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Risk factors for work-related musculoskeletal disorders among informal garment workers in Thailand

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ABSTRACT

Work-related musculoskeletal disorders (WRMDs), characterized by abnormalities in the musculoskeletal system, pose a significant health concern with increasing trends in illness and injuries. Informal workers are not covered by the social security scheme of insurance, preventing them from immediate healthcare services. This cross-sectional study investigated the prevalence and environmental risk factors influencing WRMDs among non-agricultural informal garment workers in Kalasin, totaling 296 individuals. Data were collected using the standardized Nordic questionnaire, descriptive statistics, and binary logistic regression. Results revealed 79.7% and 82.8% prevalence for WRMD symptoms in the past seven days and 12 months, respectively. The statistical analysis showed that improper workstations were the most influential (adjusted odds ratio (OR)=6.257, p=0.002, 95% confidence of interval (CI) [1.921, 20.388], followed by work-related stress (WRS) (adjusted OR=4.248, P=0.007, 95% CI [1.475, 12.231]. Moreover, inadequate lighting (adjusted OR=3.693, P<0.001, 95% CI [1.819, 7.497] and prolonged repetitive tasks lasting 3-5 minutes (adjusted OR=2.686, p=0.023, 95% CI [1.143, 6.309] were also contributing factors to the WRMDs symptoms. In conclusion, the prevalence of WRMDs among informal garment workers in Kalasin was high, mainly due to improper workstations and WRS.

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1. INTRODUCTION

Work-related musculoskeletal disorders (WRMDs) are illnesses in which the workplace environment and how the work is performed play a substantial role in the condition, possibly contributing to its developing more detrimental over time [1]. WRMDs are characterized by musculoskeletal system abnormalities and common medical issues that significantly reduce the quality of life, increase sick leave, and lead to disabilities [2]. These concerns affect formal and informal labor sectors in developed and developing industrial nations, adversely affecting occupational health and safety, and the economy [3]. Globally, the direct and indirect costs of WRMDs amount to 270 million dollars annually [4]. In the European Union, 60% of health-related problems among the workforce are related to WRMDs, making them the most severe issues and posing personal, economic, and societal burdens of medical costs, medication, and compensation [5]. If the number of affected individuals remains high, governments might face an increased economic disadvantage due to rising healthcare expenses [6].

In Thailand, most of the workforce is informal labor, which faces risks related to social welfare, income instability, and unclear regulations [7]. Without support or opportunities, this group of laborers lacks adequate protection and benefits from work and can have negative social and economic consequences in the future. The health impact of work-related issues was reflected in a global report on occupational diseases, showing that the prevalence of WRMDs ranged from 55.6 to 97.2%, making it the most common occupational illness [8]. These abnormalities are related to occupation and job characteristics and are often prevalent in physically demanding labor that involves heavy lifting, repetitive movements, awkward postures, and improper use of equipment [9].

Kalasin province is a significant silk-producing province in the northeastern region of Thailand, renowned for its intricate garment stitching processes [10]. The diverse occupations related to garment stitching play an essential role in residents' livelihoods. These occupations are central to many households, supplementing primary income sources such as farming and gardening [11]. The work environment and postures may not be ergonomic, potentially leading to musculoskeletal discomfort and pain [12]. However, risk factors for WRMDs among informal garment workers in this area have not been addressed.

Given the issue's significance, this study focused on the informal labor force engaged in garment stitching in Kalasin province. The objective was to assess their exposure to health risks due to work-related factors. This study would pave the way for future solutions in this area. If not addressed correctly, this could lead to increased healthcare expenses and reduced work efficiency, ultimately impacting the quality of life. Here, we proposed a cross-sectional study to survey and rank the levels of risk factors among informal garment workers. Therefore, the findings of this study could serve as a basis for developing health promotion strategies and effective preventive measures to address WRMDs, leading to sustainable solutions.

