Prevalence and Risk Factors of Musculoskeletal Pain among Construction Industry Workers in a Low-Income Country

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ABSTRACT

Musculoskeletal pain (MSP) is one of the major causes of disability around the world. We ought to determine the prevalence and risk factors of MSP among construction workers in Karachi, Pakistan.

We carried out a cross-sectional study among 321 construction workers from five registered construction companies in Karachi, Pakistan. We administered an Extended Nordic Musculoskeletal Questionnaire (NMQ-E) to determine the frequency of MSP and inquired about socio-demographic characteristics, occupational and ergonomic risk factors, knowledge and practices regarding MSP. Age-adjusted logistic regression analysis was carried out to identify factors that were associated with MSP.

The mean age of participants was 29.6 (±10.6) years. Low back pain was the most common (27.8%) complaint. The MSP risk was higher in the poorest strata [OR= 1.85, 95% CI:1.10-3.12], and those exposed to vibrations [OR=1.63, 95%CI: 1.05-2.54] during their work activities. Moreover, the unmarried [OR= 0.56, 95%CI: 0.35-0.91] and the workers of Punjabi ethnicity [OR=0.46, 95% CI: 0.27-0.76] were at a lower risk of MSP compared to married men and Sindhi workers. Of the 319 workers, the majority [202 (62.9%)] had low knowledge about occupational hazards, and [194 (60.4%)] health hazards, [131(40.8%)] MSP prevention strategies. More than one third [124(38.6)] workers, were not using personal protective equipment (PPEs) during work.

The construction workers in Pakistan suffer from a very high prevalence of MSP. The study reports MSP from five major registered construction companies in Pakistan. The young group of workers reported difficulty working due to MSP. There is a dire need to design contextualized occupational health and safety policies and interventions with a focus on workers at higher risk of MSP.

Keywords: Musculoskeletal Pain; Ergonomics; Construction Industry; Prevalence; Developing Country

INTRODUCTION

Musculoskeletal pain (MSP) is a major health concern in the general population and various occupations. They comprise chronic pain in muscles, bones, tendons, ligaments, joints, and nerves [1]. When caused or aggravated primarily by work performance or due to immediate work environments, they are known as work-related musculoskeletal pain (WMSPs). They are an important cause of pain, suffering, disability and productivity loss at work and income loss [2]. Further, they contribute to increased sickness absenteeism, delayed schedules and compensation claims in different occupations and industries.

MSP are multifactorial and result from their complex interactions. These include modifiable and non-modifiable factors such as socioeconomic status, work-related conditions, ergonomic and psychosocial factors [3]. Individual and socio-economic risk factors include age, gender, anthropometry, obesity, health behaviors (smoking, alcohol), race/ethnicity, low education and poverty. Work-related factors comprise physically strenuous jobs, short job tenure, longer working hours and prolonged shift work. Ergonomic factors are awkward/static postures for longer periods of time, heavy manual handling, and excessive/ repetitive motions. Psychosocial factors include high work pressures, time pressures, lack of job control, monotony, poor social support systems and isolated working environments [4-7]. Several studies have shown workers in the construction industry are amongst the top three occupations at risk of developing MSP [5, 8-10].

The construction industry is a significant contributor to the development of a country. Worldwide, more than a hundred million workers are engaged in the construction sector formally, while equal numbers are involved informally [11]. Pakistan employs about 7.6 percent of the labor force in construction industry, which contributes to 2.7 percent of the gross domestic product (GDP) of the country [12]. Of the total workforce employed in construction sector, about 16.2% of the workforce is employed in informal sector. In Sindh province, about 6.2% of the labor force is employed in the construction industry [12, 13]. Construction industry is amongst the high risk occupations with regards to its tasks and activities [14]. It includes various tasks and situations which are hazardous for e.g., working in confined space, electricity, power tools equipment, excavation work,

working at height, forceful exertions of the hands, repetitive motion, frequent or heavy lifting, pushing, pulling or the carrying of heavy objects, working above the head level and prolonged awkward postures [14, 15]. Construction workers are vulnerable due to individual, physical and psycho-social risk factors described above. As a consequence they are at risk of developing adverse health effects like respiratory, cardiovascular, musculoskeletal and psychosocial disorders [16].

