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Manual material handling risk assessment in furniture industry: REBA method

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Abstract

The Turkish furniture industry is a significant player in the global market and ranks eleventh in the worldwide in terms of exports. Despite its positive economic impact, the industry faces challenges such as a high number of occupational injuries and illnesses, especially musculoskeletal disorders (MSDs). The objective of this study is to conduct an ergonomic risk assessment using the Rapid Entire Body Assessment (REBA) method in a furniture Turkish manufacturing facility. A total of twenty-four tasks were assessed using the REBA method, revealing that 41.7% of the tasks were found to pose either a high or very high ergonomic risk. Tasks such as carrying sofa frames and cutting fabrics were found to be particularly risky due to prolonged and strenuous postures involved. Engineering and managerial control measures were recommended to mitigate these risks, including automation, workstation redesign, and employee training. While the REBA method provided valuable insights, its subjective nature highlights the need for more objective assessment methods, such as electromyography (EMG). Future research should investigate these alternative methods to improve the reliability of ergonomic assessments. In conclusion, this study highlights the significant ergonomic risks in the Turkish furniture industry and emphasizes the importance of implementing targeted interventions to safeguard employee health and improve overall productivity. By addressing these risks, companies can create safer working environments and enhance their competitiveness in the global market.

Keywords: REBA; Furniture manufacturing; Ergonomics; Risk assessment

1. Introduction

The Turkish furniture industry holds the eleventh position globally in terms of furniture exports, with an export value of $4.212 million [1], accounting for 1.66% of global furniture exports. On the contrary, furniture imports totaled $569 million in 2022. Analyzing the export and import data reveals the substantial positive impact of the furniture industry on the Turkish economy. The furniture industry in Turkey is primarily comprised of independent and small-scale workshops, which operate using traditional methods and heavily depend on craftsmanship to manufacture household items primarily for the domestic market, on the other hand, there has been a recent increase in the number of medium and large-scale enterprises [2]. The Turkish Statistical Institute [3] reported that there were 39,338 enterprises employing 209,190 individuals in the furniture industry in 2020.

Despite the positive contribution of the furniture industry to the Turkish economy, unfortunately, the number of occupational injuries and illnesses in the industry is high. In 2022, a total of 8,719 occupational injuries and illnesses were reported in the furniture manufacturing industry, roughly 1.4% of all injuries and illnesses in Türkiye [4]. The furniture industry is labor-intensive and involves numerous ergonomic risk factors, which can lead to musculoskeletal disorders (MSDs). MSDs are soft-tissue injuries caused by sudden or prolonged exposure to ergonomic risk factors including repetitive motion, working for extended duration of time, heavy load, excessive force, vibration, and awkward posture. These disorders can affect the muscles, nerves, tendons, joints and cartilage in neck, upper and lower

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extremities, and lower back. In addition to health problems, MSDs result in work disability, increasing compensation and health care expenses, declining productivity and lowering quality of life [5].

MSD risk factors can be categorized into individual, psychosocial and physical factors. Individual factors include worker's characteristics such as previous medical history, anthropometry, strength, mobility (range of motion), gender, and expertise in the work. Psychosocial risk factors can be excessive job demand, time pressure, lack of support from colleagues, lack of control or involvement and participation in decision processes. Physical risk factors include overexertion and location of the load (vertical and horizontal distances) to the body, duration, repetition, and working posture (angles, twisting, etc.). Physical risk factors also include material or container characteristics including properties of handlers, shape (regular or irregular) and asymmetry of the load.

Ergonomic risk assessment for Manual Material Handling (MMH) activities is vital to evaluate physical risk factors to eliminate or minimize the number of MSDs. Risk assessment includes observational methods and instrumentation-based methods. Observational methods have some advantages such as for their non-interference with the work performed, low price and simplicity in terms of learning and usage [6]. Most common observational whole body postural analysis ergonomic risk assessment methods are PLIBEL, Quick Ergonomic Checklist (QEC), Rodgers Muscle Fatigue Assessment, and Rapid Entire Body Assessment (REBA). These methods basically evaluate the physical load of work by analyzing body posture, movement; recurring and forceful activities and maximum force, or increasing muscle load over time. REBA developed by Hignett and McAtamney in 2000 [7] is very commonly used ergonomic risk assessment method since it provides a quick and easy measure to assess a variety of working postures for risk of MSDs.

The furniture industry involves significant physical strains, leading to frequent occurrences of MSDs among employees. It is important to conduct ergonomic risk assessments to reduce the number and severity of occupational injuries and illnesses, especially MSDs. The objective of this study is to conduct an ergonomic risk assessment using the REBA method in a furniture manufacturing facility in Turkey.

