



Assessment of posture related musculoskeletal risk levels among packaged drinking water loaders in Mumbai using rapid entire body assessment (REBA)

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Abstract

Background: Manual material handling activities, especially repetitive lifting of heavy loads, are associated with a high risk of work-related musculoskeletal disorders (WMSDs). Packaged drinking water loaders frequently perform physically demanding tasks such as lifting and carrying 20-liter water bottles, which may predispose them to musculoskeletal risk. However, limited studies have assessed posture-related risk levels in this occupational group using standardized ergonomic tools.

Objective: To assess posture-related musculoskeletal risk levels among packaged drinking water loaders in Mumbai using Rapid Entire Body Assessment (REBA) and to determine the prevalence of musculoskeletal pain using the Nordic Musculoskeletal Questionnaire (NMQ).

Methodology: A cross-sectional study was conducted on 64 packaged drinking water loaders aged 20–40 years using convenience sampling. Data were collected using a structured case record form, Nordic Musculoskeletal Questionnaire, and REBA scale. Postural analysis was performed using Kinovea software. Data were analyzed using descriptive statistics.

Results: The mean age of participants was 29.84 ± 6.35 years. Majority of participants (69%) were at high risk and 22% at very high risk according to REBA scores. Musculoskeletal pain was most prevalent in the lower back (48%), followed by shoulder (31%) and upper back (25%).

Conclusion: Packaged drinking water loaders demonstrated a high prevalence of musculoskeletal risk, particularly affecting the lower back and shoulder. The majority were categorized under high and very high risk levels, indicating the need for ergonomic interventions.

Keywords: REBA, musculoskeletal disorders, manual material handling, water loaders, ergonomics, physiotherapy

Introduction

In many countries, both developing and developed, people who do Manual Material Handling (MMH) activities are at higher risk of Work-related Musculoskeletal Disorders (WMSDs). MMH means jobs like lifting, lowering, pushing, pulling, carrying, or moving heavy loads by hand or body strength. These kinds of tasks often cause strain because they need steady posture and wide body movements.^[1]

Work-related Musculoskeletal Disorders (WMSDs) are health problems that affect the muscles, joints, nerves, tendons, cartilage, and spinal discs. They usually happen because of repeated movements, lifting heavy loads, using too much force, working in uncomfortable positions, or sitting and standing for long hours.^[2]

Packaged drinking water loaders perform tasks that involve unloading, lifting, and transporting heavy water bottles as part of their daily work. The tasks often begins with bending forward to pick bottles from lower levels, followed by lifting them overhead onto their shoulders and carrying it over a certain distance to load it into trucks for transportation.^[3]

A prevalence study among manual material handlers found that the participants reported musculoskeletal discomfort in the upper back (82.7%), followed by the neck (71.2%), lower back (65.5%), shoulders (63.3%), wrists (33.8%), knees (31.7%), elbows (26.6%), ankles (23.7%), and hips/thighs (19.4%), respectively.^[4]

Work-related Musculoskeletal Disorders (WMSDs) are one of the biggest problems caused by doing heavy or repetitive work the wrong way, which is why they are often studied in ergonomics. Studies show that tasks that are too demanding (like long hours of heavy work) and bad working positions (such as stooping, squatting, or kneeling) are the main reasons people develop WMSDs. Since these problems usually appear slowly and don't cause clear symptoms at first, they are often ignored.^[5]

According to the National Institute for Occupational Safety and Health (NIOSH), workers in the bottling industry experience a higher rate of work-related musculoskeletal disorders (WRMDs) compared to those in other manufacturing or service sectors. This increased incidence is mainly linked to the prolonged awkward and static postures required by their job roles, along with repetitive manual handling and motion tasks performed throughout various stages of the bottling process. Such working conditions not only endanger the health and well-being of employees but also negatively affect the efficiency and productivity of bottling companies.^[3]

Hignett and McAtamney (2000)^[8] developed the Rapid Entire Body Assessment (REBA) to examine postures and work activities that may contribute to musculoskeletal disorders.^[6]

There is high intra-rater reliability (ICC = 0.925) for REBA raw scores and moderate inter-rater reliability (IRR) (Fleiss

kappa=0.54) for a categorical scoring of REBA and also demonstrated good face validity.^[7]

Methodology

This study adopted a cross-sectional design and was conducted among packaged drinking water loaders in Mumbai. A total of 64 participants were selected using convenience sampling.

