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Original

Physical Risk Factors among Construction Workers by Workplace Ergonomic Risk Assessment (WERA) Method

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Abstract

Background: The recent studies have shown that the rates of musculoskeletal injuries and disorders among workers in the construction industry are much higher than those working in other industries. The aim of this study was to investigate the physical risk factor among the workers in construction workshops using Workplace Ergonomic Risk Assessment (WERA) method. **Methods:** A total of 150 workers were randomly selected from five construction workshops. They were working in the wall plastering, bricklaying, and concreting tasks. During the site visit of five workshops, tasks were observed using WERA assessment. A structured interview with self-report charts (Body Discomfort Chart) was administered to participants for each task. **Results:** An analysis of the self-report charts revealed that 94%, 92%, and 83% of workers reported discomfort in their backs in concreting, wall plastering, and bricklaying tasks, respectively. The shoulder region was the second highest reported uncomfortable region by 86% and 84% of workers in concreting and wall plastering tasks, respectively. The wrist region was the second highest reported uncomfortable region reported by 80% of workers in bricklaying task. From the WERA assessment for wall plastering, bricklaying, and concreting tasks, the final scores were 36.57 (SD=8.62), 39.66 (SD=6.92), and 40.06 (SD=7.75), respectively. The highest and lowest scores were 5.87 (SD=1.14) and 2.21 (SD=1.28), respectively for neck and vibration in wall plastering. **Conclusion:** The results showed that workers have pain in their back, shoulder, wrist, elbow, neck, and leg regions during their work in wall plastering, bricklaying, and concreting tasks. The final score for concreting task was higher than wall plastering and bricklaying tasks.

Keywords: Physical risk factor; Workplace Ergonomic Risk Assessment (WERA); Construction industry; Body discomfort

Introduction

Execution of tasks by construction workers requires twisting body parts such as shoulder joints, neck, back, and knees. In these situations, if the posture is so that body parts are strained for a long period of time, then it may cause fatigue, injuries, or in severe cases it can lead to permanent deformation.[1] Among these injuries, back injuries and work-related musculoskeletal disorders (WMSD) are the most common ones. Work-related musculoskeletal disorders have been defined by as "injuries caused or aggravated to the muscles, tendons, joints, and nerves by work". Such injuries

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occur primarily to workers involved in carrying heavy loads, kneeling, contact stress, vibration, extreme temperatures, twisting hands or wrists, and stretching activities. These injuries typically occur due to awkward work posture while carrying out tasks such as lifting loads (back and knee injuries) and working overhead (neck and shoulder injuries).[2]

Work-related musculoskeletal injuries and repetitive stresses are often associated with overexertion of the body at work[3] with general incidence rate of more than 30%according to the report of Bureau of Labor Statistics in the U.S.[4] According to a statistic report by the department of Occupational Safety and Health, Malysia (DOSH) about occupational accidents for the category of death up to August 2010, 51 of victims were reported behind the agriculture (26 of victims) and transportation (10 of victims). According to the statistic report about the number of accidents by industry up to 2007, 2900 of cases were reported in construction industry.[5] Work-related musculoskeletal disorder (MSD) is one of the most prevalent occupational health problems[6] affecting millions of workers every year. Specifically, construction workers are faced with higher rates of work-related MSDs,[7] which is approximately 16% higher than workers in other industries.[8] Major causes of MSDs among construction workers are high physical demands,[9] such as heavy lifting, repetitive motions, and awkward working postures (e.g., bending and twisting, kneeling, and working with arms above shoulder height).[8,10]Musculoskeletal disorders are costly in economic terms; they pose more than 2 billion dollars directly and 93 million dollars in directly annually.[11]Approximately 33% of all occupational injuries and disorders have been related to MSDs, 13–15% of which occur in the shoulder.[12] Fatigue in the neck and shoulder is a significant precursor for the development of shoulder and neck MSDs. From the viewpoint of physical ergonomics, muscle fatigue is defined as the decreased capacity of a muscle or a group of muscles for force generation after working and is associated with upper limb MSDs.[13]

According to a report from the Centers for Disease Control (CDC), most construction worker's disorders are due to increased job demands.[14] In a study, Berberoğluand collaborates investigated the relationship between job speed (increasing workload) and skeletal disorders.[15] Many musculoskeletal disorders in construction workers are caused by drilling, working with Hilti electric, grinding, lack of training, lack of appropriate corrective actions, and so on.[16-17] Many postural observational methods have been advocated in the literature to evaluate exposure to musculoskeletal disorder risk factors associated with work.[18-19] One widely used postural observational method is the Workplace Ergonomic Risk Assessment (WERA) method. Despite the high prevalence of ergonomic risk factors in construction work, the aim of this study was to investigate the physical risk factor among construction workers in workshops using Workplace Ergonomic Risk Assessment (WERA) method.