2. METHOD

This study employs a cross-sectional design to interview 296 informal laborers engaged in garment stitching in Kalasin Province from 13 villages. Sample size (n) was estimated using the formula given:

$$n = \frac{Nz^2pq}{+d^2(N-1)+z^2pq}$$

Where N represents the total number of the population, which was 6,788, z=percentiles of the standard normal distribution corresponding to a 95% confidence level, which is 1.96, p=proportion of the population working as informal garment workers, which was assumed to be 0.27 (from our pilot survey), q=1−p, and d denotes margin of error=5 at 95% confidence level. Therefore, using the formula, n=6,788$(1.96)^2$×0.27×0.73/$(0.05)^2$(6,788-1)+$(1.96)^2$×0.27×0.73=at least 290 [13].

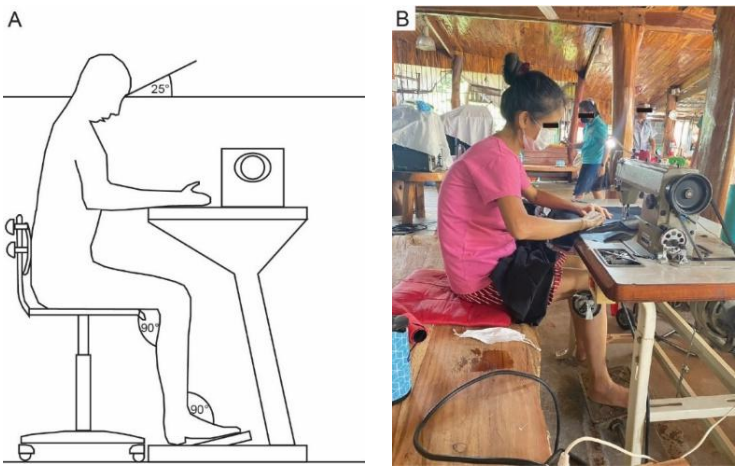
Inclusion criteria were i) informal laborers involved in the garment stitching industry with ≥7 days of experience, ii) able to communicate in Thai, and iii) signed informed consent forms. Exclusion criteria included a history of accidents in the musculoskeletal system and the laborers who relocated during the study. Data collection tools consist of a structured interview questionnaire divided into four sections: i) general information, ii) work-related information, iii) posture and environmental conditions at work, and iv) a standardized Nordic questionnaire [14]. Three occupational health and safety experts approved the questionnaire on environmental risk factors for content validity. The content validity has been confirmed by the index of item objective congruence (IOC). Only the items with IOC scores ≥0.5 were qualified for the questionnaire (an average IOC of 0.89). The items with Cronbach's α≥0.7 were accepted and used in the questionnaire (an average α of 0.92). Data analysis involves descriptive statistics and binary logistic regression. The Human Research Ethics Committee of Mahasarakham University approved the research protocol (number 286-193/2565).

3. RESULTS AND DISCUSSION

3.1. Demographic data

The majority of the participants consisted of females (86.5%). Most participants were in the early adult age group (≤50 years), representing 52.7%. About 61.1% of the participants had a body mass index within the standard range (18.5-24.9). Most had completed primary education (63.2%), and the marital status was predominantly married (80.4%). Over half of the participants (56.4%) earned less than 5,000 baht monthly from garment stitching. Regarding work characteristics, 45.6% of the sample used machine-based garment stitching. Approximately 54.1% had work experience of 10 years or more, and 67.2% considered

garment stitching as a supplementary occupation, while 60.5% primarily identified as farmers. A representative sitting posture of an informal garment worker is compared with the standard sitting posture design in Figure 1 [15]. In Figure 1(a), a standard sitting posture requires slight cervical flexion (≤25°) with proper back support and desk height. Figure 1(b) shows the sitting posture of an informal garment worker is poor and lacks adequate support.



(a) (b)

Figure 1. A representative sitting posture of an informal garment worker is compared with the standard sitting posture design (a) a standard sitting posture design adapted from [15] and (b) a representative sitting posture of an informal garment worker

3.2. Prevalence of work-related musculoskeletal disorders among informal garment workers

When considering the prevalence of WRMDs in the past seven days and 12 months, self-responses to the standardized Nordic questionnaire indicated a prevalence of 79.70% and 82.80%, respectively. The three most common affected areas in the past seven days were the shoulder (50.00%), neck (42.20%), and knee (40.50%). Similarly, the top three affected areas in the past 12 months were the shoulder (48.30%), knee (41.60%), and hip/leg/buttock (33.40%). Details are available in Table 1.