Inclusion criteria included male workers aged 20–40 years, involved in loading and unloading of packaged drinking water bottles, with a minimum of one year of work experience. Exclusion criteria included individuals with disability, congenital musculoskeletal or neurological deformities, any trauma to neck, hand, upper extremity and trunk and not willing to participate.

Ethical clearance was obtained prior to the study, and informed consent was taken from all participants. Demographic data including age, gender, working hours, and experience were recorded.

Musculoskeletal pain was assessed using the Nordic Musculoskeletal Questionnaire. Postural risk was evaluated using the Rapid Entire Body Assessment (REBA) tool. Postures were observed during work activities, and joint angles were analyzed using Kinovea software.

The task analyzed involved lifting a 20-litre water bottle from the ground during routine work activity. The most frequently performed and highest-risk posture was selected for analysis. Joint positions including trunk, neck, legs, and upper limbs were assessed, and REBA scoring was calculated based on Group A and Group B components along with load, coupling, and activity scores.

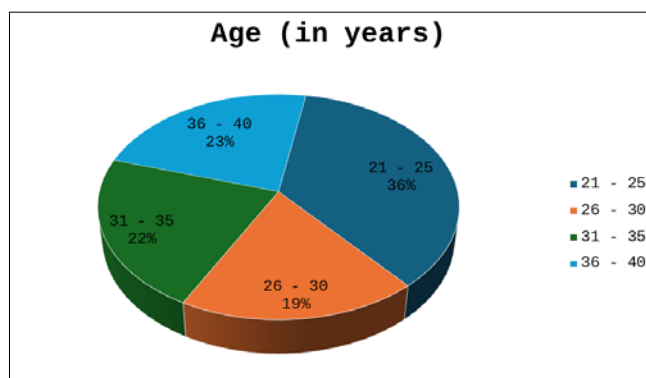
Statistical Analysis

Descriptive statistics were used for analysis. Frequency and percentage were used for categorical variables, while mean and standard deviation were used for continuous variables.

Data Analysis and Result

Table 1: Frequency and percentage of age of participants.

Age ranges (in years)	Frequency (%)
21- 25	23 (36%)
26- 30	12 (19%)
31- 35	14 (22%)
36- 40	15 (23%)

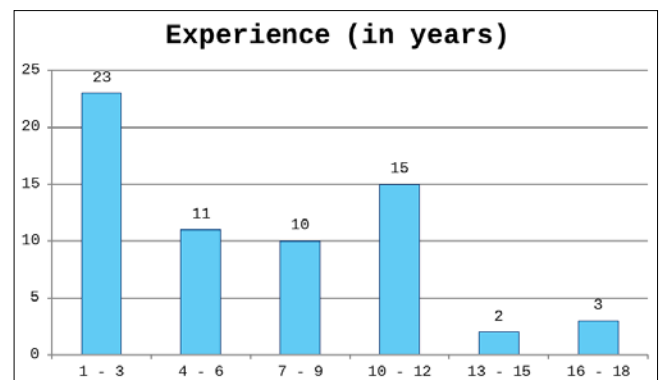


Pie Chart 1: Frequency and percentage of age of participants.

Among 64 candidates, maximum number of participants were from the age group of 21- 25 years (i.e. 23), while minimum number of participants were from the age group of 26- 30 years (i.e. 12). Participants in the age group of 31- 35 years were 14 while those within the age range of 36- 40 years were 15.

Table 2: Frequency and percentage of working experience (in years)

Experience	Number of participants
1-3	23 (36%)
4-6	11 (17%)
7- 9	10 (16%)
10- 12	15 (23%)
13- 15	2 (3%)
16- 18	3 (5%)



Graph 1: Frequency and percentage of working experience (in years)

The study showed that 36% of the total participants had minimum years of experience (i.e.1-3 years), 17% participants had 4-6 years of working experience, 16% workers had 7-9 years of working experience, 23% participants had 10-12 years of working experience, 3% percentage of participants had 13-15 years of working experience and 5% participants had 16-18 years of working.