Estimates for MSPs in construction workers are mainly from high income countries. Limited studies from low and middle income countries have been conducted to quantify the prevalence of MSP amongst construction workers. We expect that the highly hazardous environment compounded by weak regulations produce a different level of health problems in a developing country. With no health care coverage available, these workers are more susceptible and vulnerable. Moreover, the magnitude of associations found varied considerably in previously conducted studies. Variations in different quantitative findings could be due to different exposure definitions, range of exposure variables and operational definitions of MSP. Therefore, this study aimed to determine the prevalence and risk factors of musculoskeletal pain (MSP) among construction workers using standardized tools in Karachi, Pakistan.

MATERIALS AND METHODS

Study design and study setting

This cross-sectional study was conducted from June to December 2017, among construction workers in the megacity of Karachi, Pakistan. Karachi is a metropolis, located along the Arabian Sea. It is the commercial hub and accounts for up to 50% of revenue generation for the country with a large number of industries, hosts a huge labor force from the country and the region [12]. This study was carried out in five private registered construction companies; which were commercial building projects in areas of Super Highway, Malir, Korangi, Saddar and Clifton, Karachi. All companies employed around one to five hundred laborers.

Sampling Strategy and Study Participants

The construction industry in Pakistan is dominated by small and medium-sized enterprises. These are disproportionately distributed in a large informal sector and a relatively smaller formal sector. In Pakistan, both sectors are highly interdependent on each other, the formal sector provides an important source of work and income, while the informal primarily provides the labor workforce. Most of the laborers are subcontracted by the informal sector to the formal sector, as per project requirements. Due to the largely unregulated informal sector, and formal sector relying on the subcontracted workforce, no information was available with regards to the total number of companies and labor workforce. Hence, it was difficult to define a sampling frame. Therefore, purposive sampling was used to recruit the participants primarily from the formal sector (registered companies) from five districts of Karachi.

We took written permission from each company to conduct the survey. On the day of data, collection workers were selected through attendance registers, with their supervisors' help. All workers who fulfilled the eligibility criteria, and consented to participate in the study were selected. Approximately 50-60 workers were taken from each site.

A construction worker was defined as one who during the last one year, had worked for more than 75% of days and at least 8 hours/day, as plasterers, bricklayers, plumbers, fitters, scaffolders, electricians, painters, carpenters, and/or unskilled laborer.

Inclusion criteria: A person working in the construction industry for the above work at least the last one year, were males and aged 18-59 years. *Exclusion criteria*: Supervisors and those workers with a history of trauma, or who had undergone any operative procedure in the last three months, were excluded from the study.

Sample Size

The sample size was calculated using WHO Sample Size Calculator, at 5% level of significance and having absolute precision of 5%, and risk factor prevalence of 30% [12]. The required sample size was at least 323.

Data collection procedure

We took written consent from all participants. Data was collected through a structured questionnaire by trained data collectors in the local language (Urdu). Interviews with the study participants were conducted in a separate room/cabin provided by the companies at the field site. It took about twenty to thirty minutes to complete the questionnaire. Height and weight measurements were done respectively with a Seca weighing scale and measuring rod. To ensure quality, data collection was supervised and monitored and filled questionnaires were reviewed by the principal investigator daily.

A questionnaire was developed based on literature in the English language and translated into *Urdu* (local language) and back-translated into English to ensure consistency. Pre-testing of the questionnaire was done. Corrections and modifications in the questionnaire were done for the logical sequencing of questions. It had four sections: socio-demographic, work-related and occupational history, musculoskeletal pain and knowledge and practices regarding occupational hazards. The initial section requested information regarding socio-demographic characteristics including

age, ethnicity, education level, income level, marital status, religion, body mass index (BMI), smoking status, ownership of the house, permanent residence in Karachi, and living with family.

