MUSCULOSKELETAL DISORDERS AMONG CONSTRUCTION APPRENTICES IN HUNGARY

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SUMMARY

The purpose of this study was to determine the prevalence of occupationally related musculoskeletal disorder (MSD) symptoms and carpal tunnel syndrome (CTS) among construction apprentices in Hungary. Symptoms of occupational MSDs and the job factors contributing to the symptoms were determined through an administered symptom and job factors survey. The prevalence of CTS was based on a case definition that included hand symptoms and nerve conduction studies of the median nerve across the carpal tunnel. The participation rate was 96% among the 201 eligible construction apprentices. More than 50 % of the apprentices reported occupationally related musculoskeletal symptoms in the previous 12 months. Job tasks that required awkward postures and working in a static position were the two factors that contributed most to MSD symptoms. No cases of CTS were found in this sample of apprentices. Although disorders of the musculoskeletal system are more prevalent among experienced construction workers, this study indicated that symptoms of MSDs are present among young construction workers. Assessing the magnitude and nature of occupational related MSDs is the first step in promoting a healthier, safer, and more efficient workforce.

Key words: musculoskeletal disorders, carpal tunnel syndrome, construction workers, occupational health, Hungary, surveillance apprentice

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INTRODUCTION

In the European Union approximately 600 million working days (4 days per worker) are lost annually due to illness and injury with 47% of these cases resulting from musculoskeletal disorders (MSDs) such as low back pain and carpal tunnel syndrome (1). There is a large body of evidence indicating that deaths, traumatic injuries, and illnesses are more prevalent among workers in the construction industry than for most other occupational groups in all industrialized nations (2–4). Although serious injuries in construction often result from acute trauma, many injuries develop incrementally from repeated physical stress and are broadly classified as MSDs. According to Holmström (2) Swedish insurance companies determined that 72 % of all sick leave greater than four weeks in the construction industry was related to MSDs. Musculoskeletal disorders can lead to absenteeism, lost productivity, personal financial burden, physical suffering, disability and early retirement (1, 2). The health consequences of MSDs place a significant burden on the worker, the company, national economies, and health care systems (1).

Workplace factors associated with MSDs include awkward postures, static positions, high force levels, vibrating tools, and repetitive motions (5). These factors are often present in construction tasks (2, 6). Although there is clear evidence that experienced construction workers have MSDs (2), it is unclear if these disorders are present among construction apprentices at the beginning of their profession. Data from studies in the United States indicate that the prevalence of carpal tunnel syndrome (CTS) among construction apprentices may be as high as ten percent (7). However, construction apprentices in the United States are approximately 8–10 years older than their counterparts in central European countries. Age and specific occupational exposure are variables that have been associated with MSDs such as CTS (8, 9).

As part of a public health strategy to prevent MSDs in the construction industry, it would be advantageous to know when construction workers begin developing these disorders. Early recognition and treatment of MSDs may lead to faster recovery and prevention of permanent disabilities. Additionally, early intervention efforts have the potential of identifying and reducing exposure to the occupational and non-occupational risk factors associated with MSDs. Unfortunately, there are no published studies or national statistics that address these factors among Hungarian construction workers at any age. The purpose of this study was to determine the prevalence MSD symptoms and cases of CTS in a sample of construction apprentices in Hungary.

METHODS

Each participant completed a four-part questionnaire that was administered by two occupational health nurses. The nurses explained the instructions and answered questions that participants had relating to the questionnaire and overall study procedures. If the participants had difficulty reading or understanding the exact nature of the question, the questionnaire was read to the participants and filled-out by the occupational health nurse.