Table 1. Prevalence of WRMDs among informal garment workers (n=296)

Body area	Musculoskeletal disorders				Body area	Musculoskeletal disorders			
	Past 7 day		Past 12 months			Past 7 day		Past 12 months	
	n	%	n	%		n	%	n	%
Neck	125	42.20	95	32.10	Upper back	76	25.70	69	23.30
Shoulder	148	50.00	143	48.30	Low back	94	31.80	80	27.00
Elbows	33	11.10	23	7.80	Hips/Thighs/Bottom	115	38.90	99	33.40
Wrists/Hands	86	29.10	69	23.30	Knees	120	40.50	123	41.60
Upper arm	54	18.20	39	13.20	Legs	64	21.60	56	18.90
Low arm	47	15.90	36	12.20	Ankles/Feet	75	25.30	68	23.00

3.3. Environmental risk factors for work-related musculoskeletal disorders among informal garment workers

Additional analysis using binary logistic regression showed that the most significant factor was improper workstations (adjusted OR=6.257, P=0.002, 95% CI [1.921, 20.388]), followed by work-related stress (WRS) (adjusted OR=4.248, P=0.007, 95% CI [1.475, 12.231]). These data imply that improper workstations and WRS increased the risks for musculoskeletal injuries by approximately 6 and 4 times, respectively. Poor lighting and prolonged repetitive tasks lasting 3-5 minutes were other factors that contributed to the WRMD symptoms (adjusted OR=3.693, p=0.001, 95% CI [1.819, 7.497] and adjusted OR=2.686, p=0.023, 95% CI [1.143, 6.309]), respectively as shown in Table 2.

Table 2. Environmental risk factors for WRMDs among informal garment workers (n=296)

Factors	Crude OR	Adjusted OR	p-value	95% CI Lower, Upper
Needs to bend during work				
No	1			
Yes	2.019	2.686	0.023	1.143, 6.309
Inadequate lighting during work				
No	1			
Yes	2.754	3.693	<0.001	1.819, 7.497
Inappropriate arrangement of equipment				
No	1			
Yes	2.461	6.257	0.002	1.921, 20.388
Social aspects at work				
Not Stressed	1			
Stressed	2.094	4.248	0.007	1.475, 12.231

4. CONCLUSION

WRMDs, abnormalities in the musculoskeletal system, cause a substantial health risk due to escalating trends in disease and injury. This study illustrates that WRMD symptoms among informal garment workers in Kalasin are highly prevalent. The most significant factors are improper workstations and stress from the workplace, which are followed by poor illumination and prolonged repetitive duties.

It has been reported that several operators in assembly production lines run the risk of poor workstation designs [16]. In this study, the body areas that manifest the most WRMD symptoms are the shoulders, neck, knees, and hips, followed by the lower back, wrists, elbows, and ankles. This high prevalence could be attributed to the nature of the work, which involves constant forward head posture (FHP) and prolonged hunching over the task [17]. A recent piece by Nishikawa [18] and co-workers measured the activity of the trapezius (a large superficial back muscle extending from the occipital bone to the lower thoracic vertebrae and the scapula) using electromyography (EMG) displayed more overall muscle activity and subjective tiredness in the FHP group than the normal group. Therefore, the FHP might explain the WRMD symptoms mainly on the shoulders and neck. However, a study in another province of Thailand showed that the lower back was where informal garment workers most complained of muscle pain [19]. Further analysis may be required to compare other possible factors for this discrepancy, such as physical fitness and sitting time during the shift.

The term "WRS" refers to a pattern of physiological, cognitive, emotional, and behavioral responses to some particularly demanding characteristics of the nature, structure, and environment of the workplace [20]. The WRS has negatively affected employees' health and safety and their businesses' health and effectiveness [21]. Workplace stress can lead to burnout, which manifests as exhaustion and irritability. It is linked to several unfavorable reactions, such as job dissatisfaction, a lack of organizational commitment, and a high inclination to quit [21]. Interestingly, Arvidsson and colleagues explained that neck and upper extremity pain development had been linked to workplace stressors, possibly via increasing sustained muscular activity [22]. This perspective could explain why muscle discomfort, especially in the neck and shoulder area, and WRS co-exist.

