Review Article

Work-related musculoskeletal disorders and related risk factors among bakers: A systematic review

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Abstract

\textbf{BACKGROUND:} Work-related musculoskeletal disorders (WRMSDs) and ergonomic risk factors are very common in bakery workers.

\textbf{OBJECTIVE:} The purpose of this study is to (1) assess the prevalence of musculoskeletal disorders among bakers because they use automated machines or traditional baking, and (2) to determine the strategies to prevent musculoskeletal disorders in bakers.

\textbf{METHODS:} A systematic review of PubMed, Scopus, and Web of Science was conducted from the beginning to February 4, 2022, based on the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines. Mesh keywords and phrases were used to execute the search strategy. Information on MSDs and ergonomic risk factors in bakery workers was collected. Two reviewers worked independently on study selection, data extraction, and paper quality ranking.

\textbf{RESULTS:} This study identified 14 papers from seven countries. Although the prevalence of MSDs in bakery workers has been studied, only a handful of them have been studied ergonomic risk factors, and the findings have been very limited. The association between different risk factors and MSDs seemed significant compared to many other occupational diseases. The traditional bread-baking system and lack of mechanization may increase the risk of MSDs in bakery workers.

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CONCLUSION: WRMSDs for bakery workers have been less studied than other occupational diseases. Our systematic review found several significant relations between the factors influencing the prevalence of MSDs. This study also showed the comparison of traditional and modern cooking systems with diseases of the upper limbs, shoulders, and back pain as possible fields for future research.

Keywords: Occupational disease, ergonomics, food industry, bakery workers, disease, back pain

1. Introduction

The daily increase in occupational accidents and diseases is rooted in the lack of attention to ergonomics in the workplace. One of the key goals of ergonomics and the ergonomic process is to conform people’s work methods and activities within the framework of abilities and limits. The main purpose of ergonomics in the workplace is to create fit and adapt environmental conditions for humans [1]. If repetitive work activities are conditions of the profession that exceed the abilities of the worker, such activities cause harm. Repetitive trauma to the limbs is a cumulative effect that progresses over time and ultimately manifests itself as musculoskeletal disorders.

According to the National Institute for Occupational Safety and Health (NIOSH), work-related musculoskeletal disorders (WRMSDs) are disorders or injuries that affect a part of the body’s musculoskeletal system, which includes bones, nerves, tendons, ligaments, joints, cartilage, and blood vessels in the arms, legs, head, neck, or back. Their symptoms include soft tissue discomfort, insensitivity, stiffness, edema, tiredness, impatience, and a lack of control [2]. WRMSDs are common in many occupations, including office workers [3], industry workers [4], and healthcare workers [5] worldwide. WRMSDs are one of the most common and costly occupational disorders in the world [6]. These multifactorial disorders [7] can be exacerbated in the workplace as a result of acute trauma [8]. Disorders caused by occupational risk factors can cause symptoms such as chronic pain, discomfort, injury, tingling, persistent pain in the limbs, and general disability of body structures [9, 10]. Upper limb stabilization exercises such as neck stabilization can have significant effects in reducing pain and relieving chronic non-specific neck pain [11].

Ergonomists consider repetitive motion injuries (RMIs) to be one of the most important factors in increasing the risk of MSDs [12]. MSDs account for 44% of work-related compensation and cost about $45 million to $54 million a year, according to a recent U.S. Census Bureau report [13]. In the United Kingdom, the average prevalence of WRMSDs in all industries was 1,130 per 100,000 workers in the period 2018-2021. This includes 212,000 (45%) cases in which the upper limbs or neck were affected between 2020 and 2021 [14]. The most common types of WMSDs among workers in 28 European Union countries (EU-28) included low back pain and muscle pain in the upper limbs (43% and 41%, respectively) in 2015 [15]. Ergonomists can identify the points of failure by direct observation and by studying statistics and documents or inquiries, and by applying an experimental design and evaluating them, new decisions can be made to improve the situation [16].