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The questionnaire used in this study was identical (with the exception of the translation) to questionnaires employed in previous epidemiological studies of MSDs by the investigators (10–13). The test-retest reliability of the 4-part questionnaire used in the present study ranges between fair to very good depending on the questionnaire item (manuscript in review). The first section of the questionnaire consisted of questions addressing age, height, weight, years in trade, type of apprentice training, a brief medical history of systemic diseases and questions regarding work schedules. The second portion of the questionnaire addressed the period prevalence of work-related musculoskeletal symptoms within the last 12 months. This portion of the questionnaire was a modification of the Standardised Nordic Questionnaire and consisted of questions referring to nine anatomical areas (14). A body diagram with the nine anatomical areas (neck, upper back, low back, shoulders, elbows, wrist/hands, hips, knees, and feet) was incorporated to help the apprentices answer "yes" or "no" to the following question: "During the last 12 months have you had a job-related ache, pain, discomfort, etc." – followed by a list and body diagram of the nine different anatomical areas. If the respondents marked "yes" that a work-related musculoskeletal symptom had occurred, they were instructed to answer "yes or no" to two additional questions. The questions were (1) "during the last 12 months have you been prevented from doing your day's work due to this condition?" and (2) "during the last 12 months have you seen a physician for this condition?" The third section of the questionnaire addressed the apprentice's perceptions of 15 different job factors and their potential contribution to MSDs. The apprentices were given a descriptive list (Table 1) of 15 job factors and asked to indicate on a scale of 0 – 10 how much of a problem (if any) each factor was in contributing to their job-related aches and pains. The last section of the survey consisted of a hand diagram and questions regarding the presence of hand symptoms. The apprentices were asked to indicate if they had any hand symptoms (numbness, tingling, pain, burning) within the last year and shade the hand diagram where they had the symptoms. The hand symptom survey used in this study is similar to other survey tools that evaluate hand symptoms for the classification of CTS (15, 16).

Nerve conduction studies (NCS) were combined with the results of the hand symptom survey to determine the prevalence of apprentices with CTS. NCS provide an objective measure of median nerve function and have been found to be highly sensitive and specific in the assessment of CTS (17). Several studies have incorporated both nerve conduction results and the presence of symptoms in the case definition for CTS (18–20). The combination of hand symptoms and NCS have been recommended for the classification of CTS in epidemiologic studies (24).

Standardized NCS using surface electrodes were performed on both hands of the apprentices. The NCS included measurements of sensory orthodromic latency of the median and ulnar nerves from mid-palm to the proximal wrist. Sensory palmar latencies were determined over an 8 cm palmar segment with the recording electrode 8 cm proximal to the cathode of a bipolar stimulator. Median nerve latencies were measured with the active recording electrode placed over the median nerve two centimeters proximal to the distal wrist crease. The ulnar latency was determined with the active recording electrode placed 2 cm proximal to the distal wrist crease over the ulnar nerve. Sensory latency (peak latency) was determined as the time interval between onset of the stimulation artefact and the peak of the negative response of the sensory nerve action potential. Standard 8 cm orthodromic motor latencies were measured if a sensory block through the carpal tunnel was present. The choice of NCS performed in this study were based on the practice parameters set forth by the American Association of Elecrodiagnostic Medicine (17).

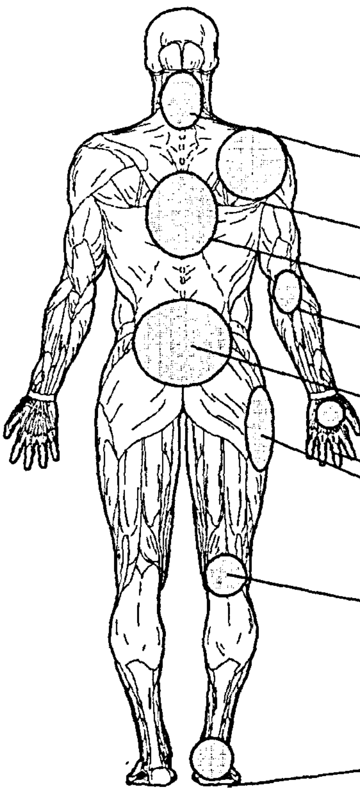
The median-ulnar latency difference (MULD) in the right and left hands was used to determine the prevalence of median mono-neuropathy. Median mono-neuropathy was defined as a MULD of 0.5 ms or greater. A 0.5 ms difference was established because it represents a conservative criterion for determining median neuropathy within the carpal tunnel (22). For surveillance purposes, a case definition of CTS was defined as an abnormally long MULD indicating median neuropathy (MULD >0.5 ms) and symptoms consistent with CTS (numbness or tingling localized to an anatomical area that included the area of the hand innervated by the median nerve). Symptoms had to be present within the previous 90 days and have had a self-rated severity score of 3 or greater (0 – 10 scale) to meet the definition of CTS hand symptoms. Hand temperature was measured using a surface thermistor probe (Electro-Therm, Model #TM99A, Cooper Instrument Corporation). Temperature was measured in the mid-palm and recorded during the NCS. Hands were warmed if they were below 29 °C. Nerve conduction studies were performed in a warm room with the ambient temperature maintained between 21 and 23 °C. Because the primary criteria for median neuropathy was a comparison of the median and ulnar nerves, temperature correction was not performed on the latency values. The ulnar nerve served as an internal control for the median nerve recordings.