2. Materials and Methods

In this study, a furniture production facility in Izmir that manufactures mattresses, bases, headboards, and seating group furniture was selected to assess ergonomic risks in the furniture manufacturing industry. The company is one of the leading suppliers to global furniture retailers and is among the few establishments in the Turkish furniture industry with high production capacity. As of 2017, it has reached an annual export volume of approximately $10 million with around 700 employees [8]. The company stands out for its production tailored to customer demands, with a focus on order-based production in line with a batch production system. The production process occurs in four stages and separate manufacturing units, which are confection (fabric cutting and sewing), metal frame, furniture frame (assembly of metal-solid construction), and upholstery (assembly line) unit. A total of twenty-four job assessments were conducted in the facility. The evaluated jobs are given in Figure 1.

To assess ergonomic risks, an ergonomic risk assessment was conducted using the Rapid Entire Body Assessment (REBA) method, which analyzes the body posture and allows the evaluation of physical characteristics of the task. The REBA method assigns a REBA score ranging from 1 to 15 based on the bending, twisting, and load on the body parts such as neck, trunk, legs, arms, and wrists in the working position in addition to activity score. The calculated REBA score classifies the risk level of the identified working posture into 5 categories ranging from "negligible" to "very high" risk." The action should be "none necessary" for the negligible risk level and "necessary now" for the very high risk level.