Poor lighting is potentially related to WRMDs–workers may adopt unnatural positions to optimize their vision in inadequate lighting, which raises the possibility of injuries [23]. Head and eye functions are closely related to neck pain. The nucleus reticularis gigantocellularis (NRG) in the subcortical area of the brain receives posture and vision information from head and eye movement, stimulating the cervical muscles through the cervical spinal cord's motor neurons and resulting in postural stability [24]. Eye diseases like focal vision disorder and double vision could co-exist in those with neck pain and the dysfunction of vertebral arteries (arteries residing in the cervical vertebrae) [25]. As a result, poor lighting in this study might interfere with eye muscle movement and cause poor neck posture and muscle pain. It has been found that active breaks and posture changes could recover high-risk sitting workers' new onset of neck and low-back pain [26]. Further study is required to implement this intervention in informal garment workers.

Similarly to garment workers, manual laborers require high physical demands, including physically intensive tasks and prolonged repetitive duties [27]. Repetitive muscle injuries cause extracellular matrix enlargement, collagen accumulation, and fiber necrosis [27]. In addition, direct damage to tendons and ligaments can also produce fibrosis and cause inflammation and collagen dysplasia [28], [29]. Due to repetitive hand and arm movements and suboptimal working postures that need to be maintained for extended periods, hand-sewing tasks may be associated with a high prevalence of WRMDs in workers, especially with extended periods while seated at a desk [30].

The limitations of this study are listed as follows. First, the cross-sectional study cannot explain temporal changes in clinical manifestations of WRMDs. Secondly, number of participants are relatively small; further studies should include more subjects to maximize the predictive power. Finally, quantitative analytic

tools should be employed to elaborate on the pathophysiological details of the injuries. In conclusion, Kalasin's informal garment workers have had a substantial number of WRMDs due to poor workstations and stress surrounding work. Therefore, relevant stakeholders ought to seek preventive and control measures that minimize the risk of WRMDs while also enhancing the quality of life for this workforce in the future.

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REFERENCES

[1] A. Pal, A. Dasgupta, S. k. Sadhukhan, L. Bandyopadhyay, B. Paul, and D. Podder, "How common are aches and pains among garment factory workers? a work-related musculoskeletal disorder assessment study in three factories of South 24 Parganas District, West Bengal," *Journal of Family Medicine and Primary Care*, vol. 10, no. 2, pp. 917–921, Feb. 2021, doi: 10.4103/jfmpc.jfmpc_55_20.

[2] J. S. Silva-Junior, M. C. Martinez, F. S. Sekiya, C. B. de Miranda, and F. M. Fischer, "Return to work after sick leave due to musculoskeletal disorder or injury: a longitudinal study conducted in Brazil," *BMC Public Health*, vol. 23, no. 1, p. 1881, Sep. 2023, doi: 10.1186/s12889-023-16789-z.

[3] N. Naicker, F. Pega, D. Rees, S. Kgalamono, and T. Singh, "Health services use and health outcomes among informal economy workers compared with formal economy workers: a systematic review and meta-analysis," *International Journal of Environmental Research and Public Health*, vol. 18, no. 6, pp. 1–15, Mar. 2021, doi: 10.3390/ijerph18063189.

[4] A. Aratikatla, N. Maffulli, H. C. Rodriguez, M. Gupta, A. G. Potty, and A. Gupta, "Allogenic perinatal tissue for musculoskeletal regenerative medicine applications: a systematic review," *Biomedicines*, vol. 10, no. 12, p. 3173, Dec. 2022, doi: 10.3390/biomedicines10123173.

[5] D. Roomes *et al.*, "Quantifying the employer burden of persistent musculoskeletal pain at a large employer in the United Kingdom," *Journal of Occupational & Environmental Medicine*, vol. 64, no. 3, pp. e145–e154, Mar. 2022, doi: 10.1097/JOM.0000000000002468.