Methods

This descriptive analysis studied construction workers in Kurdistan province, Iran (2016). In this study the sample included 150workers working in three fields of wall plastering task (n=50), bricklaying task (n=50), and floor concreting task (n=50) who were selected by convenience sampling. Inclusion criteria consisted of having work experience of at least one year and exclusion criteria included having congenital MSDs or musculoskeletal injuries caused by accidents.

The instruments used for data collection:

Demographic data questionnaire: It contains personal data (age, work experience, working hours per day).

Body Discomfort Chart: Body part discomfort scale is a subjective symptom survey tool that evaluates the respondent's direct experience of discomfort at different body parts . The body discomfort chart consists of

items about the level of pain or discomfort in terms of pain or no pain in six body parts including the shoulder, elbow, wrist, back, neck, and leg regions.[20]

WERA method: The Workplace Ergonomic Risk Assessment (WERA) was developed to provide a method of screening the working task quickly for exposure to the physical risk factor associated with work-related musculoskeletal disorder (WMSDs). The WERA assessment consists of six physical risk factors including posture, repetition, forceful, vibration, contact stress, and task duration and involves five main body regions (shoulder, wrist, back, neck, and leg). It has scoring system and action levels that provide a guide to the level of risk and need for action to conduct more detailed assessments. Since the WERA tool is a pen and paper technique that can be used without any special equipment, it can be conducted in all workplaces without disrupting them.[21]

While doing the task, observations were recorded by video camera. Three tasks were observed and recorded during the task in order to collect data for the WERA assessment. During the resting and launch times, a structured interview was conducted using self-report charts (Body Discomfort Chart provides a valid measure of body discomfort) in which all participants attended for each tasks. Figure 1 shows the three types of tasks in construction industries. In the present study, ethical considerations were observed in accordance with the Declaration of Helsinki. Furthermore, to respect the rights, principles, and ethical considerations, all participants were aware of the purpose and importance of the study. Throughout the study, they were also assured that the data were only used for research purposes and their information was confidentially reserved. Data analysis was done using Excel software. Descriptive statistics such as frequency, percentage, mean, and standard deviation were then reported for all variables.

Results

Description of the Sample

The total mean age of the samples (n=150) was 33.74 (4.38) years in the range of 20 to 55. However, the total mean of working experience was 10.35 (4.80) years that ranged from 1 to 20 years. The total working hours per day was from 8 to 10 hours mean 8.61 (0.63). Table 1 shows the demographic information of the workers in construction workshops. There was no statistically significant difference between the groups.

A **B**

C

Figure 1. Three types of tasks in construction industry including wall plastering (A), concreting (B), and bricklaying (C)

Table 1. Demographics of workers in construction workshops (n=150)

Task	Age (year)		Working Experience (year)		Working per day (hours)	
	Mean(SD)	Range	Mean(SD)	Range	Mean(SD)	Range
Wall Plastering(n=50)	37.50 (4.73)	26-55	12.35 (5.21)	2-20		
Bricklaying(n=50)	35.42 (3.82)	24-51	10.48 (4.60)	3-18		
Concreting(n=50)	28.32 (4.61)	20-47	8.21 (3.68)	1-15	8.61 (0.63)	8-10
Total(n=150)	33.74 (4.38)	20-55	10.35 (4.80)	1-20		

Body Discomfort Chart Assessment

Based on the analysis of the self-report charts (Body Discomfort Chart) from the floor wall plastering task (n=50), 92% of workers reported discomfort in the back regions. The shoulder region was the second highest discomfort body part reported by 84% of workers. This was followed by wrist/hand, neck, elbow, and leg regions reported by 82%, 76%, 71%, and 62% of workers while doing a work, respectively. Figure 2 shows the percentage of workers who reported body discomfort in wall plastering task.

An analysis of the self-report charts (Body Discomfort Chart) from the floor bricklaying task (n=50) showed that 83% of workers reported discomfort in the back regions. A wrist/hand region was the second highest discomfort reported by 80% of workers. This was followed by shoulder, neck, elbow, and leg regions reported by 78%, 67%, 60%, and 57% of workers while doing a work, respectively. Figure 3represents the percentage of workers reporting body discomfort in bricklaying task.

An analysis of the self-report charts (Body Discomfort Chart) from the floor concreting task (n=50) showed that 94% of workers reported discomfort in the back region. The shoulder region was the second highest discomfort region reported by 86% of workers. Th is was followed by wrist/hand, neck, elbow, and leg regions, where the percentage of workers who reported discomfort in these regions were 83%, 81%, 78%, and 68%, respectively. Figure 4illustrates the percentage of workers who reported body discomfort in concreting task.