According to the USDA report in Fig. 1, China, the European Union, and India are the largest consumers of wheat in the world in 2021-2022. Most of this wheat consumption includes baking bread in the food industry. The baking of bread is done according to the traditions of different ethnic groups and special nutritional patterns, and a large number of bakers work in this industry.

Bread is considered a very important food in countries and its daily consumption is impressive. In Iran, Egypt, India, Lebanon, Indonesia, Taiwan, Egypt, Ecuador, and other countries around the world, traditional bakeries make bread in various methods (Fig. 2).

Among the food industry, the highest rate of WMSDs worldwide has been consistently reported among small-scale bakers [17, 18]. A bakery is one of the occupations in which workers do a lot of physical activity and repetitive movements during their work shifts. Job fatigue during manual handling of cargo is also known as another risk factor for musculoskeletal disorders in bakers. A manual training program in material handling should be used in this profession [19].

Bakery workers face a variety of occupational diseases, including respiratory illnesses [20, 22], heat illnesses [23, 24], and sometimes incurable diseases, and are constantly exposed to extreme stress. Musculoskeletal disorders are common in bakers and similar occupations such as flour production workers in the...
waist, arms, and shoulders [25]. Lifestyle [26] and workplace conditions such as organizational factors, psychological stress [27], and shift work [28] can threaten the health and well-being of workers and lead to WRMSDs.

By reviewing the bakery WRMSD literature and background studies, it is possible to assess the prevalence and ergonomic risk factors in this profession. This research is significant in two ways: 1. It provides comprehensive information about musculoskeletal disorders in bakers. 2. Expresses new solutions for the bakery profession to prevent and reduce musculoskeletal disorders. The main question of the study is, based on the type of bread, and the use of automated machines or traditional baking, what is the prevalence of musculoskeletal disorders in bakers? We are also seeking strategies to prevent musculoskeletal disorders in bakers. The dimensions and factors revealed in this study can be used as a guide in future studies.
A systematic review of the prevalence of musculoskeletal disorders has been performed in many occupations, including drivers [29], nurses [30], school teachers, dental professionals [31], and farmers [32]. Therefore, musculoskeletal disorders in bakers must be also evaluated. In this regard, the present study was conducted to investigate the prevalence of WRMSDs among bakers and identify ergonomic risk factors affecting the occurrence of these disorders.

2. Methods

2.1. Search strategy

This is a systematic review of the prevalence of WRMSDs in bakers based on papers published in domestic and foreign journals without a time limit (from the beginning February 4, 2022). All papers were collected in journals in international databases including Web of Science, PubMed, and Scopus as well as the Google Scholar search engine and other indexes. The current study was conducted in several stages, including accurate determination of the problem, collection, analysis, and interpretation of the findings. The Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines were followed [33]. Papers were searched with appropriate Persian keywords and English equivalents (MeSH term) using a combination of AND and OR operators. The search process keywords are given in Table 1.

2.2. Entry and exit criteria

The main criterion for including papers in this study was MSDs in bakers. Exclusion criteria were also studies that only had abstracts, letters to the editor or conference, and papers in local languages of each country and without a full English text, with the exception of the Persian language.

For papers whose full text was not available, authors were contacted by e-mail to receive the full text. To prevent bias, research, selection of studies, quality evaluation, and data extraction were performed by two researchers independently.

2.3. Data extraction

After determining the relevant reviews, the selected papers were evaluated by the researchers using the PRISMA checklist. A datasheet was prepared to include the names of the authors, year of publication, place of the study, sample size, and most important findings. After evaluating the quality of the papers using a checklist and criteria considered by the researcher, which included the availability of variables examined by the checklist in the papers, 14 suitable papers were included in the study. Figure 3 shows the number of papers searched and reviewed.

