An Epidemiological Study of Work-Related Musculoskeletal Disorders Among Construction Workers in Karimnagar, Andhra Pradesh

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Introduction
Several epidemiological studies have delineated the occupational etiological factors for musculoskeletal disorders (MSDs) and the nature of its work relatedness. Some amount of quantification of the degree of relationship between MSD and exposure to physical risk factors and its modification by psychosocial factors has also been obtained. Prevention of MSD through elimination of these at source and simple ergonomic and managerial measures has been recommended. However, scant attention is being paid in the Indian context to this burgeoning epidemic in an estimated work force of over 26 million construction workers.

Globally, MSD is the largest single cause of work-related illness, accounting for over 33% of all newly reported occupational illnesses in the general population and 77% in construction workers. Joshi et al. have obtained a 59.4% prevalence of MSD in their study on industrial workers in Delhi and have recommended that due to the high prevalence of MSDs in workers, the condition needs urgent attention from the health and labor sectors. MSD is also the largest cause of sick absenteeism, days of work lost and disability. It affects productivity at work, causes increased economic burden due to costs of workers’ compensation, healthcare and insurance. Work patterns associated with MSD include heavy workloads or exertion of force concentrated on specific parts of the body, fixed or constrained body positions, awkward posturing, and continual repetition of movements, exposure to vibrating tools or material, and most importantly, a pace of work that does not allow sufficient recovery between movements. The risks of MSD can increase with low job satisfaction, high job demands, job stress and lack of support from peers and supervisors. There is a marked correlation between chronic MSDs and aberrations on the psychosocial state, which requires a biopsychosocial model to explain completely the eventual outcome of MSD instead of individual factors singly.

Materials and Methods
A five-part, semi-structured questionnaire which consisted of 1) socio-demographic profile and job characteristics; 2) distribution, duration and severity of MSD; 3) evaluation of physical risk factors; 4) evaluation of psychosocial risk factors; and 5) evaluation of psychosocial state was administered in a cross-sectional study at Karimnagar after pre-testing in a pilot study.

Sample size was calculated using the formula \( n = \frac{4pd}{d^2} \), where the prevalence (p) of MSD in construction workers was taken as 77%, precision (d) taken as 10%, and accounting for design effect and non-respondent bias. The required sample size as per calculation was 154. Due to the migrant, labile hard to reach nature of the sample, purposive sampling was employed and the largest two construction sites in the area were selected and all workers at those sites were included to obtain adequate respondents. A total of 211 workers consented and participated in the study.

A construction worker was considered to be suffering from MSD if he had one of the symptoms (pain, numbness, tingling, aching, stiffness or burning) in the
past year that lasted at least a week or more or occurred at least monthly with a pain scale rating of moderate on a 5-point scale. This definition was devised and validated in a study on work-related MSD conducted by Bernard et al. at the National Institute of Occupational Safety and Health (NIOSH). The duration, severity of symptoms, number of episodes and the amount of pain on a 5-point scale were recorded for MSD-positive subjects. Workers who had a previous history of work-related injury, accidents, joint trauma and similar medical and surgical conditions were excluded from the study.

Physical risk factors predicting an outcome of MSD were measured over six dimensions including force exertion, awkward posture, static posture, repetitive movements, exposure to vibrating tools or material and contact stress. The psychosocial categories evaluated included job dissatisfaction, lack of job control, job monotony, job demand and lack of social support. Responses were obtained on the frequency of exposure to the above factors on a 5-point Likert scale ranging from 0 to 4, with 0 corresponding to never and 4 to always. The evaluation of physical and psychosocial factors was based on a review of meta-analysis by Bernard et al., NIOSH.

The psychosocial state of the respondents was evaluated using the validated 21-item, short-version depression, anxiety and stress scale (DASS21) developed by Lovibond et al. The respondents were categorized into normal, mild, moderate, severe and extremely severe on the three axes to obtain a comparison between the psychosocial states of the two groups.

Data analysis was done using PASW (SPSS) software, version 18. The statistical measures obtained were means, confidence interval levels, chi-square values and logistic regression analysis values.

**Results**

The sample consisted of 143 (68%) manual labourers, 20 (9%) carpenters, 19 (9%) brick layers, 15 (7%) painters, 5 (2%) electricians, 5 (2%) plumbers and 4 (2%) welders. Of the 211 construction workers, 162 (77%) reported symptoms of MSD.

The sex distribution of the sample showed that it consisted of 179 (85%) males and 32 (15%) females. The age of the workers ranged from 16 to 64 years. A proportions test (chi-square) was significant ($P<0.001$) for age, migration ($P<0.001$), working more than 48 hours per week ($P<0.02$) and longer job tenures in the construction industry ($P<0.02$). There was no significant association between sex, educational status, habits of smoking, consumption of alcohol and body mass index of the respondents and outcome of MSD. This has been shown in Table 1.

The most severely affected body regions across 1 year prevalence, activity limitation over the past year and 1 week prevalence were lower back followed by neck, knees and shoulder, as shown in Graph 1.

