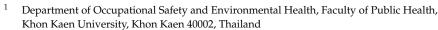


Article



Risk Factors for Developing Occupational Back Pain in Electronics Industry Workers: A Cross-Sectional Study

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Abstract: Back pain is an occupation-related problem among workforces. This cross-sectional study aimed to identify the prevalence of back pain and the risk factors of occupational back pain among workers in the electronics industry. In total, 354 electronics workers in Thailand participated in the study. Data were collected using the Musculoskeletal Disorders Severity and Frequency Questionnaire, the Job Content Questionnaire, and ergonomics risk assessment via the Rapid Upper Limb Assessment (RULA). Risk factors of back pain were identified by multiple logistic regression analysis, providing adjusted odds ratios (OR_{adj}) and 95% confidence intervals (95% CI). The study found that most workers were operators (92.09%) and had repetitive work (83.62%). A high ergonomics risk was observed in workers who stood during work (68.49%) and operated machines (71.70%). The 1-month prevalence of developing back pain was 20.62% and the significant factors correlated with back pain were low levels of job control and decision-making (OR_{adj} = 2.26; 95% CI [1.26, 4.05]), lack of exercise (OR_{adj} = 8.30; 95% CI [1.35, 24.28]), repetitive work (OR_{adj} = 2.94; 95% CI [1.19, 7.29]), and high ergonomic risk level (OR_{adj} = 2.81; 95% CI [1.16, 5.07]). These findings suggest that measures should be implemented by empowering electronics workers to make decisions and control their jobs, as well as promoting health through muscle-stretching exercise, to support back pain prevention.

Keywords: back pain; ergonomics; RULA; repetitive work; electronics workers

1. Introduction

Musculoskeletal disorders (MSDs), especially work-related musculoskeletal disorders (WMSDs), are the most common health problem impacting workforces, resulting in the high prevalence of WMSDs (40.6–90.0%) found in various occupations and affecting different areas of the body [1–4]. Previous studies have shown a high prevalence of WMSDs among industrial workers, such as those in the garment industry [1], the potato chip manufacturing process [2], and electronics manufacturing [3,5]. Workers involved in manual materials handling, manual assembly, and those who maintain a persistent posture during electronics inspections have reportedly been affected by WMSDs [4,5].

Workers in the electronics industry in Thailand are widely distributed across the northeast region, where previous reports have indicated a high incidence of low back pain and shoulder pain [6]. Their work characteristics involve prolonged periods of standing or sitting to inspect or assemble small electronic parts, as well as tasks requiring focused eye work in the industrial process [6]. The working conditions often lead to awkward postures involving waist twisting or the use of the upper shoulders, which have been reported to cause shoulder pain among electronic workers [5,7].

Previous studies have reported long-term exposure to ergonomic risk factors among electronic workers in the industrial process [4,6]. Additionally, factors such as twisting and bending of the body during work activities, lack of backrest support in sitting postures, and repetitive work have been identified as contributors to the development of low back pain



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Copyright: © 2024 by the authors. Licensee MDPI, Basel, Switzerland. This article is an open access article distributed under the terms and conditions of the Creative Commons Attribution (CC BY) license (https:// creativecommons.org/licenses/by/ 4.0/). (LBP) [6]. The etiology of LBP is considered multifactorial, with individual, physical, and psychosocial factors contributing to its development and persistence. Furthermore, personal factors such as gender, body mass index, health status, exercise, and work experience have been previously indicated as correlating with WMSDs [6,8,9].

It is still unclear which factor plays the most predominant role in back pain among workers in the electronics industry. This study aimed to investigate occupational back pain prevalence and the risk factors of back pain among those kinds of workers to obtain information and apply it in organisations for the prevention of back pain.

