Ergonomic workplace analysis in an elevator manufacturing company
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1. Introduction
The elevator is a type of vertical transport equipment that efficiently moves people or goods between floors of a building, vessel or other structure. Manufacture of elevators involves significant manual material handling such as lifting, carrying, pulling, unloading raw materials, transporting materials in the workplace, loading finished products for delivery, packing etc. Many of these tasks can result in musculoskeletal disorders (MSDs) and other types of injuries. However, not all manual handling is hazardous. No previous studies have reported the ergonomic risk factors involved in an elevator manufacturing company. The aim of this study was to know the outcome of an ergonomic workplace analysis done at an elevator manufacturing company.

2. Methodology
A prospective study was conducted in which all the sections of an elevator manufacturing company was evaluated through a floor to floor visit by a team of ergonomists. Photos and videos recordings of all the tasks which needed to be evaluated further was taken. Ergonomic workplace analysis tools focusing on assessing posture, muscle fatigue, body part at risk, task assessment and redesigning were selected based on the tasks to be evaluated. Each task was assessed separately by a team of experts and the results were analysed to prepare the final report.

Rapid Entire Body Assessment (REBA) was used to assess activities involving prolonged static posture. Muscle Fatigue Assessment (MFA) for activities with repeated movements, static posture and physical exertion that might lead to fatigue in different body part. Revised NIOSH Lifting equation (RNLE) for lifting weights more than 3 kgs, Key Indicator Method (KIM)-push/pull and lifting/carrying to know the overall risk involved and Strain Index - risk of getting an upper extremity disorder in works involving repetitive movements.

3. Results
A total of 80 tasks were evaluated separately. Tasks that had similar body movement and function were categorised and considered as a single task. All the tasks starting from the store area to manufacturing area, cleaning area, etc. were assessed. Various tools used and number of tasks assessed are listed in table 1.

<table>
<thead>
<tr>
<th>Tools used</th>
<th>No of tasks assessed</th>
</tr>
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<tbody>
<tr>
<td>REBA</td>
<td>27</td>
</tr>
<tr>
<td>MFA</td>
<td>32</td>
</tr>
<tr>
<td>RNLE</td>
<td>08</td>
</tr>
<tr>
<td>Strain Index</td>
<td>19</td>
</tr>
<tr>
<td>KIM</td>
<td>29</td>
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</tbody>
</table>

Risks ranged from low to very high. Commonest body part that were found to be at risk were lower back, neck and shoulder. 74% of the tasks assessed with REBA, 58% of the tasks assessed by Strain Index, 88% of the task assessed by RNLE and 28% of the tasks assessed by KIM showed a very high risk score. MFA showed neck, back and right shoulder as the regions that are prone for easy muscle fatigue.

4. Discussion
The workers of the elevator manufacturing industry were adopting awkward postures which involved frequent twisting, bending, and over-reaching, forceful exertions, high repetition, and localised vibration. Many biomechanical risk factors had a strong association with work related musculoskeletal disorders (WRMSD) of...
the lower back, neck, and shoulders. The workers were under moderate to high risk and in some postures at a very high risk of developing WRMSD.

References