[6] V. Gorasso *et al.*, "The health and economic burden of musculoskeletal disorders in Belgium from 2013 to 2018," *Population Health Metrics*, vol. 21, no. 1, p. 4, Apr. 2023, doi: 10.1186/s12963-023-00303-z.

[7] Y. Ghorpade, C. Franco Restrepo, and L. E. Castellanos, *Social protection and labor market policies for the informally employed: a review of evidence from low- and middle-income countries*. Washington, DC: World Bank, 2024. doi: 10.1596/41328.

[8] S. Chaiklieng, C. Chagkornburee, and P. Suggaravetsiri, "Situations of work-related diseases and injuries among agriculturists in the upper northeast regions of Thailand," *F1000Research*, vol. 11, p. 145, 2023, doi: 10.12688/f1000research.73221.2.

[9] T. Andrasfay, A. R. Pebley, and N. Goldman, "Physical work exposures of older workers: does measurement make a difference?," *Work, Aging and Retirement*, vol. 9, no. 2, pp. 179–189, Apr. 2023, doi: 10.1093/workar/waab014.

[10] N. Sangkhachantharanan and S. Singyabuth, "Praewa, the queen of silk: phu tai ethnic identity and invented tradition in Kalasin Province, Thailand," *The International Journal of Interdisciplinary Cultural Studies*, vol. 17, no. 2, pp. 37–47, 2022, doi: 10.18848/2327-008X/CGP/v17i02/37-47.

[11] W. Komin, R. Thepparp, B. Subsing, and D. Engstrom, "COVID-19 and its impact on informal sector workers: a case study of thailand," *Asia Pacific Journal of Social Work and Development*, vol. 31, no. 1–2, pp. 80–88, Apr. 2021, doi: 10.1080/02185385.2020.1832564.

[12] L. Boonkhao, S. Kantow, N. Kunhayat, N. Boonkla, and P. Rattanachaikunsopon, "Factors associated with ergonomic risk among informal workers in the Northeast of Thailand," *Universal Journal of Public Health*, vol. 11, no. 3, pp. 351–358, Jun. 2023, doi: 10.13189/ujph.2023.110309.

[13] W. W. Daniel and C. L. Cross, *Biostatistics: a foundation for analysis in the health sciences*. John Wiley & Sons, 2018. doi: 10.2307/2531929.

[14] A. H. Tesfaye, G. G. Kabito, F. M. Aragaw, and T. H. Mekonnen, "Prevalence and risk factors of work-related musculoskeletal disorders among shopkeepers in Ethiopia: evidence from a workplace cross-sectional study," *PLoS ONE*, vol. 19, p. e0300934, Mar. 2024, doi: 10.1371/journal.pone.0300934.

[15] R. Dinesh and K. Muthukumar, "Ergonomic study in domestic sewing machine," in *Advances in Behavioral Based Safety*, Singapore: Springer Nature Singapore, 2022, pp. 147–159. doi: 10.1007/978-981-16-8270-4_11.

[16] A. Realyvásquez-Vargas, K. C. Arredondo-Soto, J. Blanco-Fernandez, J. D. Sandoval-Quintanilla, E. Jiménez-Macías, and J. L. García-Alcaraz, "Work standardization and anthropometric workstation design as an integrated approach to sustainable workplaces in the manufacturing industry," *Sustainability*, vol. 12, no. 9, p. 3728, May 2020, doi: 10.3390/su12093728.

[17] N. F. Mahmoud, K. A. Hassan, S. F. Abdelmajeed, I. M. Moustafa, and A. G. Silva, "The relationship between forward head posture and neck pain: a systematic review and meta-analysis," *Current Reviews in Musculoskeletal Medicine*, vol. 12, no. 4, pp. 562–577, Dec. 2019, doi: 10.1007/s12178-019-09594-y.

[18] Y. Nishikawa *et al.*, "Influence of forward head posture on muscle activation pattern of the trapezius pars descendens muscle in young adults," *Scientific Reports*, vol. 12, no. 1, p. 19484, Nov. 2022, doi: 10.1038/s41598-022-24095-8.