2. Materials and Methods

2.1. Population and Sample Size

This study was a cross-sectional study conducted between August and December 2015. The population consisted of workers in medium-sized enterprises of up to 200 workers in the electronics industry located in the north-east of Thailand. The sample size was calculated by using the sample size formula for a cross-sectional analytic study using logistic regression analysis for risk factor identification [10]. The proportion of workers with back pain was calculated by considering the factors of working posture that caused fatigue in industrial workers according to a study by Widanarko et al. [11], where the proportion of workers with back pain among workers who were prone to fatigue due to their working posture was 0.57. The minimum required number of subjects was 354 people, and simple random sampling was used. The inclusion criteria for subject participation in this study were as follows: (1) full-time employment in a production process of a manufacturing department in the electronics industry for at least 1 year; and (2) voluntary agreement to participate in the project. The exclusion criteria were as follows: (1) a history of back pain treatment by a physician in the past month; (2) diagnosis of a chronic musculoskeletal disease or injury affecting the cervical, thoracic, or lumbar spine by a physician; and (3) being pregnant.

The study protocol was approved according to human research ethics considerations by the Human Research Ethics Committee, Khon Kaen University (HE582213).

2.2. Study Tools

This study used three questionnaires: the structural interview questionnaire on work characteristics, the Musculoskeletal Disorders Severity and Frequency Questionnaire (MSFQ) [2], and the Job Content Questionnaire (JCQ) [12]. The interview questionnaire was adapted from a previous questionnaire by collecting data related to personal characteristics, health, working characteristics and working environment, and various relevant risk factors that were expected to be associated with back pain, which were used to describe the sample group [6].

The structured interview questionnaire had details according to the variables to be studied and was classified into two parts: part 1, personal characteristics and health status, consisting of demographic characteristics including gender, age, education level, job position, work experience, weight, height, physical activity, and chronic disease; and part 2, the nature of work and the working environment, consisting of working hours per day, number of working days per week, the working area, and the lighting and posture requirements while working, sitting/standing, and focusing the eyes.

The MSFQ, applied from Chaiklieng [2], was used to indicate back pain experienced in the past month, with the severity and frequency of pain specified. The back questionnaire requested information on self-reported back pain complaints experienced during the previous month. Back pain complaints were defined as "aches, pain, or discomfort that have been caused by your work".

The questionnaire on work stress, consisting of questions on workloads, work decisions, and work control, was based on the Job Content Questionnaire, or JCQ [12], which assesses the ratio of workload to decision-making power and ability to control work; when there is a higher total workload score, it will identify stress from work. The questions were based on the 12 items from the JCQ with a 5-point Likert scale (1–5 points for each item). The details of the 12 items were related to aspects of job content in regard to work demands, including demands for highly skilled work, hard work, excessive workload, and fast work. JCQ items of job control and decision-making authority were based on the following: learning new things, being an interesting and exciting job, requiring creativity, having the opportunity to plan one's own work, being allowed to make one's own decisions, the variety of work, being able to take a rest when feeling tired, and having corporate rules which do not put restrictions on work.

The ergonomic risk assessment aimed to study the working posture though observations, utilising the RULA (Rapid Upper Limb Assessment) technique developed by McAtamney and Corlett [13] to assess the upper limb posture during work. RULA is used for posture analysis and risk assessment of mainly the upper limbs of the body, which are involved in repetitive movement, and is appropriate for jobs that require sitting or use of the upper extremities. It is used for assessing the position and movement characteristics of various body parts. The body was divided into two groups: Group A consisted of the wrists, lower arms, and upper arms, while Group B consisted of the torso, legs, and neck. Group A and B scores were added to the muscle use and workload scores, respectively, resulting in four levels of ergonomic risk which were as follows: Level 1 = score of 1–2, which is an acceptable risk; Level 2 = score of 3–4, which is a low risk that should be investigated and may require change; Level 3 = score of 5–6, which is a moderate risk that should be investigated and corrected soon; and Level 4 = score of 7, which means the risk is very high, so the work should be investigated and corrected immediately.

