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Task content and physical ergonomic risk factors in construction ironwork

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Abstract

Construction ironwork (CI) has been identified as a trade wherein the exposures to ergonomic risk factors are high. In this study, quantitative exposure assessments for seven specific ironwork tasks selected from the four main specialties of CI—machinery moving/rigging, ornamental, reinforcing, structural—were performed. A total of 13,821 observations were made using the work-sampling, specialty-task-activity-based analysis method called PATH (posture, activity, tools, and handling) and a taxonomy developed specifically for CI. The PATH data provided specialty-task-activity estimates of the percentage of time ironworkers spent in specified postures of the trunk, arms, and legs, and also gave estimated frequencies of manual materials handling activities as well as 11 other predefined activities. Depending on the specialty-task-activity performed, results showed that ironworkers spent anywhere from 13% to 48% of their work time in non-neutral trunk postures; worked with one or both arms at or above shoulder level 6–21% of the time; and stood on uneven/unstable work surfaces 3–53% of the time. The type of activity performed was consistently found to be a major predictor of the frequency of work time spent in non-neutral postures for the trunk, legs, and arms.

Relevance to industry

These results can be used to target hazardous activities in CI such as rebar and structural ironwork and confirms the need for specialty-task-activity-specific information within each construction trade on exposures and worker activities so that the most appropriate ergonomic interventions can be designed and implemented.

Keywords: Ironwork; Construction ironwork; Exposure assessment; Ergonomic risk factors

1. Introduction

Recent studies and statistics have shown that the rates of musculoskeletal injuries and disorders among workers in the construction trades are much higher when compared to those working in other industries (Schneider, 1997; CPWR, 1996).

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According to the US Bureau of Labor Statistics, construction workers suffer work-related injuries and illnesses at a rate of 7.9 cases per 100 equivalent workers compared to the all-industry average of 5.7 (BLS, 2001). Construction workers had the highest rate of injuries of 7.8 versus that all industry average of 5.4 (BLS, 2001). In general, construction workers are at a high risk of developing work-related musculoskeletal disorders (WRMSDs) that are associated with exposure factors in this work environment (Holstrom et al., 1993; Guo et al., 1995; Kisner and Fosbroke, 1994; Schneider and Susi, 1994).

Despite the high prevalence of ergonomic risk factors in construction work (Schneider and Susi, 1994; Schneider, 1997; Kisner and Frosbroke, 1994), research has been limited in this industry. This can be attributed mainly to logistical reasons. Specifically, some of the main problems faced by researchers seeking to design studies for this segment of the working population are high task variability, highly irregular work periods, constantly evolving work environments, and high worker mobility. As a result, systematic and comprehensive *trade*- and *task-specific* investigations of the relationship between ergonomic exposures and WRMSDs have been undertaken for only a limited number of trades (e.g., Lindstrom et al., 1974; Wickstrom, 1978; CPWR, 1994; Riihimaki, 1985; Cook et al., 1996). Just as office- or factory-based exposure information is often inapplicable to the dynamic construction work environment, so to, each construction trade and the major tasks associated with it often present different and unique ergonomic challenges to the worker. Trade- and task-specific information on tools, exposures, worker tasks and work conditions is likely to prove most useful in designing and selecting the most appropriate prevention measures to minimize the incidence of WRMSDs among construction workers.

The term 'construction' ironwork (CI) (also commonly referred to as 'outside' ironwork) is used to distinguish this type of ironwork from 'shop' or 'fabricating' ironwork which, unlike CI, tends to take place indoors in more structured, factory-like settings. In general, CI involves the erection of structural steel, placement of reinforcing bars in concrete structures, moving heavy machinery, rigging and erection of equipment and scaffolding, installation of fabricated building components, and welding and cutting. In the United States, CI is sub-classified around four main specialties (Robertson, 1975): (1) structural ironwork (SIW), (2) reinforcing ironwork (RIW), also know as rod or rebar work or concrete reinforcement work, (3) ornamental ironwork (OIW), and (4) machinery moving/rigging ironwork (MMRIW).

Each CI specialty consists of key tasks and activities that are specific to that specialty (Table 1). Those entering the ironwork trade are required to undertake a 3-year apprenticeship training program wherein they are taught and exposed to all four ironwork specialties (Robertson, 1975). On completion of the training program, the ironworker gains "journeyman" status and begins to specialize in one or two of the above CI specialties. Journeymen can, however, and do regularly change their specialty based on job requirements and current job market demands.

A few studies that have specifically collected ergonomic exposure data on CI (e.g., Forde, 2000a,b; Lindstrom et al., 1974; Hart and Link, 1991). These studies have found that typical of CI is that it requires the ironworkers to lift, carry, and manipulate heavy loads; work in severely cramped

Table 1
Representative list of major tasks commonly performed by construction ironworkers within each CI specialty

Trade type	Specialty	Tasks
CI	MMRIW	Heavy equipment lifting
		Crane assembly
	OIW	Door installation (e.g., revolving door)
		Window installation
		Finishing work (e.g., decorative sidings, railings, etc.)
	RIW	Pre-cast concrete assembly
		Rod work
		Caisson cage construction
	SIW	Structural steel assembly
		Bolt and nut assembly
		Bolting
		Decking (floor) installation