3. Results

178 articles were found in the databases. 104 articles were excluded due to duplication and 14 articles due to non-relevance. After the full review of the articles, 14 articles related to the study topic that was selected for the final review were included in the research. Their results are explained in Table 2, focusing on several topics, description of risk factors found in each article, report pain areas and pain prevalence, intervention and intervention results. The final selected articles were all research articles. Regarding

<table>
<thead>
<tr>
<th>Table 1</th>
<th>Search process information from databases</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of searches</td>
<td>Search term</td>
</tr>
<tr>
<td>S1</td>
<td>musculoskeletal disorder* OR musculoskeletal injury* OR musculoskeletal discomfort*</td>
</tr>
<tr>
<td>S2</td>
<td>bakery* OR bakery* workers* OR food industry*</td>
</tr>
<tr>
<td>S3</td>
<td>food-baking OR small-sized industry OR bakery business</td>
</tr>
<tr>
<td>S4</td>
<td>risk factors* OR prevent* OR interventions</td>
</tr>
<tr>
<td>S5</td>
<td># S1 AND # S2 AND # S3 AND # S4</td>
</tr>
</tbody>
</table>
Working in a bakery is associated with exposure to physical loads during the production process of bakery products, which affects the risk of WMSDs. Bakers are prone to musculoskeletal disorders due to their daily tasks, which involve a lot of repetitive movements [8]. These risk factors are due to some organizational characteristics such as incorrect work-rest cycle, high speed of work (or tasks, the speed of which is determined by the machine), long duration of work, unknown jobs, lack of variety in work, receiving wages based on the number of breads produced, and other related factors are exacerbated. The most common types of diseases and adverse effects of the work environment in bakers are heat stress [23], respiratory diseases [34], mental workload [35], and most importantly MSDs that lead to reduced productivity, efficiency, and disability. While WMSDs are common among workers, bakers are more likely to develop a work-related musculoskeletal disorder than workers in other occupations because their jobs are often physically arduous. Baker-related MSDs include back pain, shoulder pain, recurrent compression injuries, and joint pain that impedes movement.

Fig. 3. Strategy flow chart of systematically reviewed studies.
Table 2
General information on selected studies in the present study

<table>
<thead>
<tr>
<th>Author and year</th>
<th>Country</th>
<th>Type of study</th>
<th>Number of samples</th>
<th>Intervention or measurement method</th>
<th>Pain areas (prevalence)</th>
<th>Risk factors</th>
<th>Evaluation</th>
<th>Results</th>
</tr>
</thead>
<tbody>
<tr>
<td>Joudakinia et al. (2021)</td>
<td>Iran</td>
<td>Cross-sectional</td>
<td>20</td>
<td>No intervention</td>
<td>The neck and the back</td>
<td>Improper position of neck and back of bakers while baking bread</td>
<td>Working postures and movements of the back and neck during work were continuously recorded with inclinometry measurements during three hours</td>
<td>Physical workload in bakers was characterized by awkward postures and the percentage of time spent with the neck flexed more than 20°. Besides, low angular velocity and lack of postural variation during baking shows that bakers' back is in the static position and bakers have to work with constrained back for a long time.</td>
</tr>
<tr>
<td>Beheshti et al. (2021)</td>
<td>Iran</td>
<td>Cross-sectional</td>
<td>Not reported</td>
<td>No intervention</td>
<td>The shoulder/arm, wrist, the hand, head/neck, and the back</td>
<td>Biomechanical risk factors (force, posture, repetition, duration) and additional factors during bread baking</td>
<td>ART (assessment of repetitive tasks) and OCRA Index (Occupational Repetitive Actions)</td>
<td>The correlation between the results of the OCRA index (Occupational Repetitive Actions) and the ART method (assessment of repetitive tasks) in determining the ergonomic status of workers was statistically significant.</td>
</tr>
<tr>
<td>Lakshmi et al. (2021)</td>
<td>India</td>
<td>Cross-sectional</td>
<td>15</td>
<td>No intervention</td>
<td>The shoulder (40%), the neck, and the arm (33.3%)</td>
<td>Improper posture in standing and bent positions</td>
<td>Interview and Checklist</td>
<td>Most musculoskeletal disorders were in the tasks of mixing, cooking, and packaging.</td>
</tr>
</tbody>
</table>