The light intensity was measured by using a spot measurement technique at all of the main workstations of workers with a lux meter (Extech instruments, Nashua, NH, United States), the equipment used for measuring work lighting intensity at workstations. The machine, whose serial number was Q431675, had been approved after calibration and corrected measurement performed following the regulations of the Ministry of Labor, B.E. 2561 [14]. Comparison of the results to the regulatory standards of the Department of Labor Protection and Welfare (2018) [15] was conducted by considering the type of task, i.e., machine operation, materials assembly, general inspection tasks with a computer monitor or profile projector, inspection with a lamp, and inspection with a microscope. The spot measurement was performed at a table or workstation, with a computer monitor and documents on the table of the worker, or under a lamp or microscope and within the inner-arm and outer-arm range areas as a three-area method [3], or the spot where eyes were focused while working.

2.3. Statistical Analysis

Data were analysed using STATA 10.1, College Station, TX, USA (2007). Descriptive statistics were used to describe the characteristics of workers, work environments, ergonomic risk, and work stress. Means (standard deviation) and percentages were used to describe the results. Inferential statistics, namely univariate analysis and multiple logistic regression analysis, were used to find the correlation between the studied factors and back pain. All variables with a *p*-value < 0.20 from simple logistic regression analysis were entered into the model of multiple logistic regression analysis to produce the odds ratio (OR), adjusted odds ratio (OR_{adj}), and 95% confidence interval (95% CI). Factors that indicated significant correlation were factors with *p*-values < 0.05.

3. Results

3.1. Personal and Work Characteristics

The personal characteristics of all 354 electronics assembly workers were as follows: most of them were female (81.36%); and the highest proportion of workers was aged between 20 and 29 years old (63.84%), followed by those aged 30–39 years (31.07%). The numbers of single and married people were equal. Most workers had an education level equivalent to secondary school or had a vocational certificate (77.12%). The vast majority of

workers were at the operator level (92.09%). The length of work experience was less than 5 years for 75.71% of workers. It was found that most workers had a BMI at the normal level (51.84%). In terms of exercise, 74.01% did not exercise, 92.37% did not smoke, and 22.88% had congenital disease, with the most common diseases being those of the stomach (10.17%), while others had eye problems (8.76%) and stress (2.54%). Most workers did 3 h of overtime work (99.70%), worked 6 days a week (90.11%), and performed repetitive work in the same posture (83.62%).

Most workers were operators who were mainly responsible for assembly work and inspection as the main tasks. The survey found that the most common types of equipment used were microscopes and lamps. As a result, some workers used their eyes to focus on work and had repetitive movement of upper limbs. The work corresponds to continuous activity for more than 2 h per day and repeated movement to support the inspection of pieces of a product under a lamp or microscope. Lighting intensity measurement at the main workstations of workers using the spot measurement method was able to show that 36.44%, or 129 workstations, did not meet the standards for lighting intensity. The majority of stations where workers worked on tasks involving a microscope (n = 115; 76.52%) did not meet the standard requirements of Thailand's Ministry of Labour [15].

Using the 12 items of the JCQ, work stress was determined by considering the ratio of the workload score to the total score of work control ability and decision-making power. This study found that in terms of workload, workers had quite a high workload due to work requiring high skills (60.73%), followed by work requiring speed, or fast work (51.69%), with the scores of individual workers ranging from 4 to 20 points (see Table 1). The average score was 13.28 (SD = 2.77), which meant workers had a likely high workload. There were 205 workers (57.91%) who had likely low demands of work and 149 workers (42.09%) who had likely high demands of work.

Table 1. The job demands, and job control and decision-making power classified into the 12 items of the questionnaire conducted with electronics workers (n = 354).