WERA Assessment

The WERA assessment for wall plastering, bricklaying, and concreting tasks showed that the final scores were 36.57 (8.62), 39.66 (6.92), and 40.06 (7.75), respectively. The highest and lowest scores were 5.87 (1.14) and 2.21 (1.28), respectively for neck and vibration in wall plastering. Th e total final scores for 3 tasks were at medium risk level. Although they are at acceptable levels, further investigations are required and working conditions should be changed. Table 2 shows the final scores and action levels for these three tasks in construction workshops.

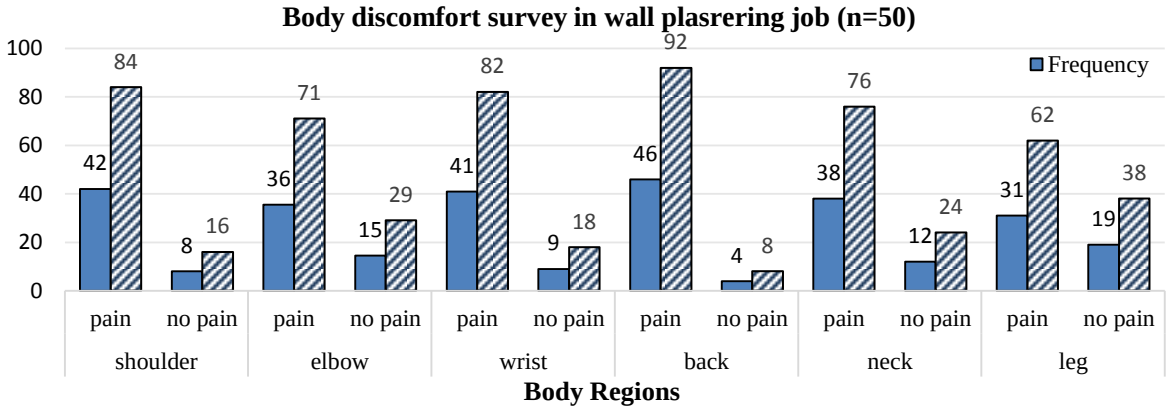

Figure 2. Percentage of workers reporting body discomfort in wall plastering task