(continued)
<table>
<thead>
<tr>
<th>Author and year</th>
<th>Country</th>
<th>Type of study</th>
<th>Number of samples</th>
<th>Intervention or measurement method</th>
<th>Pain areas (prevalence)</th>
<th>Risk factors</th>
<th>Evaluation</th>
<th>Results</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nourollahi et al. (2020)</td>
<td>Iran</td>
<td>Cross-sectional</td>
<td>57</td>
<td>No intervention</td>
<td>The right shoulder (66%) and the left shoulder (64%)</td>
<td>Work in long time</td>
<td>The Nordic Musculoskeletal Questionnaire (NMQ) and Visual analogue scales (VAS)</td>
<td>Organizational factors in bakery work such as increased work speed and insufficient rest in combination with biomechanical factors for arms and their significant effect on muscle tension in the shoulder area.</td>
</tr>
<tr>
<td>Chen et al. (2020)</td>
<td>Taiwan</td>
<td>Cross-sectional</td>
<td>87</td>
<td>No intervention</td>
<td>The right hand/wrist (66.3%), left hand/wrist (51.8%), right shoulder (50.6%), left shoulder (45.8%) and lower back (48.2%)</td>
<td>The use of a rolling pin Non-matching of anthropometric dimensions of bakers with tools, age, and moving the load.</td>
<td>The Nordic Musculoskeletal Questionnaire (NMQ) and Electro goniometer</td>
<td>Frequent turning of the hand/wrist causes symptoms of skeletal-muscular disorders in bakery workers.</td>
</tr>
<tr>
<td>Habib et al. (2019)</td>
<td>Lebanon</td>
<td>Cross-sectional</td>
<td>504</td>
<td>No intervention</td>
<td>The upper regions (23%)</td>
<td>High physical workload, psycho-social factors</td>
<td>The Nordic Musculoskeletal Questionnaire (NMQ)</td>
<td>Somatization was positively associated with upper extremity musculoskeletal pain (OR = 1.51; 95% CI = 1.22–1.86).</td>
</tr>
<tr>
<td>Carrera et al. (2019)</td>
<td>Ecuador</td>
<td>Cross-sectional</td>
<td>119</td>
<td>No intervention</td>
<td>The upper body areas Improper workstation design in 3 tasks: kneading, cooking, and packing</td>
<td>The Rapid Entire Body Assessment (REBA) and repetitive OCRA (Occupational Repetitive Actions) Checklist</td>
<td>The high-risk level in terms of percentage with forced postures according to the REBA method was equal to 11.1% and according to the OCRA method (Occupational Repetitive Actions), it was equal to 39% in the areas affected by trunk, neck, arms, and wrists.</td>
<td></td>
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<tr>
<td>Bidiawati et al. (2018)</td>
<td>Ecuador</td>
<td>Cross-sectional</td>
<td>*</td>
<td>No intervention</td>
<td>The right arm, shoulders, and upper body Lots of repetitive movements</td>
<td>REBA and Occupational Repetitive Actions (OCRA)</td>
<td>Designing and making a tool that is in the form of a trolley rack. This trolley made of iron uses the anthropometric data of the worker’s body and conforms to the ergonomic rules.</td>
<td></td>
</tr>
<tr>
<td>Study</td>
<td>Country</td>
<td>Study Design</td>
<td>Sample Size</td>
<td>Intervention</td>
<td>Main Findings</td>
<td>Methodology</td>
<td>Key Risk Factors</td>
<td></td>
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<tr>
<td>------------------------------</td>
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<td></td>
</tr>
<tr>
<td>Motamedzade et al. (2017)</td>
<td>Indonesia</td>
<td>Cross-sectional</td>
<td>30</td>
<td>No intervention</td>
<td>The back (92.68%), knee (80.49%), shoulder (30.95%), forearm (19.26%), and wrist (26.19%)</td>
<td>Improper posture, hand carrying loads, twisting and bending of the body</td>
<td>Nordic Body Map (NBM questionnaire) and Occupational Repetitive Actions (OCRA)</td>
<td></td>
</tr>
<tr>
<td>Beheshti (2015)</td>
<td>Iran</td>
<td>Cross-sectional</td>
<td>129</td>
<td>No intervention</td>
<td>The right and left hand</td>
<td>The intensity and duration of applying force and the high speed of work during bread baking</td>
<td>The Nordic Musculoskeletal Questionnaire (NMQ), Visual Analogue Scale and ACGIH-HAL</td>
<td></td>
</tr>
<tr>
<td>Khamirchi et al. (2015)</td>
<td>Iran</td>
<td>Cross-sectional</td>
<td>*</td>
<td>No intervention</td>
<td>The shoulder 58.6% and wrist 45.45%</td>
<td>Standing posture, repetitive posture of sticking bread into the oven</td>
<td>The Nordic Musculoskeletal Questionnaire (NMQ), Occupational Repetitive Actions (OCRA)</td>
<td></td>
</tr>
<tr>
<td>Beheshti (2014)</td>
<td>Iran</td>
<td>Cross-sectional</td>
<td>70</td>
<td>No intervention</td>
<td>Pain in the neck, back, and hands</td>
<td>Non-compliance of bakery worker’s workstations with ergonomic principles</td>
<td>Rapid Upper Limb Assessment (RULA) and the Nordic Musculoskeletal Questionnaire (NMQ)</td>
<td></td>
</tr>
<tr>
<td>Mehrizi et al. (2014)</td>
<td>Iran</td>
<td>Cross-sectional</td>
<td>423</td>
<td>No intervention</td>
<td>Back, knee, and hand/wrist</td>
<td>Long working time and lack of suitable work tools that conform to ergonomic principles</td>
<td>Occupational Repetitive Actions (OCRA) and the Nordic Musculoskeletal Questionnaire (NMQ)</td>
<td></td>
</tr>
<tr>
<td>Ghamari (2009)</td>
<td>Iran</td>
<td>Cross-sectional</td>
<td>232</td>
<td>No intervention</td>
<td>The knee, 62.2%, back (58.8%), and legs (53.9%)</td>
<td>Bending, turning, and combined positions with longer duration during bread baking</td>
<td>The Open Web Application Security Project (OWASP) and the Nordic Musculoskeletal Questionnaire (NMQ)</td>
<td></td>
</tr>
</tbody>
</table>