Body composition was determined in the apprentices using near infrared spectrophotometry [Futrex 5000A Spectrophotometer, Futrex, Inc., Gaithersburg, MD, USA]. The spectrophotometer consisted of a small DC powered multi-key microprocessing unit and a cable connected hand-held transducer probe. The transducer probe contains four infrared diodes and a silicon detector located at the center of the probe that measures the near infrared energy re-emitted from the test site (right biceps). The light detected from the test site is converted to optical density measurements and a percent body fat and lean body mass is calculated.

Means, standard deviations, and percentiles were used to describe demographic data, physical measurements and symptoms. Medians with interquartile ranges described responses to job factors. Odds ratios and 95% confidence intervals were used to describe the association between responses to specific job factors and self reported job-related low back pain. All data were analyzed with Statistical Analysis Software for Windows, Version 8.0 (SAS Institute, Cary, NC, USA).

RESULTS

Apprentices that participated in the study were enrolled in one of three trade schools: 1. sheet metal, 2. electrical, or 3. plumbing. The trade schools were associated with the Construction Trade Union of Hungary. Of the 201 apprentices enrolled in these programs, 193 participated (response rate of 96%) and completed a symptom and job factors survey. Those that did not participate were absent on the day the questionnaire was administered. Of the 193 apprentices that completed a questionnaire, 175 volunteered for the electrophysiologic testing. Two apprentices chose not to be tested and 16 were absent on the days of the testing. The participants were enrolled in a 3-year apprenticeship program in their respective trade. The mean age of the apprentices was 17 years (S.D., ± 1.2, range 15 to 21) and all were male. The apprentices had an average weight and height of 67.1 ± 12.4 kg and 175 ± 6.9 cm,



Anatomical Area	Percent Reporting Work-Related Symptoms	Percent Missing Work	Percent Visiting Physician
Neck	5.2	2.1	0
Shoulders	12.0	4.7	0.5
Upper Back	12.0	5.2	1.6
Elbows	3.1	1.6	1.0
Low Back	29.0	11.5	3.6
Wrist / Hands	19.3	8.9	1.6
Hips / Thighs	3.6	2.1	0.0
Knee	8.3	5.2	3.1
Ankles / Feet	8.3	2.6	1.0

Fig. 1. 12-month period prevalence (in percent) of work-related MSD symptoms, missed work as a result of symptoms, and physician visits for symptoms among construction apprentices in Hungary.

respectively. The average number of years working in the trade was 2.9 ± 1.0 and the average number of hours working per week was 26.6 ± 12.2. The apprentices had a mean body mass index (BMI) of 21.8 ± 3.7 and a mean percent body fat of 14.8 ± 7.2. Fifty-six percent of the apprentices indicated that they smoke cigarettes.

The 12-month period prevalence of reported work-related MSD symptoms by anatomical area for the 193 apprentices responding to the questionnaire are summarized in Fig. 1. Low back symptoms were the most prevalent musculoskeletal problem reported in this sample of construction apprentices. Nearly 30% of all apprentices indicated that they had work-related low back pain within the previous 12 months. Low back symptoms were also reported to account for the most lost work time (11.5%) and most physician visits (3.6%).