Table 3: Characteristics of Participants

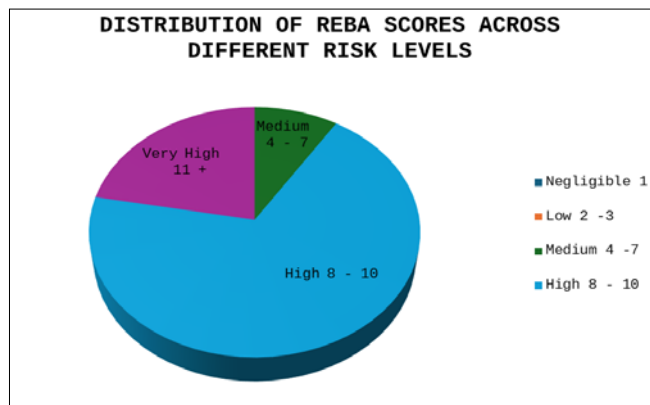
Characteristics	Mean $\pm$ SD	Median (IQR)
Age (in years)	29.84 $\pm$ 6.35	29.5 (24 - 35)
Years of Experience	6.64 $\pm$ 4.42	6 (2.75 - 10)

SD = Standard Deviation, IQR = Interquartile Range

The characteristics of participants are shown in **Table 3**. The study comprised of 64 Males participants of mean age of 29.85 plus/minus 6.35 years and having total mean experience of 6.64 plus/minus 4.42 years and working for 9 hours per day for 6 days per week.

Table 4: REBA Score

Risk Level	Score Range	Count	Percentage
Negligible	1	0	0%
Low	2 – 3	0	0%
Medium	4 – 7	6	9%
High	8 – 10	44	69%
Very High	11 +	14	22%



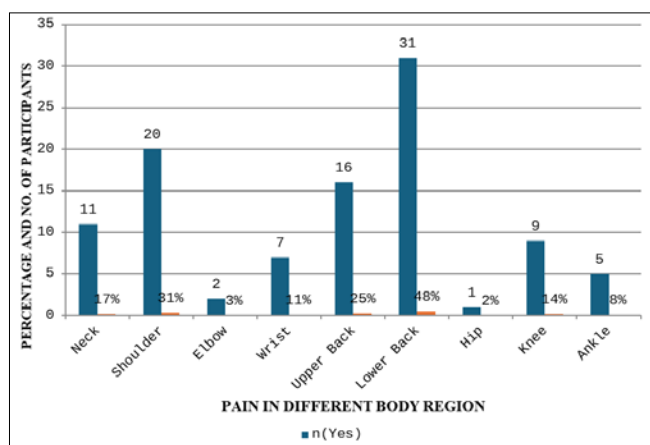
Pie Chart 2: Final REBA Score

Chart 1 shows final REBA score of the study participants. Majority of the participants $n = 44$ (69%) were at High risk (blue) of developing work related musculoskeletal disorder, about a quarter $n = 14$ (22%) are in the Very high risk (purple) range, very few are Medium risk (green) $n = 6$ (9%) and none of the participants fall into Negligible (dark blue) or Low (red)

Table 5: Nordic Musculoskeletal Questionnaire

Pain during last 12 months			
Body Part	n(Yes)	n(No)	Percentage
Neck	11	53	17%
Shoulder	20	44	31%
Elbow	2	62	3%
Wrist	7	57	11%
Upper Back	16	48	25%
Lower Back	31	33	48%
Hip	1	63	2%
Knee	9	55	14%
Ankle	5	59	8%

Nordic Body Pain Analysis



Graph 2: Nordic Pain Musculoskeletal Complaints

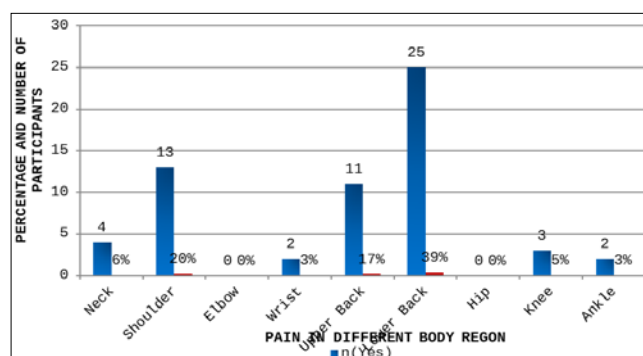
Based on the Nordic Musculoskeletal Questionnaire, the prevalence of musculoskeletal pain or trouble during the last 12 months was highest in the lower back (48%), followed by the shoulder (31%) and upper back (25%). Moderate levels of symptoms were reported in the neck (17%), knee

(14%), and wrist (11%), while the ankle (8%), the elbow (3%) and hip (2%) showed relatively low prevalence.