*Not reported.*
The bread-baking system in the included studies includes the countries of Iran, India, Ecuador, Lebanon, Indonesia, and Taiwan. In Iran, the most common types of bread include Lavash, Barbari, Sangak, Taftoon, and types of fancy bread, which are baked in both traditional and semi-mechanized ways. The method of baking Sangak bread is that after making the sourdough, the workers spread the dough inside the oven with a special paddle. The oven of the Sangak bread baking system is a dome-shaped space of 5x4 meters, the floor of which is covered with pebbles. In the oven bread baking method, workers knead the dough and bake it in the oven. In the case of Lavash and Taftoon cooking systems, the oven is almost semi-mechanized and consists of a plate that is rotated by a conventional rotary device. In this device, the heat required for cooking is provided by two burners with the direct and indirect flame from below and above the cooking surface. In the Taftoon cooking system, the oven is made of clay with a tile surface and is available in two ways: buried in the ground and installed at a height. The type of bread consumed in India is millet. By roasting and grinding millet, workers mix flour with salt, yeast, spices, sugar, and other ingredients to prepare the dough and bake in the oven, which is finally made into bread, cakes, rolls, etc. In Taiwan, it is a type of oven bread, and bakery workers bake it in the oven after three stages of kneading, rolling, and rounding the dough. Also, in Lebanon, it is a type of oven bread, and bakery workers bake it in the oven after kneading the dough. In Ecuador, the daily diet consists mainly of bread, the staple food that is part of the traditional diet, usually cooked with a paste made of flour, salt, water, and additives. Table 3 shows the tools used in baking bread, the specific problems of traditional bread baking, and the ergonomic situation of bakers in forced labor at different heights.

