផ្នែកទី២ លខក្ខ័ការងារ

ចរិកលក្ខណៈការងារ

1. តើអ្នកធ្វើការក្នុងផ្នែកណាមួយក្នុងរោងចក្រនេះ

☐ផ្នែកដេរ ☐ ផ្នែកតុកាត់ ☐ផ្នែកវាយឡេវ ☐ ផ្នែកអ៊ុត

2. តើអ្នកធ្វើការប៉ុន្មានម៉ោងក្នុងមួយថ្ងៃ

☐<8 ម៉ោង ☐8-10 ម៉ោង ☐>10 ម៉ោង

3. តើអ្នកធ្វើការងារបន្ថែមចំនួនប៉ុន្មានម៉ោងក្នុងមួយថ្ងៃ?

❒ តិចជាង២ម៉ោង ❒ច្រើនជាង២ម៉ោង

4. តើអ្នកធ្វើការក្នុងរោងចក្រនេះបានរយៈពេលប៉ុន្មានឆ្នាំហើយ?

ចំនួន.....ឆ្នាំ

5. តើចលនាធ្វើការរបស់អ្នកមានភាពច្រំដែលឬទេ?

❒បាទ /ចាស ❒អត់ទេ

បរិយាកាសការងារ

1.តើកៅអីរបស់អ្នកមានបង្អែកដៃរឬទេ?

❒បាទ /ចាស ❒អត់ទេ

2. តើកៅអីរបស់អ្នកអាចកែតំរូវកម្ពស់ឬបង្វិលបានដៃរឬទេ?

❒បាទ ចាស ❒អត់ទេ

3. កំពស់តុធៀបទៅនឹងកែងដៃរបស់អ្នក

❒កំពស់កែងដៃ ❒ទាបជាងឬខ្ពស់ជាងកែងដៃ

4. ពេលអ្នកអង្គុយលើកៅអីតើអ្នកអាចដាក់ជើងដល់កំរាលឬទេ?

❒បាទ/ ចាស ❒ទេ

5. ឥរិយាបថក្បាលរបស់អ្នកពេលធ្វើការ

❒នៅត្រង់ ❒អោនទៅមុខឬងើយទៅក្រោយ

6. ឥរិយាបថរបស់ខ្នងពេលធ្វើការ

❒នៅត្រង់ ❒អោនទៅមុខឬពើងទៅក្រោយ

7. តើអ្នកយល់យ៉ាងណាពីសីតុណ្ហភាពនៅកន្លែងធ្វើការ?

❒ត្រជាក់ណាស់ ❒ល្មម ❒ក្តៅណាស់

8. តើអ្នកយល់យ៉ាងណាពីពន្លឺនៅកន្លែងធ្វើការ?

❒ងងឹតណាស់ ❒ភ្លឺល្មម ❒ភ្លឺណាស់

9. តើអ្នកយល់យ៉ាងណាពីសំលេងនៅកន្លែងធ្វើការ?

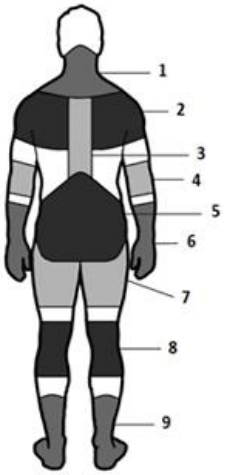
❒មានសំលេងរំខានខ្លាំង ❒មិនអ៊ូអរពេកហើយក៏មិនស្ងាត់ពេកដែរ

❒ស្ងាត់ណាស់

សង្គមចិត្តសាស្ត្រ

សំនួរ	យល់ស្របទាំងស្រុង	យល់ស្រប	អព្យាក្រិត	មិនយល់ស្រប	មិនយល់ស្របទាល់តែសោះ
1.តើអ្នកគិតថាការងាររបស់អ្នកជាការងារមិនគួរអោយចាប់អារម្មណ៍ឬទេ?					
2.តើអ្នកគិតថាអ្នកបានសំរាកគ្រប់គ្រាន់ឬទេនៅថ្ងៃធ្វើការ?					
3.តើអ្នកយល់ថាការងាររបស់អ្នកជាការងារធ្ងន់ឬទេ?					
4.តើអ្នកយល់ថាការងាររបស់អ្នកធ្វើអោយអ្នកមានអារម្មណ៍តានតឹងឬទេ?					
5.តើអ្នកមានអារម្មណ៍ថាគ្មានការជុំរុញលើកទឹកចិត្តនៅកន្លែងធ្វើការងារឬទេ?					
6.តើអ្នកគិតថាអ្នកទទួលសំពាធពីអ្នកគ្រប់គ្រងឬទេ?					