Job Content Questionnaire (JCQ)

Likely Low	Likely High
139 (39.27)	215 (60.73)
241 (68.08)	113 (31.92)
260 (73.45)	94 (26.55)
171 (48.31)	183 (51.69)
196 (55.37)	158 (44.63)
235 (66.38)	119 (33.62)
274 (77.40)	80 (22.60)
234 (66.10)	120 (33.90)
182 (51.41)	172 (48.59)
223 (62.99)	131 (37.01)
261 (73.73)	93 (26.27)
250 (70.60)	104 (29.38)
	139 (39.27) 241 (68.08) 260 (73.45) 171 (48.31) 196 (55.37) 235 (66.38) 274 (77.40) 234 (66.10) 182 (51.41) 223 (62.99) 261 (73.73)

Regarding work control and decision-making power, considering the scores of the eight items of the JCQ, the workers were judged to have relatively low levels of control and decision-making; the highest percentage of workers had likely low levels of control and decision-making according to the JCQ item on work which required creativity (77.4%), followed by the items on being able to take a rest when feeling tired (73.73%), and having corporate rules which do not put restrictions on work (70.60%), respectively. When considering the total score of all eight items, each worker was found to be in the range of 9–40 points (min-max), and the average score of the eight items was 25.04 (SD = 5.18). There were 202 workers (57.06%) who had likely low levels of control and decision-making in

Level [n (%)]

work and 152 workers (42.94%) who had likely high levels of control and decision-making in work.

For work stress, the result was calculated by using the following formula:

Stress =
$$(workload \times 2)/work \text{ control and decision-making}$$
 (1)

The analysis indicated if stress > 1, work stress was high. This study found that 193 workers (54.52%) had high work stress.

The results of an ergonomic risk assessment using RULA were used in this study to provide the same baseline risk profile for all workers. It was found that the highest proportion had a Level 3 ergonomic risk, where the work had begun to cause problems that should be investigated further and should be improved (47.46%), followed by those at Level 2, who performed work which required additional inspection and might need remedial work (42.37%), and those at Level 4, whose tasks led to very high levels of ergonomic problems and should be improved immediately (10.17%). An acceptable level of ergonomic risk was not found.

3.2. Occupational Back Pain Prevalence

The 1-month prevalence of WMSDs found by MSFQ identification showed that the predominant area of pain was in the back area (75.14%), followed by shoulders (74.58%) and neck (69.77%). Considering a severity level of pain from moderate to high, it was found that the highest level of severity was that of back pain. Taking the frequency of pain into account, it was found that the majority of workers had the highest frequency of pain in the back, with the highest frequency levels at 3–4 times a week.

When the prevalence of pain in this study was considered by using the pain intensity criteria from a moderate level to a very high severity level, back pain (lower and upper areas) in the past month was found to be the most prevalent when compared to other areas (20.62%; 95% CI [16.38, 24.86]), followed by shoulder pain (16.10%; 95% CI [12.25, 19.95]), as shown in Table 2.

Table 2. Prevalence of WMSDs in the past month among electronics workers, classified by different areas (n = 354).

Area	Prevalence [Number (%)]	95% CI	
Neck	36 (10.17)	7.00, 13.33	
Shoulders ²	57 (16.10)	12.25, 19.95	
Lower back	50 (14.12)	10.48, 17.77	
Upper back ³	54 (15.25)	11.49, 19.01	
Back ¹	73 (20.62)	16.38, 24.86	
Lower arm	25 (7.01)	4.38, 9.74	
Wrists/hands	28 (7.91)	5.08, 10.73	
Hip	29 (8.19)	5.32, 11.06	
Knee	37 (10.45)	7.24, 13.63	
Calf	35 (9.86)	6.76, 13.01	
Feet/ ankles	45 (12.71)	9.23, 16.20	

Remark: ^{1, 2, 3} are the first, the second, and the third ranking of highest prevalence, respectively.