4. Discussion

4.1. Bread baking system

In today's world, foods related to nutrition patterns are produced with a combination of high-consumption grains such as wheat, rice and millet. These products are not only valuable food but also are very important in maintaining people's health. In many countries, bread is baked in small industrial units with semi-mechanized machines or traditional methods. In Iran, the bread industry is very extensive, and different types of bread are baked in a traditional and machine way. Bakers and bakery workers perform tasks such as mixing flour, making dough, adding yeast, processing, and baking. In general, different methods of baking common bread are offered and consumed according to the customs and traditions of each community. India has the highest demand for millet grain food and is, therefore, the largest producer of millet in the world. In Iran, traditional bread has different types due to the variety of baking methods (table 3). Among them are Taftoon bread with a rotating machine and a tandoor oven, Sangak bread, and baguette bread, but the way of baking bread is different from each other. In the study by Nourollahi-Darabad et al. [39], types of bakers were classified including Lavash tandoor oven, Sangak and Taftoon. It is estimated that about 90,000 traditional bakeries and about 1.5 million full-time and part-time workers work in traditional bakeries in Iran. Bread production has a long history in Iran. Due to the inseparable connection of the Iranian people with bread, an increasing variety of this healthy and nutritious food is prepared and consumed throughout the country [40].

4.2. Ergonomic risk factors

In the study by Nourollahi-Darabad et al. [39], the highest prevalence of musculoskeletal symptoms was reported among bakers in the right and left shoulders (66% and 64%, respectively). In the process of baking bread, bakers use their right hands to lift and place the dough in a traditional oven using a bread paddle. In such situations, bakers are exposed to a combination of physical risk factors such as poor posture, excessive force, and repetitive movements in the shoulder area. The results showed that Sangak bakery workers were exposed to higher levels of extreme conditions and angular rotation speed compared to Taftoon and Tandoor oven bread bakery workers. In the study by Joudakinia [17], the MSDs of bakers in four traditional bread baking systems (Sangak, Lavash, Taftoon, and Tandoor oven bread) in Iran were investigated. In this study, bakers spent an average of 18.2% of their working time with a curved trunk of more than 20 degrees. The highest and lowest percentage of time spent in inappropriate postures in the neck area (20%) were measured in bakers working in the tandoor oven bread (23%). Medium angle velocity was measured among bakers for the neck area at 30 degrees per second. High physical workload and high amount of time spent in the
Table 3
The tools used in baking bread, the specific problems, and Forced work at different heights

<table>
<thead>
<tr>
<th>Type of bread</th>
<th>Country</th>
<th>Bread baking system</th>
<th>Tools used</th>
<th>Special difficulties in manual work</th>
<th>Forced work at different heights</th>
<th>Picture</th>
</tr>
</thead>
<tbody>
<tr>
<td>Millet</td>
<td>India</td>
<td>Traditional</td>
<td>Mixers, ovens, dough maker</td>
<td>Exposure to heat stress, burning eyes, pain in the neck and hands</td>
<td>Neck and hand</td>
<td>From Nourollahi et al. [39]</td>
</tr>
<tr>
<td>Sangak</td>
<td>Iran</td>
<td>Traditional</td>
<td>Measure cup, scales, mixers, ovens, dough and dough spreader</td>
<td>Exposure to heat stress, burning eyes, slipping and discomfort, sneezing, pain in the neck, hips, upper leg, lower leg, ankle and foot.</td>
<td>Neck, hips, upper leg, lower leg, ankle and foot</td>
<td>From Nourollahi et al. [39]</td>
</tr>
<tr>
<td>Tanoori</td>
<td>Iran</td>
<td>Traditional</td>
<td>Measuring cup, scale, mixer, oven, and surface for spreading bread</td>
<td>Exposure to heat stress, burning eyes, pain in the neck, and legs</td>
<td>Neck and legs</td>
<td>From Nourollahi et al. [39]</td>
</tr>
</tbody>
</table>