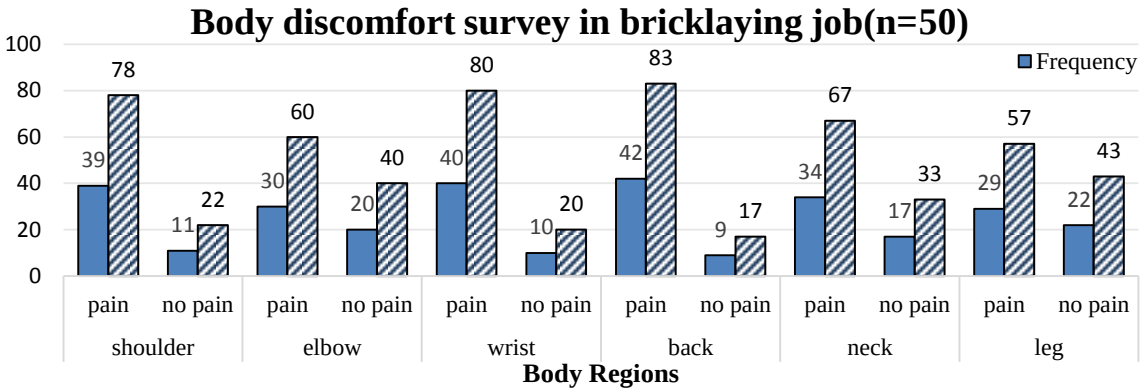

Figure 3. Percentage of workers reporting body discomfort in bricklaying task

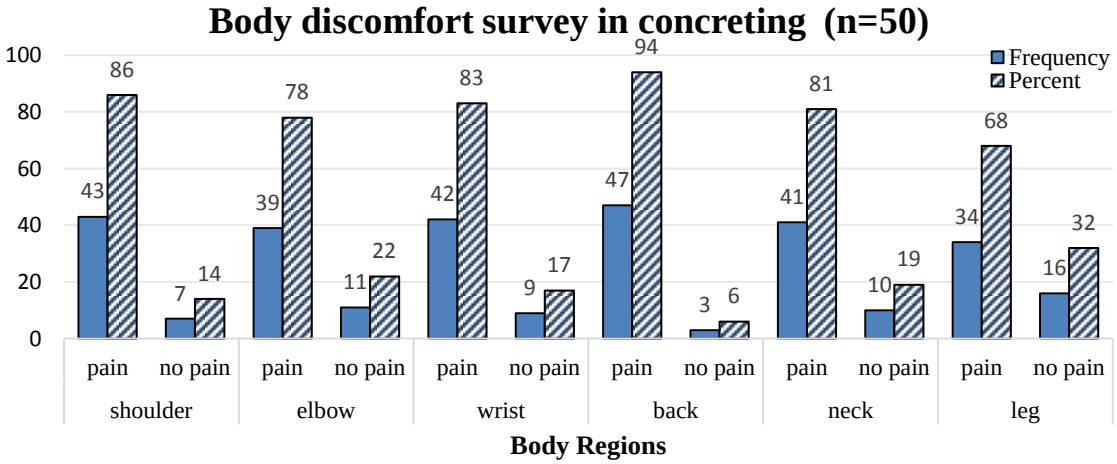

Figure 4. Percentage of workers reporting body discomfort in concreting task

Table 2. Final scores and action levels for 3 tasks in construction workshops

Tasks	Scores of WERA assessment									Final score	Action level
	SH (SD)	WR (SD)	BC (SD)	NC (SD)	LG (SD)	FC (SD)	VB (SD)	CS (SD)	TD (SD)		
Wall Plastering (n=50)	4.32 (1.21)	5.10 (0.73)	4.80 (1.02)	5.87 (1.14)	3.68 (0.65)	2.46 (1.08)	2.21 (1.28)	3.94 (0.67)	4.19(0.84)	36.57 (8.62)	Medium
Bricklaying (n=50)	5.41 (0.62)	4.84 (0.52)	5.46 (0.37)	5.75 (1.04)	3.54 (0.44)	3.10 (0.54)	2.84 (1.64)	4.16 (1.02)	4.56(0.73)	39.66 (6.92)	Medium
Concreting (n=50)	4.11 (0.81)	5.74 (0.47)	5.21 (0.56)	5.63 (1.08)	4.12 (0.81)	3.46 (0.67)	3.15 (1.27)	4.36 (1.05)	4.28(1.03)	40.06 (7.75)	Medium

Notes: SH for shoulder, WR for wrist, BC for back, NC for neck, LG for leg, FC for forceful, VB for vibration, CS for contact stress, TD for task duration, and SD is standard deviation

Discussion

The aim of this study was to investigate the relationship between musculoskeletal discomforts with ergonomic risk factors based on WERA method among 150 workers in construction workshops in Kurdistan province, Iran. According to WERA method assessment, ergonomic risk factors have significant impact on the prevalence of musculoskeletal disorders. In other words, they are the most common causes of discomfort due to wall plastering, bricklaying, and concreting tasks.

Earlier researches in the construction field showed that construction workers are at risk for MSDs [22]and that MSDs are a determinant of early retirement or disability.[23] Based on these previous findings and the high prevalence of MSDs found in the present study, prevention of MSDs among construction workers is of significant importance. However, further information on the nature and degree of MSDs is required to conduct workplace interventions.[24] According to reports, back pain is a common musculoskeletal disorder in construction industry. Moreover, the wrist discomfort has a direct relationship with the instruments. As mentioned in Verma et al. study, the most common symptoms of musculoskeletal disorders was in wrist, ankle, knee, and back, respectively.[25] According to Abdul Rahman who investigated the physical risk factor in wall plastering task using WERA method, the most discomfort have been reported in the shoulder, wrist, and back.[5]

A study conducted in Australia showed that 64% of dentists suffer from back pain.[26] In another study with similar results regarding the back pain carried out by Morse et al. 44% of dentists in the United States suffered from back pain.[27] An analysis of the self-report charts (Body Discomfort Chart) from the floor concreting task have shown that 94% of workers had discomfort in the back regions, while in wall plastering and floor bricklaying tasks 92% and 83% of workers reported discomfort in these regions, respectively. The prevalence of shoulder pain in wall plastering was 84% in this research and the results were similar to those reported in other studies such as Abdul Rahman study.[5]However, the prevalence of back pain in this study was higher than the one reported in Abdul Rahman study. In this study from the WERA assessment for wall plastering, bricklaying, and concreting tasks, the final scores were 36.57 (8.62), 39.66 (6.92), and 40.06 (7.75), respectively. The total final score for the three tasks was in the medium risk level. This result shows that the task is still acceptable but needs further investigation and change.

The result shows that workers suffer from back, shoulder, wrist, elbow, neck, and leg pain during their work in wall plastering, bricklaying, and concreting tasks where they need to bend and twist their backs. The final score for concreting task was higher than the ones related to wall

plastering and bricklaying tasks. In other words, the risk of musculoskeletal disorder is more than two others.

Contradiction of interest

The authors did not report any contradiction of interests.

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