The section on work-related characteristics and occupational history inquired regarding job designation, current employment status, total work experience in the construction industry, working days per week, and the number of hours per day. We also collected information about frequencies of ergonomic risk factors including excessive force, awkward postures, contact stress, vibration and repetitive hand force. The last section inquired information regarding worker's knowledge of MSP and their current practices. Variables assessing knowledge were regarding occupational hazards, health hazards, risk factors for musculoskeletal disorders and how to prevent them, and for practices and use of personal protective equipment (PPE)

Extended Nordic Musculoskeletal Questionnaire (NMQ-E):

MSP was defined as a positive response to pain, ache or discomfort in any of the nine body regions, including neck, shoulders, upper back, elbows, lower back, wrist/hands, hips, knees, ankle/feet. A diagrammatic body map was given for the ease of identification of pain in all nine regions. The NMQ-E collects information regarding the age at onset of musculoskeletal pain, prevalence at various duration (ever, last one year, last one month and pain at the time of the survey), and consequences of musculoskeletal pain (any medication, hospitalization due to pain, absenteeism from work, change of jobs due to pain).

Participants were asked if they ever had any concern (pain, ache or discomfort) in each of the nine body regions. In case of a positive reply to pain in a body region they were asked details about the age at onset of pain, seeking health care, hospitalization, changed jobs due to pain, pain in last twelve months, last one month, and at the time of the survey.

Data Analysis

Data were entered in Epi Data version 3.1 and exported to SPSS (version 21.0) for analysis. Demographics were analysed using descriptive statistics. The outcome variable was musculoskeletal pain (MSP), which was determined by combining positive responses to musculoskeletal pain in any body region for different duration i.e. period prevalence (lifetime, annual, last month) or at the time of survey (point prevalence). Chi-Square test and univariate logistic regression were performed to determine the association between MSP and risk factors. Statistically significant variables and those considered to be biological plausible were carried forward for age-adjusted analysis. A P-value of ≤ 0.05 was taken as significant.

Ethical consideration

Ethical approval for the study was taken from the Ethics Review Committee of Aga Khan University Karachi. After explaining the procedures of the study written informed consent (signature or thumb impression) were taken from the participants. In order to maintain the confidentiality of the study subject's identification codes were used on the questionnaire. All identified cases of MSPs were referred to a public sector hospital for further work-up.

RESULTS

Table 1 shows the descriptive characteristics of the 321 participants included in the study. The mean (±SD) age of the participants was 29.6 ± 10.6 years. Most of them were married [212 (66.0%)], Muslims [317 (99.0%)] and had no education [141 (43.9%)]. More than two-thirds of the participants were living in rented houses [250 (77.9%)] and [84 (26.2%)] of the participants had income less than USD 100.0 [15000 PKR, conversion 1 USD = 150 PKR]. The mean age of initiation of work was 18.8 ±5.2 years. The majority of the participants were skilled laborers [289 (90%)], and the majority [200 (62.3%)] worked for seven days of the week, with 8.6 ±1.4 mean number of working hours in a day. Only a small number of participants received any formal training for this work [59(18.4%)].

Table 2 shows the analysis of E-NMQ questionnaire to estimate the prevalence of musculoskeletal pain, in nine anatomical body regions. Lower back pain was the most commonly reported symptom. Lifetime, annual and point prevalence of low back pain was 27.1%, 21.8%, and 8.1%, respectively. This was followed by neck (19%), shoulder (18.7%), knee (14.8%), upper back (13.4), wrist/hand (11.8), respectively, during their lifetime.