Table 6: Nordic Musculoskeletal Questionnaire

Pain during last 7 days			
Body Part	n(Yes)	n(No)	Percentage
Neck	4	60	6%
Shoulder	13	51	20%
Elbow	0	64	0%
Wrist	2	62	3%
Upper Back	11	53	17%
Lower Back	25	39	39%
Hip	0	64	0%
Knee	3	61	5%
Ankle	2	62	3%

Nordic Body Pain Analysis

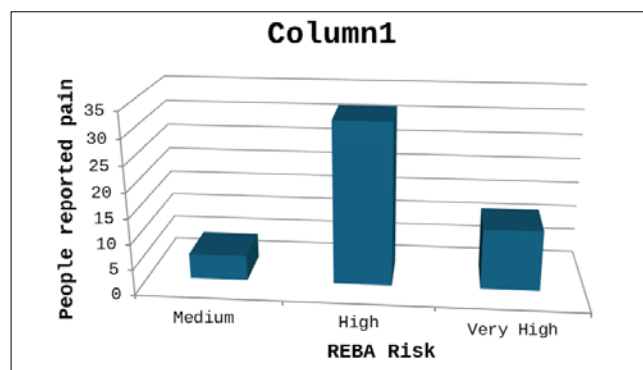


Graph 3: Nordic Pain Musculoskeletal Complaints

Based on the Nordic Musculoskeletal Questionnaire, the prevalence of musculoskeletal pain or trouble during the last 7 days was highest in the lower back (39%), followed by the shoulder (20%) and upper back (17%). Moderate levels of symptoms were reported in the neck (6%) and knee (5%) while the wrist (3%) and ankle (3%) showed relatively low prevalence. No participants reported pain in the elbow and hip regions.

Table 7: Distribution of Musculoskeletal pain Across REBA Risk Levels.

REBA Risk	Pain : yes	Pain : No	Total
Medium	5	1	6
High	32	12	44
Very High	12	2	14
Total	49	15	64



Graph 4: Distribution of Musculoskeletal pain Across REBA Risk Levels.

The analysis of REBA (Rapid Entire Body Assessment) scores in relation to musculoskeletal pain demonstrates a significant association between ergonomic risk and the prevalence of work-related musculoskeletal disorders (MSDs). Within the medium risk category, only a small proportion of workers reported pain, the high risk group exhibited the highest burden and the very high risk group reported fewer cases of pain than the medium-risk group.

Discussion

The present study assessed posture related musculoskeletal risk levels among Packaged drinking water loaders in Mumbai using the Rapid Entire Body Assessment (REBA) tool.

For this, 64 Packaged drinking water loaders aged between 20-40 years were selected as per the inclusion and exclusion criteria. The work posture was assessed using Rapid Entire Body Assessment (REBA Scale) while Nordic body map was used to identify the painful body regions. The findings revealed that the majority of the participants 69% were categorized into the High risk group, with 22% in the very high-risk group and 9% in the medium risk group. None of the participants fell into the negligible and low risk.

The findings of the present study indicate that packaged drinking water loaders are consistently exposed to significant postural and physical stress, predisposing them to work-related musculoskeletal disorders (WRMSDs). Unlike relatively static occupations, this population performs repetitive lifting and carrying of heavy 20-litre water bottles, often involving forward bending, trunk rotation, and load transfer to the shoulder. Such biomechanical demands place considerable strain on both the axial and appendicular musculoskeletal systems.

The results obtained from the Nordic Musculoskeletal Questionnaire further highlight a high burden of musculoskeletal complaints among these workers. The 12-month prevalence of pain was highest in the lower back (48%), followed by the shoulder (31%) and upper back (25%). Moderate levels of symptoms were reported in the neck (17%), knee (14%), and wrist (11%), while the ankle (8%), the elbow (3%) and hip (2%) showed relatively low prevalence.

This pattern can be explained by the nature of their work, where lifting heavy loads onto the shoulder leads to sustained compression and overuse of the shoulder girdle, while repeated squatting, lifting, and prolonged standing contribute to lower back strain. The relatively high prevalence in these regions reflects chronic exposure to improper lifting techniques and lack of ergonomic support.