3.3. Risk Factors Correlated with Occupational Back Pain

According to univariate analysis, the factors associated with back pain were lack of exercise (OR = 5.72; 95% CI [1.35, 24.38]), chronic disease (OR = 2.26; 95% CI [1.09, 3.04]), high ergonomic risk (Level 4 of RULA) (OR = 2.43; 95% CI [1.16, 5.07]), likely high workload (OR = 2.07; 95% CI [1.19, 3.62]), and likely low levels of job control and decision-making (OR = 1.84; 95% CI [1.07, 3.19]) (see Tables 3 and 4). The multiple logistic regression analysis showed that the factors correlated with back pain were no exercise (OR_{adj} = 8.30; 95% CI [1.35, 24.38]), no overtime work (OR_{adj} = 3.39; 95% CI [1.16, 9.88]), repetitive work posture (OR_{adj} = 2.94; 95% CI [1.19, 7.29]), very high ergonomic risk according to RULA

 $(OR_{adj} = 2.81; 95\% \text{ CI } [1.20, 6.60])$, and relatively low levels of work control and decision-making $(OR_{adj} = 2.26; 95\% \text{ CI } [1.26, 4.05])$, as shown in Table 5.

Table 3. Factors of worker characteristics correlated with back pain among electronics workers, found by univariate analysis (n = 354).

Factor	Back Pain;	Number (%)		¥7.1
	No Pain	Back Pain	— OR [95% CI]	<i>p</i> -Value
Gender				
Male	55 (83.3)	11 (16.7)	1.00	
Female	226 (78.5)	62 (21.5)	1.37 [0.67, 2.78]	0.380
Age (years)		. ,		
<30	183 (79.06)	49 (20.94)	1.00	
>30	96 (80.0)	24 (20.00)	0.94 [0.57, 1.63]	0.836
Marital status				
Married	127 (75.15)	41 (24.85)	1.00	
Single	154 (83.24)	32 (16.76)	1.64 [0.97, 2.76]	0.061
Job Position				
Leader/Supervisor/QA	25 (89.29)	3 (10.71)	1.00	
Operator	256 (78.53)	70 (21.47)	2.25 [0.67, 7.77]	0.188
Education				
Diploma/bachelor's or higher	69 (85.19)	12 (14.81)	1.00	
High school or lower	212 (77.66)	61 (22.34)	1.65 [0.84, 3.25]	0.144
Work experience (years)				
>5	215 (80.22)	53 (19.78)	1.00	
<5	66 (76.74)	20 (23.26)	1.23 [0.69, 2.21]	0.488
BMI				
Normal (18.5–23.0)	144 (78.26)	40 (21.74)	1.00	
Underweight/ overweight / obese	137 (80.59)	33 (19.41)	0.87 [0.51, 1.45]	0.589
Exercise				
Yes	39 (95.12)	2 (4.88)	1.00	
No	242 (77.32)	71 (22.68)	5.72 [1.35, 24.28]	0.018 *
Smoking				
No	260 (78.8)	70 (21.2)	1.00	
Yes	21 (87.5)	3 (12.5)	0.53 [0.15, 1.83]	0.316
Chronic disease		· · /		
No	224 (82.05)	49 (17.95)	1.00	
Yes	57 (70.37)	24 (29.63)	2.26 [1.09, 3.04]	0.024 *

* Significant at *p*-value < 0.05.

Table 4. Factors of work characteristics and work environments correlated with back pain among electronic workers, found by univariate analysis (n = 354).

Factor	Back Pain;	Back Pain; Number (%)		<i>p</i> -Value
Factor	No	No Back Pain		
Shift work				
Yes	213 (81.92)	47 (18.08)	1.00	
No	68 (72.34)	26 (27.66)	1.73 [0.99, 3.01]	0.051

RULA

Likely low

Lower than Level 4

Level 4 (high risk)