The second and third highest prevalence for work-related symptoms were in the wrist/hands (19.3%), and shoulders (12%) as well as upper back (12%). In the present study, 51.3 percent of the apprentices reported at least one work-related musculoskeletal symptom in the previous 12 months. Although these symptoms were related to missed work, very few (0–3.6 %) of the apprentices saw a physician for any of their musculoskeletal symptoms. Construction apprentices reported a higher prevalence of missed work than physician visits for all anatomical areas included in the survey. Thus, apprentices were more likely to miss work than consult a physician for their MSD symptoms.

Results of the job factors survey were summarized by calculating the median score for each job factor description (Table 1). The job factors (JF) with the highest score (indicating the most problematic) for the apprentices were JF #5 "working in awkward or cramped positions", and JF #6 "working in the same positions for long periods". Not surprisingly, the contribution of JF #5 "working in awkward or cramped positions" to job-related low back symptoms yielded an Odds Ratio of 21.3 (95% CI 4.98–90.81). Thus, apprentices that indicated JF #5 was to some degree problematic were 21 times more likely to report low back symptoms in the previous 12 months. Overall, the job factor scores were relatively low. The low scores indicated that the apprentices did not perceive their job tasks as being problematic in terms of leading to work-related MSD symptoms.

The hand symptom survey indicated that twenty-one apprentices met the criteria for symptoms consistent with CTS. However, none of these apprentices also had NCS that indicated a median neuropathy (median-ulnar latency difference of 0.5 ms or greater) within the carpal tunnel. Alternatively, ten apprentices had abnormal NCS but none had corresponding hand symptoms. Thus, no apprentices in this sample had CTS as defined by our surveillance case definition of symptoms and abnormal nerve studies. The group results of the NCS measurement are listed in Table 2. The mean median-ulnar latency difference across the wrist for the 175 apprentices was 0.06 ms on the right and 0.05 ms on the left. The mean temperatures of the right and left hands during the NCS were 31.1 and 31.3 °C, respectively.

DISCUSSION

There are several methodological limitations related to interpreting the information in this study. The 12-month period prevalence rates of work-related MSD symptoms do not represent the prevalence of a specific medical pathology but may, however, precede the diagnosis of a work-related MSD. A 12-month recall period has limitations due to the duration of elapsed time and should be taken into account when drawing conclusions from data sources involving recall of events and information. Additionally, because of the limited sample size in this study, the results should not be considered repre-

Table 1. Results of Job Factors Survey for 193 Hungarian construction apprentices

JF#	Job factors contributing to MSD symptoms	Median	Inter quartile range	Range
1.	Performing the same task over and over	0	2	0 - 7
2.	Working very fast for short periods (lifting, grasping, pulling, etc.).	0	2	0 - 7
3.	Having to handle or grasp small objects	0	0	0 - 6
4.	Insufficient breaks or pauses during the workday	0	0	0 - 8
5.	Working in awkward or cramped positions	3	4	0 - 10
6.	Working in the same positions for long periods	3	4	0 - 10
7.	Bending or twisting your back in an awkward way	1	3	0 - 10
8.	Working at or near your physical limits	1	3	0 - 10
9.	Reaching or woring over your head or away from your body	2	4	0 - 8
10.	Hot, cold, humid, wet conditions	0	3	0 - 10
11.	Continuing to work while injured or hurt	2	4	0 - 10
12.	Carrying, lifting, or moving heavy materials or equipment	0	3	0 - 10
13.	Work scheduling (overtime, irregular shifts, length of workday)	0	0	0 - 3
14.	Using poor tools (design, weight, vibration, etc.)	0	0	0 - 9
15.	Training on how to do the job	0	0	0 - 0

Table 2. Results of nerve conductions studies for 175 Hungarian apprentices

NCS variable	Mean (S. D.)
Right median sensory latency	2.03 (0.23)
Right ulnar sensory latency	1.97 (0.23)
Left median sensory latency	2.02 (0.23)
Left ulnar sensory latency	1.97 (0.20)

sentative of all trades and apprentices in the construction industry in Hungary. Additionally, the study results are restricted to workers at the beginning of their career.