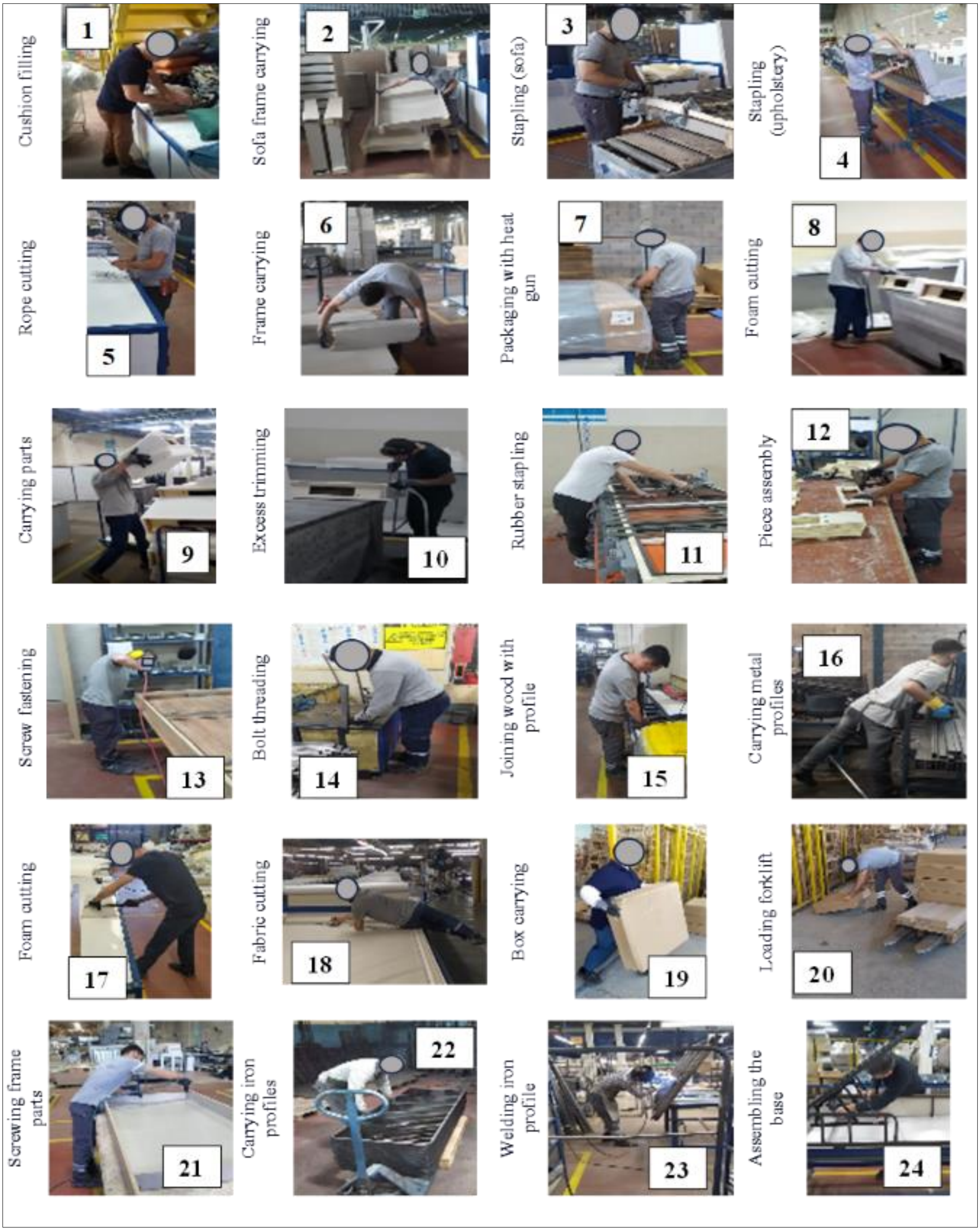

Figure 1 The evaluated jobs

1 = Negligible risk
2 or 3 = low risk, change may be needed
4 to 7 = medium risk, further investigation, change soon
8 to 10 = high risk, investigate & implement change
11+ = very high risk, implement change

Figure 2 Scoring REBA

A worksheet about how to conduct the REBA analyses is provided in the Appendix. It should be noted that it is an Excel spreadsheet version of the paper-based analysis. It was converted by Cornell University's researchers after granted permission by Lynn McAnatomany. It is accessible by the link given in [9]. All analyses in the present study were jointly conducted by both authors, who possess significant expertise in biomechanics and ergonomic risk assessment techniques.

No personal or demographic information was collected from the employees. However, the ethical principles, rules, and guidelines of the Belmont Report, Nuremberg Code, and Helsinki Declaration were meticulously followed by the researchers to protect the confidentiality of the employees. All participants were provided with information about the purpose and procedures of the study.

3. Results and Discussion

Twenty-four different tasks underwent assessment using the REBA ergonomic risk assessment method. The analysis of these assessments is outlined in Table 1. Among the twenty-four tasks, 2 (8.3%) received a REBA score exceeding 11, indicating a very high risk level requiring immediate action. Additionally, 33.3% of tasks scored between 8 and 10 on the REBA scale, signifying a high risk level demanding prompt attention. It is imperative to conduct investigations and implement necessary changes promptly for these high-risk tasks. The majority of tasks (37.5%) received REBA scores ranging between 4 and 7, indicating a medium risk level. While control measures are essential, they are not as urgently required as for tasks classified as very high risk or high risk. Nevertheless, further investigation and potential changes should be considered promptly if deemed necessary. Approximately 20.8% of tasks (5 tasks) were deemed safe, with a low or negligible risk level associated with them.

Tasks classified as very high risk included carrying sofa frames and cutting fabric. These tasks involved prolonged and strenuous body postures. Sofa frames were notably heavy and cumbersome, making carrying them particularly challenging. Utilizing assistance from another individual or mechanical devices could alleviate the strain associated with this task. Similarly, fabric cutting necessitated workers to lie on the table to reach the upper part of the textile. A vertical or inclined fabric cutting table will minimize the need for workers to reach out. Additionally, the cutting process can also be carried out with long-levered cutters.

Different engineering and managerial control measures can be applied to tasks with high REBA scores. For instance, mechanical tools or robots can be employed. The work station can be fully automated with the help of robots. Fully automating the production line may not be feasible initially due to various reasons, including cost. However, some other ergonomic control measures can be applied. For example, the layout and workflow can be redesigned to alleviate ergonomic risks [10]. Employees can be subjected to rotation [11] or provided with training on tasks that involve repetitive or poor postures. One of the administrative measures taken to prevent musculoskeletal disorders that may arise from repetitive movements is that operators can work by rotating between stations or tasks every two hours or less. Considering its protective role [12,13], employees can adopt exercise habits that enhance their physical fitness level, including muscle strength, flexibility, and endurance.