Tab	ole 4. Cont.			
Factor	Back Pain; Number (%)		OR [95% CI]	<i>p</i> -Value
	No	Back Pain		
Overtime (OT) work				
Yes	267 (80.42)	65 (19.58)	1.00	
No	14 (63.64)	8 (36.36)	2.35 [0.94, 5.83]	0.066
Repetitive work				
No	50 (86.21)	8 (13.79)	1.00	
Yes	231 (78.04)	65 (21.95)	1.76 [0.79, 3.90]	0.164
Eye-focusing job				
No	136 (80.95)	32 (19.05)	1.00	
Yes	145 (77.96)	41 (22.04)	1.20 [0.72, 2.02]	0.487
Lifting				
No	194 (81.86)	43 (18.14)	1.00	
Yes	87 (74.36)	30 (25.64)	1.56 [0.92, 2.64]	0.102
Lighting intensity				
Met the standard	173 (76.89)	52 (23.11)	1.00	
Lower than the standard	108 (83.72)	21 (16.28)	0.65 [0.37, 1.33]	0.128
Workload				
Likely low	128 (85.91)	21 (14.09)	1.00	
Likely high	153 (74.63)	52 (25.37)	2.07 [1.19, 3.62]	0.011 *
Job control and decision-making				
Likely high	129 (84.87)	23 (15.13)	1.00	
·····				0.000 /

50 (24.75)

60 (18.87)

13 (36.11)

Table 4. Cont.

23 (63.89) * Significant at *p*-value < 0.05.

152 (75.25)

258 (81.13)

Table 5. Multiple logistic regression analysis of risk factors correlated with back pain among electronic workers (n = 354).

1.84 [1.07, 3.19]

1.00

2.43 [1.16, 5.07]

0.028 *

0.018 *

Factor	Back Pain;	Number (%)	OR _{adj} [95% CI]	<i>p</i> -Value	
	No	Yes		<i>p</i> -value	
Gender					
Male	55 (83.33)	11(16.67)	1.00		
Female	226 (78.47	62 (21.53)	1.31 [0.58, 2.97]	0.517	
Age (years)					
>30	96 (80.00)	24 (20.00)	1.00		
<30	185 (79.06)	49 (20.94)	1.19 [0.66, 2.15]	0.565	
Exercise					
Yes	39 (95.12)	2 (4.88)	1.00		
No	242 (77.32)	71 (22.68)	8.30 [1.35, 24.28]	0.007 *	
Overtime					
Yes	267 (80.42)	65 (19.58)	1.00		
No	14 (63.64)	8 (36.36)	3.39 [1.16, 9.88]	0.025 *	
Repetitive work					
No	50 (86.21)	8 (13.79)	1.00		
Yes	231 (78.04)	65 (21.95)	2.94 [1.19, 7.29]	0.020 *	
RULA					
Lower than Level 4	258 (81.13)	60 (18.87)	1.00		
Level 4 (high risk)	23 (63.89)	13 (36.11)	2.81 [1.20, 6.60]	0.018 *	
Job control and decision-	naking		-		
High	129 (84.87)	23 (15.13)	1.00		
Low	152 (75.25)	50 (24.75)	2.26 [1.26, 4.05]	0.006 *	

* Significant at *p*-value < 0.05; gender and age were confounders adjusted to all models of multivariate analysis.

4. Discussion

This study found that back pain had the highest prevalence (20.62%) among WMSDs, followed by shoulder pain (16.10%), and upper back pain (15.25%), respectively, in 354 electronic workers. That is consistent with a previous study on electronics workers in China [3]. The workers felt uncomfortable and had experience of perceived musculoskeletal pain, which was predominantly in the back and shoulder areas. Moreover, shoulder pain, which had the second highest prevalence, had been reported in another previous study of electronic workers for its association with work environments and the nature of the repetitive work [3,5].

As per the previous study, it was found that electronics assembly manufacturing workers were at high risk as their work involved persistent standing to control the machine, input material into the machine, and assemble parts, and persistent sitting to inspect fine parts of products. This study discovered that the majority of workstations for inspection under a lamp or microscope did not meet the standard for lighting intensity following the three-area spot measurement method. One study among office workers has already explained the correlation between lighting intensity that is lower than the standard and the prevalence of musculoskeletal pain [16].