In Table 3, Univariate analysis showed that those participants belonging to the Punjabi ethnicity were 60% less likely to develop MSP compared to other ethnicities [OR= 0.40, 95%CI: 0.24-0.67]. Unmarried were 44% less likely to develop MSP compared to the married ones [OR= 0.56, 95%CI: 0.35-0.91]. Similarly, those exposed to vibrations were 1.63 times more likely of developing MSP compared to those who were not exposed [OR=1.63, 95%CI: 1.05-2.54]. Statistically significant variables considered to be biological plausible were carried forward for adjusted analysis. All variables included in this analysis were adjusted for age. Those workers having a monthly income of less than 15000 PKR per month were 1.85 times more likely to have MSP compared to those earning higher [OR= 1.85, 95% CI:1.10-3.12]. Moreover, Punjabi ethnic workers were 54% less likely to develop MSP compared to workers belonging to other ethnicities [OR=0.46, 95% CI: 0.27-0.76].

Table 1: Socio-demographic and work-related characteristics of construction workers in Karachi, Pakistan (n=321).

Variables	Frequency	Percentages
Age in years [Mean (±SD)]	29.6 (±10.6)	10.6
BMI in kg/m^2 [Mean (±SD)]	22.5 (±4.1)	
Marital Status		
Unmarried	108	33.6
Married	212	66.0
Religion		
Islam	317	98.8
Others (Hindu + Christian)	04	1.2
Ethnicity		
Sindhi	62	19.3
Punjabi	123	38.3
Others*	136	42.4
Education		
Uneducated	141	43.9
Educated	180	56.1
Ownership of house		
Yes	63	19.6
No	250	77.9
Monthly income in Pakistani rupees		
≤15000	84	26.2
>16000	237	73.8
Current occupation		
Skilled labourers		
Plasterer	82	25.5
Bricklayer	67	20.9
Scaffolders	46	14.3
Plumber	33	10.3
Others¤	61	19.0
Unskilled labourers	32	10.0
Age initiated working (in years) [Mean (±SD)]	18.8 (±5.2)	
Received any training for this work		
Yes	59	18.4
No	262	81.6
Duration of work (in years)		
< 5	120	37.4
5-12	103	32.4
> 12	98	30.5
Working days per week		
7	200	62.3
≤ 6	121	37.7
Working hours per day [Mean (±SD)]	8.6 (± 1.4)	

*Other languages include: Urdu, Pashto and Balochi
¤Other skilled labourers include: Carpenters, Electricians, Fitter and Painters

Table 2: Frequencies and proportions of musculoskeletal pain-body region-wise among construction workers in Karachi, Pakistan (n=321)

Body region	Ever N (%)	Last 1 Year N (%)	Last 1 month N (%)	Today N (%)
Lower back pain	87 (27.1)	70 (21.8)	46 (14.3)	28 (8.1)
Neck pain	61 (19.0)	39(12.1)	25(7.8)	17(5.3)
Shoulder pain	60(18.7)	38(11.8)	26(8.1)	21(6.5)
Knee pain	47 (14.6)	32 (10.0)	20 (6.2)	12 (3.7)
Upper back pain	43(13.4)	43(13.4)	28(8.7)	13(4.0)
Wrist/hand pain	38 (11.8)	23 (7.2)	16 (5.0)	10 (3.1)
Elbow pain	14(4.4)	9 (2.8)	9 (2.8)	4 (1.2)
Hips pain	10 (3.1)	9 (2.8)	7(2.2)	3 (0.9)
Ankle pain	10 (3.1)	9(2.8)	7 (2.2)	3 (0.9)

Table 3: Age-adjusted analysis for predictors of lifetime musculoskeletal pain among construction workers, Karachi

