

COMPREHENSIVE ERGONOMIC RISK ASSESSMENT IN DIFFERENT INDUSTRIES USING FULL BODY IMU'S: A COMPARATIVE ANALYSIS OF RULA AND RAMP II

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Summary

This study utilised a full-body inertial measurement unit (IMU) suit to assess ergonomic risks in construction, manufacturing, warehousing and healthcare industries. Eighteen workers were monitored while executing their everyday tasks, with data analysed using RULA (Rapid Upper Limb Assessment) and RAMP II (Risk Assessment and Management tool for manual handling Proactively) calculations for risk exposures. Results showed healthcare workers faced lower full body risks (average RULA score: 6.93 ± 0.04) compared to all other industries; however, manufacturing workers experienced the least cumulative risk exposure to trunk (percentage time spent moderately bending: 17 ± 9) versus warehousing (35 ± 11), attributed to repetitive motions and prolonged awkward postures. The study highlights the importance of considering both task-based and cumulative risks in these industries. The use of IMU technology provided detailed biomechanical data, enabling more precise risk quantification. Findings suggest the need for tailored intervention strategies addressing both types of ergonomic risks in all industry settings.

Introduction

Work-related musculoskeletal disorders (WMSDs) remain a significant concern in industries that involve manual handling, being the leading cause of sick leave, reduced working time, and increased health costs of industrial labour [1]. This study aimed to quantify ergonomic risks associated with these sectors using a full body Inertial Measurement Unit (IMU) suit to measure trunk movement throughout everyday tasks.

Methods

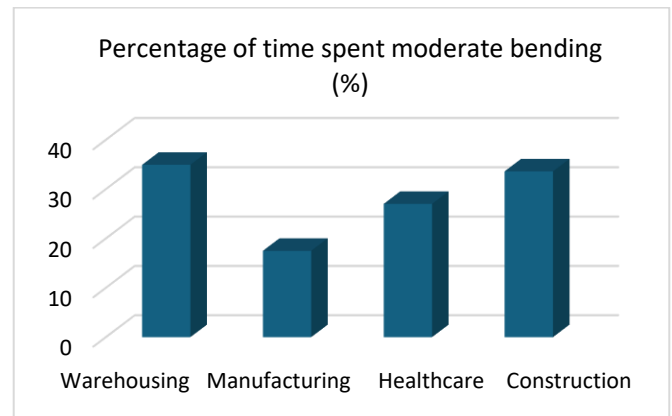
Eighteen workers wore the IMU suit during various tasks they reported to be representative of their full 8-hour shift. Biomechanical data was collected and analysed using two ergonomic assessment tools: Rapid Upper Limb Assessment (RULA)[2] for task-based risk evaluation and Risk Assessment and Management tool for manual handling Proactively (RAMP II)[3] for time dependent risk evaluation; movement data for each task was combined, and extrapolated to represent a full 8-hour shift.

Results and Discussion

RULA analysis revealed that healthcare workers experienced lowest whole-body risks (mean RULA score: 6.93 ± 0.04), with the lowest percentage of time (93%) spent in RULA score 7 (high risk, change immediately) compared to Warehousing with the highest RULA scores (mean score: 6.97 ± 0.01) with the highest percentage of time spent in RULA score 7 (97%). RAMP II assessments indicated that

Warehousing and Construction had greatest cumulative trunk exposure (Graph 1) over a representative period of a full 8-hour shift (mean scores 35 ± 11 & 34 ± 20 respectively) compared with Manufacturing (mean score: 17 ± 9), due to limited prolonged bending and increase static holding in manufacturing.

Graph 1: The average time spent moderately bending according to RAMP II expressed as a percentage of time.



Conclusions

This study demonstrates the necessity of task-based and full-shift ergonomic risk assessments to ensure a full worker/job profile is assessed. While results presented show all industries posed higher risks to the trunk/back compared with other body segments, in agreement with previous literature, further investigation is needed into the disparity between risk levels in Manufacturing and previous findings. This is likely due to the sample size of the group. The use of IMU technology provided unprecedented granularity in biomechanical data, enabling more accurate risk quantification of tasks in real-world environments. Future research should establish controls in all industries to minimise risks to workers, especially within healthcare where there are limited interventions.

Acknowledgments

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References

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