According to the risk-factor analysis on predicting back pain, the findings indicated that the factors which significantly correlated with back pain among electronics workers were personal factors, work characteristics, and working conditions. Most workers in this study were operators who were mainly responsible for assembly work and inspection tasks. The survey found that the most common types of equipment used were microscopes and lamps. The work corresponds to the following criteria: continuous activity for more than 2 h per day; and repeated movement to support the inspection of pieces of a product under a lamp or microscope. As a result, some workers used their eyes to focus on work and had repetitive movement of upper limbs. It was indicated that workers who had repetitive work had about a three times higher risk of back pain than those who had no repetitive work. The working postures used in the repetitive movement of upper limbs and prolonged sitting during sedentary work for more than 2 h cause back pain in such workers, as reported previously [6]. This supports a previous study which found that repetitive work caused shoulder pain in electronics workers [5] and another which found that it led to back pain among workers in a Japanese manufacturing company [17].

Regarding the personal factors, chronic disease and no exercise were correlated with back pain according to the univariate analysis. Workers who had a chronic disease had about a two times higher risk of developing back pain than those who had no chronic diseases. In addition, workers who did no exercise had an extremely higher risk of back pain than those who did regular exercise. This result could contribute to the implementation program by providing a suggestion for short exercise breaks; a previous ergonomic intervention to relieve musculoskeletal symptoms among assembly line workers at an electronic parts manufacturer in Iran also involved exercise [18].

Regarding the ergonomic risk factors, it was found that high ergonomic risk (RULA Level 4) was the most significant factor associated with back pain. A previous study indicated that improper working posture over a long period of time had the highest impact on shoulder pain [5]. In this study, it was found that workers at high ergonomic risk which required immediate correction had about a three times higher risk of developing back pain than those who had lower ergonomic risk. The fact that back pain prevalence was caused by high ergonomic risk conditions confirms the results of a previous study on electronics workers in Iran [18], who had back disorders resulting from a high level of ergonomic risk.

The results from the univariate analysis showed that back pain was correlated with low levels of job control and decision-making power, and it was also found that another factor contributing to back pain was the likely high workload of workers. This study supports a previous report [6] stating that over 50 percent of workers had occupational work stress related to the likely high job demands; most workers in this study had overtime work of more than 3 h a day and 6 days a week. Moreover, the multiple logistic regression findings confirmed the identified risk factors—such as lack of exercise and low levels of job control—that, when combined, increase their predictive effect on back pain compared to univariate analysis. Low levels of work control and decision-making, along with specific concerns regarding a lack of creativity, restrictions at work, and not having enough time for rest and exercise provided, might cause work stress, and consequently, have an impact on occupational back pain among workers in electronics assembly manufacturing in Thailand. Another personal factor, chronic disease, which was reported in a follow-up cohort group as a significant risk factor of low back pain [6], was not supported by this cross-sectional study and was excluded in the final model of the multivariate analysis. Accordingly, the identified risk factors can serve as guidelines for the prevention of back pain in electronics workers.

As this study was designed as a cross-sectional study, one limitation was the presence of recall bias concerning episodes or the severity of back pain, since these occurred without a confirmed diagnosis. Information on risk factors was collected through questionnaires and postural observations made by the researchers at the time of data collection. Therefore, it is recommended that a prospective cohort study design be employed in the future to confirm the relationship between occupational back pain and the identified risk factors.

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Institutional Review Board Statement: The study was conducted in accordance with the Declaration of Helsinki and approved by the Institutional Human Research Ethics Committee of Khon Kaen University (HE 582213, approved on 1 September 2015) for studies involving humans.

Informed Consent Statement: Informed consent was obtained from all subjects involved in the study before entering into the study.

Data Availability Statement: Data will be made available on request due to privacy or ethical restrictions.

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