Variables	Ever MSP Crude odds ratio cOR (CI)	Ever MSP Age-adjusted odds ratio aOR (CI)
Ethnicity		
Sindhi	0.56 (0.30-1.02)	0.63(0.34-1.17)
Punjabi	0.40 (0.24-0.67)	0.46(0.27-0.76)
Others*	1	1
Educational status		
Uneducated*	0.98 (0.63-1.53)	0.91(0.58-1.43)
Educated	1	1
Income		
≤ 15000 rupees	1.58 (0.96-2.62)	1.85(1.10-3.12)
> 15000 rupees	1	1
Ownership of house		
No	0.96 (0.55-1.68)	1.14 (0.64-2.01)
Yes	1	1
Marital Status		
Unmarried	0.56 (0.35-0.91)	0.75(0.45-1.27)
Married	1	1
Duration of work		
>12 years	1.83 (1.06-3.14)	0.96 (0.45-2.06)
5-12 years	1.14 (0.67-1.94)	1.02(0.59-1.76)
< 5 years	1	1
Days Per Week		
7 days per week	0.96 (0.61-1.51)	1.09(0.68-1.74)
≤ 6 days per week	1	1
Hours per day		
≤ 8 hours per day	1	1
≥ 9 hours per day	0.81 (0.50-1.32)	0.78(0.48-1.27)
Occupation		
Scaffolders	0.81 (0.37-1.75)	0.86(0.39-1.88)
Bricklayer	0.88 (0.44-1.77)	0.94(0.46-1.91)
Plasterer	1.00 (0.55-2.07)	1.03(0.52-2.02)
Plumber	1.48 (0.63-3.51)	1.39(0.58-3.32)
Others	0.66 (0.27-1.57)	0.69(0.28-1.68)
Unskilled labourers	1	1
Excessive Force		
Yes	0.68 (0.33-1.37)	0.86(0.41-1.79)
No	1	1
Awkward Posture		
Back/neck bended		
Yes	1.25 (0.32-4.74)	1.39(0.36-5.31)
No	1	1
Arms above shoulder		
Yes	1.13(0.68-1.90)	1.12(0.66-1.89)
No	1	1
Contact Stress		
Yes	1.28(0.68-2.42)	1.18(0.62-2.25)
No	1	1
Vibration		
Yes	1.63 (1.05-2.54)	1.49(0.95-2.35)
No	1	1
Repetitive Movement		
Yes	0.78 (0.30-2.04)	0.84(0.31-2.25)
No	1	1

Table 4 shows the occupational hazards and safety knowledge and practices of the participants. The majority of the participants [202(62.9%)] were unaware of the occupational hazards in the construction industry. Most of them [194 (60.4%)] did not know health hazards, and only one-third of them [107(33.3%)] identified injuries as the major hazard in the construction industry. Almost half of the participants [131(40.8%)] were unaware of any MSP prevention strategies. More than one third [126 (38.6%)] workers did not use PPEs while at work.

Table 4: Knowledge and practices of construction workers regarding occupational and health hazards in Karachi, Pakistan (n=319)

Variable	Frequency	Percentages
Occupational Hazards		
Injury	107	33.3
Health problems	5	1.6
Other (Environmental/Burn)	5	1.5
Don't know	202	62.9
Health hazards		
Death	54	16.8
Injury	35	10.9
Blindness	4	1.9
Don't know	194	60.4
Prevention of MSP		
Medical Care	99	30.8
Healthy lifestyle(diet and exercise)	49	15.3
Safety precautions	25	7.8
Others (Rest, massage)	17	5.2
Use PPEs		
Yes	197	61.4
No	124	38.6

DISCUSSION

This is amongst the first studies which assessed the prevalence and risk factors, affecting MSP amongst construction workers in Pakistan. Our study showed, at least one-third of the workers suffered from MSP during their lifetime. Globally, wide variations occur in the prevalence of MSPs ranging from thirty-nine to sixty-nine percent [9, 16-19]. The variations may be attributed to differences in operational definitions, assessment tools and methods, used for categorizing MSP. In our study, the lower back was identified as the most affected anatomical body region, with 27% MSP. Similarly, studies from Nordic countries (Sweden and Germany) reported high rates of low back pain ranging from 26-57% [18-20]. A Pakistani study reported, high LBP (44%) among car mechanics [20]. However, this finding was three times higher than nurses who reported (9.6%) LBP in Pakistan [21]. This high LBP could be due to labor intensive activities in the construction industry.

