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Ergonomic interventions for the furniture manufacturing industry. Part I—lift assist devices

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Abstract

The objectives of this intervention research project were to develop and evaluate engineering controls for the reduction of low back injury risk in workers in the furniture manufacturing industry. An analysis of injury/illness records and survey data identified upholsterers and workers in the machine room as two occupations within the industry at elevated risk for low back injury. A detailed ergonomic evaluation of the activities performed by these workers was then performed and the high risk subtasks were identified. The analysis for upholsterers revealed: (1) high forces during the loading and unloading of the furniture to and from the upholstery bucks, (2) static awkward postures (extreme flexion > 50°, lateral bending > 20°, twisting > 20°) during the upholstering of the furniture, and (3) repetitive bending and twisting throughout the operation. For machine room workers, this ergonomic evaluation revealed repetitive bending and twisting (up to 5 lifts/min and sagittal flexion > 80°, lateral bending > 15°, twisting > 45°) when getting wooden components from or moving them to the shop carts that are used to transport these materials. Engineering interventions were then developed and evaluated in the laboratory to document the reduction of exposure to these stressors. The height-adjustable upholstery buck system eliminated the lifting and lowering requirements and affected trunk kinematics during the upholstery operation by reducing peak sagittal angles by up to 79% (average: 52%; range: 27–79%), peak sagittal accelerations by up to 42% (average: 71%; range: 0–74%) and peak lateral position by up to 31% (average: 20%; range: 12–31%), and showed no impact on time to complete the task. The machine room lift reduced peak sagittal angle by up to 90% (average: 76%; range: 64–90%), peak sagittal accelerations by up to 86% (average: 72%; range: 59–86%) and had a positive impact on the time to complete the task (average reduction: 19%).

Relevance to industry

The ergonomic intervention research documented in this report shows the impact of engineering controls for the furniture manufacturing industry on the risk factors for work-related low back injuries.

Keywords: Low back injury; Intervention research; Furniture industry; Trunk motion; Trunk posture

1. Introduction

The furniture manufacturing industry is of great importance to the economy of the southeastern

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United States. In North Carolina alone, there are over 75,000 people employed by the industry (Standard Industry Code (SIC): 25) ranking it second in the state's manufacturing sector employment. This constitutes about 9.7% of the state's manufacturing workforce. About 75% of these establishments are producers of household furniture (SIC 251) making up 88% of the furniture manufacturing workforce (NC ESC, 2000).

As with many manufacturing industry sectors, the furniture manufacturing industry has struggled with problems associated with work-related low back pain and other musculoskeletal illnesses. Bureau of Labor Statistics data from the years 1992–1996 indicate that the incidence rate for low back pain cases involving days away from work was 21.98/10,000 workers (BLS, 1992, 1993, 1994, 1995, 1996). This is compared to the incidence rates of low back pain cases of 15.94 for private industry as a whole and 15.6 for general manufacturing industry. The residential furniture manufacturing industry can be broken into three separate categories: (1) upholstered furniture (sofas, chairs, loveseats, etc.), (2) casegoods (tables, desks, bookshelves, dressers, etc,) and (3) hardwood chairs (such as dining room chairs—sometimes upholstered, sometimes not). All three have historically high rates of musculoskeletal disorders, but the specific risk factors in each sector vary.

A review of the recent literature with regard to safety and health research in the furniture industry illustrates that the majority of the previous work has focused on issues of exposure to sawdust (Demers et al., 1997; Goldsmith and Shy, 1988; Piasaniello et al., 1991, 1992; Scheeper et al., 1995; Vinzents, 1988), chemical exposure (Estill and Spencer, 1996; Goldsmith and Shy, 1988; Vinzents and Laursen, 1993; Voog and Jansson, 1992), noise (Vinzents and Laursen, 1993), and acute injury (Aaltonen, 1996). While these topical areas are clearly important, it is also recognized that furniture workers have known exposures to a number of recognized occupational risk factors for low back injury/illness: physically heavy work, highly repetitive bending and twisting, pushing, twisting, frequent lifting over 25 pounds, sustained awkward postures of the torso, and dynamic movements of the torso (Andersson, 1981; Damkot et al., 1984; Frymoyer et al., 1983; Kelsey et al., 1984; Magora, 1970; Marras et al., 1993; Pope et al., 1984). Surprisingly, there is little literature specifically related to work-related musculoskeletal injuries/illnesses among furniture industry jobs or related to interventions aimed towards the prevention of these disorders among these workers. One study that did consider musculoskeletal problems in the furniture manufacturing industry was conducted by Christensen et al. (1995). In their study, they considered body posture and manual material-handling activities in the wood and furniture industry. They report that 75% of the employees experienced symptoms of pain, ache or discomfort from the musculoskeletal system during the previous year. They found a 1-year prevalence of low back symptoms of 42% (13% reported pain within the last week and 6% reported daily symptoms), a 1-year prevalence of shoulder pain of 28% and a 1-year prevalence of hand/wrist symptoms of 24%. In their biomechanical assessment of the manual materials handling tasks, they cited repetitive lifting, awkward postures, static muscle loads and high external loads as critical components to be considered in ergonomic intervention development. They conclude by noting that "Optimal strategies for job redesign including more variation between the work tasks may be worked out using this information in order to reduce the high prevalence of occupational musculoskeletal disorders seen in this industry" (p. 803). A review of the scientific literature has revealed little progress towards this goal through either administrative or engineering controls. The objectives of this current research were to develop and evaluate engineering controls for the reduction of low back injury risk in workers in the furniture manufacturing industry.

2. Methods

2.1. OSHA Form 200 Log analysis and survey

The first step in this ergonomic intervention process was to identify those jobs that posed the greatest risk for low back injury. This was