Table 1 Results of REBA analyses

Task	Table A			Table B			Force/Load	Coupling	Activity Score	Score A	Score B	Score C	REBA Score
	Trunk	Neck	Legs	Upper Arm	Lower Arm	Wrist							
Cushion filling	3	2	2	2	1	1	0	0	1	5	1	4	5
Frame carrying (sofa)	4	1	3	4	1	1	2	3	1	8	7	10	11
Stapling (sofa line)	1	2	1	2	1	1	0	0	2	1	1	1	3
Stapling (upholstery)	3	3	2	5	2	2	0	1	0	6	9	10	10
Rope cutting	1	2	1	1	1	1	0	0	2	1	1	1	3
Frame carrying (frame)	4	2	1	3	2	3	1	2	0	6	7	9	9
Packaging with heat gun	1	2	1	1	1	1	0	0	2	1	1	1	3
Foam cutting	1	2	1	1	2	1	0	0	2	1	1	1	3
Carrying parts	1	1	2	6	2	1	1	2	0	3	10	8	8
Excess trimming	2	2	1	2	2	1	0	0	2	3	2	3	5
Rubber stapling	3	1	1	4	2	1	0	0	2	2	5	4	6
Piece assembly	1	2	1	2	1	1	0	0	2	1	1	1	3
Screw fastening	2	2	1	5	2	1	0	0	1	3	7	6	7
Bolt threading	3	2	1	2	1	1	0	0	2	4	1	3	5
Joining wood with profile	3	2	1	2	1	1	0	0	2	4	1	3	5
Carrying metal profiles	4	1	3	2	1	1	1	1	1	7	2	7	8
Foam cutting	3	2	2	4	2	2	0	0	2	5	6	7	9
Fabric cutting	5	1	3	3	2	1	0	0	3	7	4	8	11
Box carrying	1	1	1	4	1	1	1	2	2	2	6	4	6
Loading the box onto the forklift	4	2	2	5	1	1	1	1	0	7	7	9	9
Screwing the frame parts	3	3	1	5	2	2	0	0	1	5	8	8	9
Carrying iron profiles	4	1	1	2	1	1	1	0	1	4	1	3	4
Welding iron profile	5	3	1	3	2	1	0	0	1	7	4	8	9
Assembling the base	3	2	1	3	2	2	0	1	1	4	6	6	7

It's important to recognize that the REBA method relies on observation, rendering it subjective and heavily reliant on the individual applying it. When more objective and reliable results are necessary, instrumentation-based methods like employing an electromyograph (EMG) device might be preferred. Future research endeavors could be pursued to explore and mitigate this limitation.

4. Conclusion

In this study, twenty-four common tasks were assessed to evaluate ergonomic risks. Among these tasks, 8.3% were classified as very high risk, necessitating immediate control measures, while another 33.3% fell into the high-risk category. This indicates that a total of 41.7% of all tasks assessed posed either a high or very high level of risk. These findings suggest that the furniture manufacturing industry presents significant risks to employees. It is imperative to examine the factors contributing to high-risk REBA scores and develop ergonomic solutions accordingly. The implementation of ergonomic interventions can offer benefits to both employees, enabling them to carry out their tasks comfortably, and companies, by improving production, efficiency, and profitability.

Compliance with ethical standards

Disclosure of conflict of interest

The author declares that he has no competing interests.

References

[1] General Directorate of Industry. Furniture Sector Report. Republic of Turkey Ministry of Industry and Technology; 2023.

[2] Ministry of Trade. Mobilya Sektör Raporu. İhracat Genel Müdürlüğü, Maden, Metal ve Orman Ürünleri Dairesi. 2021.

[3] TUİK. Foreign Trade Statistics. 2021.

[4] SGK. Work Accidents and Occupational Diseases Statistics. 2022.

[5] C H Roux, F Guillemin, S Boini, F Longuetaud, N Arnault, S Hercberg, et al. Impact of musculoskeletal disorders on quality of life: an inception cohort study. Ann Rheum Dis 2005;64:606. https://doi.org/10.1136/ard.2004.020784.

[6] Genaidy AM, Al-Shedi AA, Karwowski W. Postural stress analysis in industry. Applied Ergonomics 1994;25:77–87. https://doi.org/10.1016/0003-6870(94)90068-X.

[7] Hignett S, McAtamney L. Rapid Entire Body Assessment (REBA). Applied Ergonomics 2000;31:201–5. https://doi.org/10.1016/S0003-6870(99)00039-3.

[8] Karsiyaka O, Sutcu A. Improving Efficiency for Furniture Manufacturing Processes by using 5S Applications: Case study. Bilge International Journal of Science and Technology Research 2019;3:87–101. https://doi.org/10.30516/bilgesci.463121.

[9] Cornell University Ergonomics. REBA Worksheet https://ergo.human.cornell.edu/ahREBA.html 2024.

[10] Oz E, Cakmak B. Evaluating of work routine from the point of ergonomics and work safety in a farm machinery manufacturer. Journal of Engineering Sciences and Design 2017;5:275–82.

[11] Aksüt G, Alakaş HM, Eren T, Karaçam H. Model proposal for physically ergonomic risky personnel scheduling problem: An application in textile industry for female employees. Journal of the Faculty of Engineering and Architecture of Gazi University 2023;38:245–56. https://doi.org/10.17341/gazimmfd.882419.

[12] Volinn E. Do workplace interventions prevent low-back disorders? If so, why?: a methodologic commentary. Ergonomics 1999;42:258–72. https://doi.org/10.1080/001401399185937.

[13] Kaplansky BD, Wei FY, Reecer MV. Prevention strategies for occupational low back pain. Clin Occup Environ Med 2006;5:529–44. https://doi.org/10.1016/j.coem.2005.11.018.