[19] S. Chaiklieng, P. Suggaravetsiri, and S. Andajani, "Risk factors associated with work-related low back pain among home-based garment workers," in *Proceedings of the 3rd International Conference on Intelligent Human Systems Integration (IHSI 2020): Integrating People and Intelligent Systems*, Modena, Italy, 2020, pp. 753–759. doi: 10.1007/978-3-030-39512-4_115.

[20] T. A. Birhan, M. Ambissa, T. G. Delele, and H. Dagne, "Work-related stress and associated factors among garment workers in Bole Lemi Industrial Park of Addis Ababa, Ethiopia: a multi-center institution-based cross-sectional study," *BMC Psychiatry*, vol. 22, no. 1, p. 806, Dec. 2022, doi: 10.1186/s12888-022-04460-7.

[21] B. Chen, L. Wang, B. Li, and W. Liu, "Work stress, mental health, and employee performance," *Frontiers in Psychology*, vol. 13, Nov. 2022, doi: 10.3389/fpsyg.2022.1006580.

[22] I. Arvidsson, C. Dahlqvist, H. Enquist, and C. Nordander, "Action levels for the prevention of work-related musculoskeletal disorders in the neck and upper extremities: a proposal," *Annals of Work Exposures and Health*, vol. 65, no. 7, pp. 741–747, Aug. 2021, doi: 10.1093/annweh/wxab012.

[23] T. Andrasfay, N. Raymo, N. Goldman, and A. R. Pebley, "Physical work conditions and disparities in later life functioning: potential pathways," *SSM - Population Health*, vol. 16, p. 100990, Dec. 2021, doi: 10.1016/j.ssmph.2021.100990.

[24] K. K. Y. Leung, E. C. P. Chu, W. L. Chin, S. T. K. Mok, and E. W. S. Chin, "Cervicogenic visual dysfunction: an understanding of its pathomechanism," *Medicine and Pharmacy Reports*, vol. 96, no. 1, pp. 16–19, 2023, doi: 10.15386/mpr-2507.
[25] C. Teo, P. Giffard, V. Johnston, and J. Treleaven, "Computer vision symptoms in people with and without neck pain," *Applied Ergonomics*, vol. 80, pp. 50–56, 2019, doi: 10.1016/j.apergo.2019.04.010.
[26] P. Waongenngarm, A. J. van der Beek, N. Akkarakittichoke, and P. Janwantanakul, "Effects of an active break and postural shift intervention on preventing neck and low-back pain among high-risk office workers: a 3-arm cluster-randomized controlled trial," *Scandinavian Journal of Work, Environment and Health*, vol. 47, no. 4, pp. 306–317, 2021, doi: 10.5271/sjweh.3949.
[27] C. N. Igwesi-Chidobe, I. O. Sorinola, B. C. Ozumba, and E. L. Godfrey, "Challenges of measuring self-reported exposure to occupational biomechanical risk factors amongst people with low literacy engaged in manual labour: findings from a cross-cultural adaptation and psychometric investigation in an african population with chr," *Journal of Occupational Rehabilitation*, Feb. 2024, doi: 10.1007/s10926-024-10171-5.
[28] D. M. Klyne, M. F. Barbe, G. James, and P. W. Hodges, "Does the interaction between local and systemic inflammation provide a link from psychology and lifestyle to tissue health in musculoskeletal conditions?," *International Journal of Molecular Sciences*, vol. 22, no. 14, p. 7299, Jul. 2021, doi: 10.3390/ijms22147299.
[29] L. Jiang *et al.*, "Inflammation-related signaling pathways in Tendinopathy," *Open Life Sciences*, vol. 18, no. 1, Sep. 2023, doi: 10.1515/biol-2022-0729.
[30] O. Lotter, T. Lieb, V. Breul, and J. Molsner, "Is repetitive workload a risk factor for upper extremity musculoskeletal disorders in surgical device mechanics? a cross-sectional analysis," *International Journal of Environmental Research and Public Health*, vol. 17, no. 4, p. 1383, Feb. 2020, doi: 10.3390/ijerph17041383.

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