The most striking finding of this study was the relatively high prevalence of work-related MSD symptoms in the low back of young construction apprentices. Although the mean age of the apprentices is only 17 years, 30 % of them reported work-related MSD symptoms in the low back during the previous 12 months. The work-related lowback symptoms may be associated with several factors including prolonged standing, working in a bent over position at workbenches in the shops where the apprentices practice their learned skills, weekend construction work, as well as non-occupational activities.

Studies of experienced construction workers in the United States and the Slovak Republic have reported a much higher prevalence of work-related MSD symptoms than those reported by apprentices in this study (11–13). Using an identical questionnaire, 65 % of 1,096 experienced construction workers in the Slovak Republic reported work-related MSD symptoms in the low back (12). In a similar study in the United States, 70 % of 2,516 experienced construction workers reported work-related MSD symptoms in the low back in the previous 12 months (11). In a pilot study of 65 experienced Hungarian construction workers, Rosecrance and colleagues (23) reported prevalences for MSD symptoms, missed work, and physician visits that were almost twice as high for experienced workers as compared to the apprentices for all anatomical areas. In the low back for example, 58 % of the 65 Hungarian experienced construction workers reported work-related MSD symptoms in the low back as compared to 30 % of the apprentices. It is surprising, however, that apprentices in their late teens report work-related MSDs at such an early age. Whereas, 42 % of experienced Hungarian construction workers missed work due to their low back symptoms, only 12 % of apprentices missed work due to low back symptoms. This difference suggests that the MSD symptoms among apprentices may be less severe than those for experienced construction workers. The higher prevalence of symptoms among experienced construction workers is likely related to a combination of factors including, general health status, age, and the cumulative physical stresses involved with construction tasks (2).

Musculoskeletal disorders in construction work have been strongly associated with heavy physical work, vibration exposure, hand tool use, repetitive work, and awkward postures (3). Musculoskeletal disorders are an enormous economic burden for construction enterprises. Besides causing human suffering, MSDs result in absenteeism and early retirement, which are significant financial costs for private companies and governments. During 1988–1989, 72 % of all sick leaves longer than four weeks in the construction industry in Sweden were due to MSDs (2). In Hungary, the construction industry employs roughly 35 % of the active working population (24). These workers are exposed to physical risk factors, work under "non-optimal" physical strain; 1.5 % and 1.9 % are exposed to partial and whole body vibration, respectively (24). If the prevalence of MSDs among Hungarian construction workers is similar to that in other nations, this will eventually lead to a major burden to the economy and competitiveness of construction enterprises within Hungary. These data underline the importance of investigating and preventing the work-related MSDs among Hungarian construction workers.

Although hand/wrist symptoms were the second most prevalent MSD symptom, we did not find any apprentices that met the CTS case definition. Though some apprentices may have had early symptoms of CTS, no hands with symptoms were severe enough to also have a median neuropathy across the carpal tunnel. This finding is in contrast to studies of CTS among construction apprentices in the United States that have reported a prevalence (using the same case definition as in the present study) of ten percent (7). It should be noted that apprentices in the United States are approximately 8–10 years older than those in Hungary. Both occupational exposure and age are likely factors that account for the differences among apprentices in these countries.

Despite the fact that construction work is one of the most physically stressful occupations (in nearly every country), there are no large epidemiological studies assessing occupationally related MSDs among construction workers in Hungary, or many other Central European countries. Assessing the magnitude and nature of work-related MSDs is the first step in promoting a healthier, safer, and more efficient workforce. Better information about MSDs and an emphasis on improved safety and health can prevent many MSDs thereby reducing the associated financial costs, improving the quality of work life, and decreasing human suffering. Because of the multi-factorial nature of MSDs, an effective approach to reducing work-related MSDs must incorporate primary prevention strategies (25). Primary prevention of MSDs in the construction industry requires the cooperation of policymakers, construction management, labor organizations, individual workers, health care providers, and researchers. Additional studies involving larger populations of construction workers of all ages are needed to determine the magnitude of MSDs in Hungary and other Central European countries. A multinational comparison of the prevalence of work-related MSDs and the job factors contributing to MSDs would assist in the identification of best work practices and tools that help prevent MSDs for workers in the construction industry.

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