In addition, the 7-day prevalence data suggest that acute episodes of pain are also common, particularly in weight-bearing joints and the shoulder complex. These short-term complaints may represent flare-ups due to continuous workload without adequate rest, indicating that both acute and chronic musculoskeletal issues coexist in this occupational group.

When compared with previous studies conducted among other occupational groups such as restaurant chefs, certain similarities and differences can be observed. For instance, studies like those by Karelia *et al.* (2021)^[6] reported higher prevalence in the neck (19.03%) and wrist position (18.73%) followed by upper arm position (18.41%), which are more associated with repetitive fine motor activities and sustained upper body postures. In contrast, the present study

demonstrates a greater involvement of the lower back(48%), shoulder(31%) and upper back(25%) likely due to the heavy manual handling and load-bearing nature of the work performed by water loaders. This contrast emphasizes that the anatomical distribution of musculoskeletal disorders is highly influenced by task-specific occupational demands.

Furthermore, ergonomic risk assessment using the Rapid Entire Body Assessment (REBA) tool in the current study revealed that a majority of participants fall under high risk (69%)and very high risk(22%) categories. This is consistent with findings from other occupational studies, where workers engaged in repetitive or physically demanding tasks show similar risk distributions. The predominance of high risk suggests that while the working postures are not immediately hazardous, they are likely to cause cumulative trauma over time if not addressed. The presence of a significant proportion of workers in the very high risk category further indicates the urgent need for ergonomic interventions.

Comparative studies, such as those by Gawai *et al.*, have also reported high prevalence of musculoskeletal pain in regions like the lower back, upper back, shoulders and neck among manual workers. The alignment of these findings with the present study reinforces the understanding that occupations involving repetitive lifting, awkward postures, and prolonged standing are inherently associated with increased musculoskeletal risk.

The distribution of musculoskeletal pain across different REBA risk levels has been observed among the study participants. Most of the individuals who reported pain were found in the high-risk group (32 participants), followed by the very high-risk group (12 participants) and the medium-risk group (5 participants). A similar pattern can also be seen, where a larger number of workers experiencing pain are grouped under higher REBA risk levels, especially the high-risk category.

At the same time, musculoskeletal complaints were present across all levels of risk, not limited only to higher categories. However, a greater number of cases appearing in the high and very high-risk groups suggests that workers exposed to more awkward and demanding postures tend to report more discomfort in comparison to those in lower risk levels. Overall, the findings of this study underscore that packaged drinking water loaders represent a vulnerable occupational group with a high prevalence of both acute and chronic musculoskeletal problems. The combination of heavy load handling, poor ergonomic practices, and repetitive movements contributes significantly to this burden. These results highlight the need for targeted preventive strategies, including ergonomic training, modification of work techniques, use of assistive devices, and implementation of adequate rest periods, to reduce the risk of WRMSDs and improve the overall occupational health of this population.

Conclusion

- Majority of participants reported Musculoskeletal symptoms in Lower Back.
- Majority of participants (69%) had REBA scored (8-10) indicating High Risk of Musculoskeletal disorder due to the awkward working posture.

Limitation

- **Sample size:** Although 64 workers were included, a larger and more diverse sample may provide more generalizable results.
- **Self-reported pain:** Pain data was collected via questionnaires, which may be influenced by recall bias or underreporting, especially due to fear of job insecurity.

Clinical Implications

The findings of this study carry significant clinical and occupational health implications:

Ergonomic Risk Reduction: A large proportion of workers were found to be at high to very high risk of musculoskeletal strain due to repetitive lifting and awkward postures, particularly forward bending and shoulder loading. This indicates a strong need for ergonomic modifications at the workplace, such as reducing manual load through assistive devices (trolleys, ramps), optimizing loading heights, and improving task techniques.

Musculoskeletal Health Monitoring: Regular screening of workers using tools like REBA and the NMQ can help in identifying early signs of musculoskeletal problems. Early detection is essential in this population, as many workers tend to ignore pain until it becomes severe, which can lead to chronic conditions.

Preventive Programs: Introducing posture-correction training, safe lifting techniques, strengthening and stretching exercise, and scheduled micro-breaks may reduce cumulative musculoskeletal load.

If not addressed, these occupational stresses may lead to chronic musculoskeletal conditions such as low back pain, cervical strain, shoulder impingement, and repetitive strain injuries. These conditions can negatively affect the worker's productivity, earning capacity, and quality of life. Therefore, preventive strategies are not only clinically important but also economically beneficial for workers.

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