By occupation, our study identified the highest estimates of MSP among plumbers (60%). Studies from developed countries showed that the prevalence of MSP varied by job designations within the construction industry [9, 16, 22-24]. Furthermore, plumbers had 1.39 times higher odds of developing MSP as compared to other workers, but this was not statistically significant. Nevertheless, this finding calls for strategies to relieve these workers from strenuous jobs, perhaps through frequent breaks at work and shorter job shifts. There is a need for further research to explore the determinants in high-risk groups.

Our study showed differences in MSP with regards to socio-economic risk factors. The poorest workers (Monthly income < 15000 PKR per month) were associated with a higher risk of MSP. In order to make their ends meet, these most underprivileged strata of the society may be performing extra strenuous work for longer hours to earn some extra pennies and hence exposing themselves to long term disabilities. Further, the Sindhi workers were found to have higher risks of developing MSP. Our findings point towards the cultural impacts of musculoskeletal complaints. These findings were similar to a study that identified, socio-cultural differences between Indian and English construction workers [25]. it points towards channelizing efforts for developing prevention strategies and interventions, towards these vulnerable workers.

Repetitive hand movement and bearing excessive force were the highest reported ergonomic risk factors (88.5% and 67.6%) respectively. This finding is similar to an Iranian study where 50 % of the workers lifted heavyweights [26]. Similarly, a Nigerian study showed working at a fast pace 62.6% and awkward posture of head/arms 60.0% had the highest prevalence[22]. To protect our workers, measures such as mechanization, reducing shift work, and worker training are needed.

Our study identified more than half of the workers had low occupational health and safety, MSP prevention knowledge, and the majority had poor practices. This was, in contrast, to study from Canada, where the workers had higher levels of knowledge and good practices [27]. This information may be used to develop contextualized interventions.

Strengths

This study has several strengths. It is amongst the first attempts to quantify the magnitude of MSP amongst construction workers in Karachi, Pakistan. Secondly, it used a validated questionnaire to assess the prevalence of MSP. Furthermore, workers from five major sites of the city were recruited through which we were able to capture diverse (ethnicities) populations. This study adds to the identification of various individual, socio-economic and ergonomic risk factors with musculoskeletal pain which have not been done before in Pakistan. These are important findings in order to develop focussed and contextualized interventions for preventing MSP.

Limitations

Attempts were made to conduct this study in the best possible way however there are few limitations of the study. We have relied on self-reported data which could be affected by worker's literacy level and

comprehension or question interpretation, however, we have tried to address it with the use of a validated questionnaire. Another limitation would be that we were unable to supplement the measurements with clinical examination for specific disorders; which might affect the overall prevalence. We were also unable to objectively measure the ergonomic risk factors due to a lack of logistics and feasibility issues. The healthy worker effect in these workers should be considered, further supplemented by the observation of a small number of older age participants in the study. Another limitation could be that there is a possibility of recall bias, however, for this purpose a validated tool was used.

CONCLUSION

This study has identified a very high prevalence of MSP in construction workers of Pakistan. Moreover, it has also identified several socioeconomic and ergonomic risk factors associated with MSP in Pakistan. This study calls for further research, to look deeply into the causes of MSP. Nevertheless, MSP needs to be considered as a priority and calls for designing contextualized occupational health and safety measures for this vulnerable group.

ETHICAL ISSUES

Ethical issues have been completely observed by the authors.

CONFLICT OF INTEREST

The authors have declared no competing interests.

AUTHORS' CONTRIBUTIONS

NS was involved in cconception, design, data management, analysis and interpretation of data, write-up of the manuscript. ZF reviewed and gave final approval of the manuscript.

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