The mean scores for the dimensions of physical and psychosocial risk factors have been depicted in Table 2. The mean score obtained was higher in the group with MSD, with a narrow confidence interval. The largest variation in means among the two groups was observed in the awkward posture and force exertion dimensions of the physical risk factors and the dimensions of job dissatisfaction and lack of job control of the psychosocial risk factors. A binary logistic regression analysis was performed with MSD as the outcome and the score of the frequency of exposure of physical and psychosocial risk factors as predictors. A strong predictive value of the above factors was obtained with a Nagelkerke $R^2$ amounting to 0.771 for physical risk factors and 0.699 for psychosocial risk factors.

There were no cases of very severe stress, anxiety or depression in the sample. Forty-three respondents

| Table 1: Socio-demographic and job characteristics of the respondents |
|----------------------|-----------|-----------|-------|
| Age (years)          | MSD absent | MSD present | $P$ value |
| 15–25                | 16         | 22         | $<0.001$ |
| 26–35                | 10         | 73         |         |
| 36–45                | 9          | 49         |         |
| 46–55                | 7          | 13         |         |
| 56–65                | 7          | 5          |         |
| Sex                  |            |            | NS     |
| Female               | 6          | 26         |         |
| Male                 | 43         | 136        |         |
| Education            |            |            | NS     |
| Illiterate           | 9          | 15         |         |
| Primary              | 12         | 46         |         |
| Secondary            | 14         | 38         |         |
| Intermediate or diploma | 14     | 63         |         |
| Migration            |            |            | $<0.001$ |
| No                   | 34         | 69         |         |
| Yes                  | 15         | 93         |         |
| Body mass index Kg/m² (BMI) |       |            | NS     |
| <18                  | 11         | 50         |         |
| 18–25                | 16         | 63         |         |
| >25                  | 22         | 49         |         |
| Working hours per week |          |            | $<0.02$ |
| <48                  | 37         | 83         |         |
| >48                  | 12         | 79         |         |
| Job tenure (years)   |            |            | $<0.02$ |
| <1                   | 5          | 26         |         |
| 1–5                  | 22         | 46         |         |
| 5–10                 | 15         | 38         |         |
| >10                  | 7          | 52         |         |
| n                    | 49         | 162        |         |

NS: Not significant
showed mild to severe impact on the stress axis, 33 on the depression scale and 17 on the anxiety scale in the MSD-positive group. Six, five and two workers showed impact on the stress, depression and anxiety scale, respectively, in the MSD-negative group. The mean scores obtained on each axis showed a trend of being larger in the group with MSD when compared to the group without MSD. This is shown in Table 3.

### Discussion

Previous studies have shown that when compared to the prevalence in the general population, the odds of construction workers for an outcome of MSD are more than twice, requiring emergent means for prevention and mitigation. Joshi et al. recommend that the high prevalence of MSDs in workers needs urgent attention from the health and labor sectors. Increasing age is significant for an outcome of MSD in the current study. The role of age in the outcome of MSD has also been reported by Holmstrom et al. and the association has been seen in non-weight-bearing joints as well. This may be a reflection of the accumulation of repeated insults rather than mere age-related degenerative changes. The association between the cumulative nature of these injuries and an outcome of MSD is further strengthened by the significant associations between the length of the job tenure and the number of working hours. These factors reinforce the dose–response relationship.

The most commonly affected region was the back, followed by neck and knees closely. The use of human labor in lieu of machinery for moving weights, lack of ergonomic training regarding proper weight lifting and distribution are all contributory to the involvement of these joints and are highly amenable to prevention.
Among the physical risk factors, the mean scores were the highest on the dimension of awkward posture followed by force exertion, similar to the findings of Holmstrom et al.\(^{(7)}\) Their study also revealed a stronger association between work in awkward postures and MSD than psychosocial factors, as evidenced by the logistic regression correlation values in our study. Improper force exertion and load bearing once again reinforce the acute need of pre-placement training and demonstration of ergonomic measures in the sample and construction workers in general.

Among the psychosocial indices, job dissatisfaction followed by lack of job control showed the strongest relationship with MSD. Nahit et al.\(^{(5)}\) described the importance of psychosocial risk factors and their association with MSD. Psychosocial risk factors are more difficult to measure and evaluate than physical risk factors and present a bigger challenge while developing investigative, intervention and prevention measures. A measure of the overall psychosocial state with instruments such as DASS21 reflects a repeatable and more objective measure of psychosocial distress and may predict a predilection to outcome of MSD.\(^{(4,5)}\) The means scores were higher on the three axes of anxiety, depression and stress in the MSD group in the present study. Intervention and prevention of MSD should be conducted in a holistic manner by understanding the interplay of these risk factors and should not be limited simply to the evaluation of pain, thereby mitigating the effects of this condition and leading to a safer and healthier work environment.

**Limitations**

Being a cross-sectional study, causal inference is difficult to obtain. Data obtained were subjective perception of the respondents, and the degree of MSD was not quantified by investigation due to the community-based nature of the study.

**Conclusion**

Four in five construction workers exhibited symptoms of MSD, with age, long hours and duration of work contributing to the cumulative effect. Addressing both physical and psychosocial risk factors along with objective measurement of psychosocial state, effective ergonomics and training are required for effective prevention.

**References**

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