គំរូសំនួរតាមន័រឌីក

គំនូរតាងផ្នែកនៃរាងកាយ	ផ្នែកនៃរាងកាយ	តើរយៈពេល១២ខែចុងក្រោយនេះអ្នកធ្លាប់ជួបបញ្ហា ឈឺចាប់ ចុកចាប់ មិនស្រួលរឺទេ?	តើរយៈពេល៧ថ្ងៃចុងក្រោយនេះអ្នកធ្លាប់ជួបបញ្ហា ឈឺចាប់ ចុកចាប់ មិនស្រួលរឺទេ?
	1. កញ្ចឹងក	❒ចាស ❒អត់ទេ	❒ចាស ❒អត់ទេ
	2. ស្មា	❒ចាស ❒អត់ទេ	❒ចាស ❒អត់ទេ
	3. ខ្នងផ្នែកខាងលើ	❒ចាស ❒អត់ទេ	❒ចាស ❒អត់ទេ
	3. ខ្នងផ្នែកខាងលើ	❒ចាស ❒អត់ទេ	❒ចាស ❒អត់ទេ
	4. កែងដៃ	❒ចាស ❒អត់ទេ	❒ចាស ❒អត់ទេ
	5.ខ្នងផ្នែកខាក្រោម	❒ចាស ❒អត់ទេ	❒ចាស ❒អត់ទេ
	7. ត្រគាក ភ្លៅ	❒ចាស ❒អត់ទេ	❒ចាស ❒អត់ទេ
	8. ជង្គង់	❒ចាស ❒អត់ទេ	❒ចាស ❒អត់ទេ
	9. កជើង ប្រអប់ជើង	❒ចាស ❒អត់ទេ	❒ចាស ❒អត់ទេ

APPENDIX C ETICAL APPROVAL FOR THE STUDY

ព្រះរាជាណាចក្រកម្ពុជា
KINGDOM OF CAMBODIA
ជាតិ សាសនា ព្រះមហាក្សត្រ
NATION RELIGION KING

ក្រសួងសុខាភិបាល
MINISTRY OF HEALTH
គណៈកម្មាធិការជាតិក្រមសីលធម៌
សំរាប់ការស្រាវជ្រាវសុខភាពដែលទាក់ទងនឹងមនុស្ស
National Ethics Committee for Health Research

ថ្ងៃព្រហស្បតិ៍ ១១កើត ខែពិសាខ ឆ្នាំខាលចត្វាស័ក ព.ស.២៥៦៦

Phnom Penh, May 26, 2022

№ 149 NECHR

Ms. Try Phally

Project: Association between working conditions and musculoskeletal symptoms among female garment workers Khan Meanchey, Phnom Penh City, Cambodia. Version № 1, dated 27th April 2022.

Reference:
- Your letter on 11th May 2022
- Report of NECHR's secretaries on 18th May 2022

Dear Ms. Try Phally,

I am pleased to notify you that your study protocol entitled "Association between working conditions and musculoskeletal symptoms among female garment workers Khan Meanchey, Phnom Penh City, Cambodia. Version № 1, dated 27th April 2022" has been approved by National Ethics Committee for Health Research (NCEHR).This approval is valid for twelve months after the approval date.

NECHR also wish to remind the Principal Investigator that all research activities to be conducted during the COVID-19 pandemic must strictly follow the latest prevention measures set by the MOH and the relevant load authorities.

The Principal Investigator of the project shall submit following document to the committee's secretariat at the National Institute of Public Health at #80, Samdach Penn Nouth Blvd (289), Sangkat Boeungkok2, Khan Tuol Kork, Phnom Penh. (Tel: 012 528 789, 086 762 113, 012 203 382 Email: nouthsarida@gmail.com , cheatasoft27@gmail.com):

- Annual progress report
- Final scientific report
- Patient/participant feedback (if any)
- Analyzing serious adverse events report (if applicable)

The Principal Investigator should be aware that there might be site monitoring visits at any time from NECHR team during the project implementation and should provide full cooperation to the team.

Regards,

Chairman

Prof. ENG HUOT

National Ethics Committee for Health Research (NECHR)

ទូរស័ព្ទលេខ៨០, វិថីសម្តេច ប៊ែន នុត (២៨៩) សង្កាត់បឹងកក់ ២, ខណ្ឌ ទួលគោក, រាជធានីភ្នំពេញ, ទូរស័ព្ទ(៨៥៥-០១២) ៨៨២ ៨៨២, (៨៥៥-០១២) ៥២៨ ៧៨៩, (៨៥៥-០១២) ២០៣ ៣៨២
Lot #80, Samdach Penn Nouth Blvd (289), Sangkat Boeung Kok 2, Khan Tuol Kork, Phnom Penh, Cambodia. Tel: (855-012) 842 442, (855-012) 528 789, (855-012) 203 382

VITA

NAME Try Phally

DATE OF BIRTH 18 June 1994

PLACE OF BIRTH Cambodia