(continued)
<table>
<thead>
<tr>
<th>Type of bread</th>
<th>Country</th>
<th>Bread baking system</th>
<th>Tools used</th>
<th>Special difficulties in manual work</th>
<th>Forced work at different heights</th>
<th>Picture</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lavash and Taftoon</td>
<td>Iran</td>
<td>Semi-mechanized</td>
<td>Measuring cup, rolling pin, leveler, mixer, oven, dough spreader</td>
<td>Exposure to heat stress, eye irritation, pain in the neck, hands and feet</td>
<td>Neck, hands and feet</td>
<td>From Joudakinia [17]</td>
</tr>
<tr>
<td>Taftoon</td>
<td>Taiwan</td>
<td>Traditional</td>
<td>Rolling pin, measuring cup, scale, mixer, oven, kneader and dough spreader</td>
<td>Exposure to heat stress, burning eyes, pain in the neck, hips, hands, legs, ankles and feet</td>
<td>Neck, hips, hands, legs, ankles and feet</td>
<td>From Chen [41]</td>
</tr>
<tr>
<td>Tanoori</td>
<td>Lebanon</td>
<td>Traditional</td>
<td>Measuring cup, scale, mixer</td>
<td>Exposure to heat stress, pain in the neck, hands and feet</td>
<td>Neck, hands and feet</td>
<td></td>
</tr>
<tr>
<td>Tanoori</td>
<td>Ecuador</td>
<td>Traditional</td>
<td>Measuring cup, mixer, oven</td>
<td>Exposure to heat stress, pain in the neck, hands and feet</td>
<td>Neck, hands and feet</td>
<td></td>
</tr>
</tbody>
</table>
traditional bread-baking system are the most important ergonomic risk factors. In the study by Chen [41], the overall prevalence of MSDs in any part of the body during the year was 93.0% among 81 bakers in Taiwan, with the highest prevalence in the wrist (66.3% on the right and 51.8% on left), and shoulders (50.6% on the right and 45.8% on the left). Repetitive movement in the wrist (changes in wrist movement and maximum range of motion during kneading, rolling, and rounding of dough) has been reported as one of the most important ergonomic risk factors in bakers. The findings of Chen et al.’s study can also be used to explain why bakers report a high proportion of wrist and shoulder disorders and can be used as a reference for rescheduling and redesign [41]. In the study by Tajvar et al., MSDs are more common among bakery employees than in the general population of the country. Based on the results of this study, the type of bakery, type of work, and work experience have a significant effect on the prevalence of cumulative trauma disorders in the four regions of the neck, shoulders, hands/wrists, and waist [42]. In the study by Ghamari et al., MSDs of the neck, shoulders, elbows, and knees showed a significant relationship with work experience [38]. In the study by Carrera et al., poor posture and poor job design ergonomic risk factors were mentioned and could be considered potential risks for MSDs in the upper extremities [43].

4.3. Solutions and recommendations

Traditional baking of bread can cause chronic and uncomfortable pain in the upper limbs, back, and shoulders. The bakery is one of those jobs that require a stand for a long time, so these jobs are also prone to MSDs. Repetitive hand activities combined with force, inappropriate posture, high mobility, and repetition of tasks during the baking process can increase the likelihood of upper extremity disorders in bakers. Therefore, it can be said that the baking profession is one of the professions in which the risk of cumulative disorders due to trauma is high, especially in the three areas of the back, shoulders, and hands/wrists.

All activities that affect and burden these areas need to be identified and modified. Therefore, the prevention of these disorders in the workplace and the elimination of risk factors associated with them should be considered. Therefore, to improve the status quo, it is best to use ergonomic control methods, which are considered to be the most important part of the ergonomics program, and the effect of lowering the WRMSDs rate has been proven so far. The first and best way to reduce or even eliminate WRMSDs is to redesign the entire baking system and how to bake bread in a traditional oven. The results of the current review showed that workers in the traditional and semi-mechanized systems of bread baking in developing countries are exposed to more biomechanical risk factors compared to the mechanized system.

In the mechanized system, the pressure of physical activities of the person has been reduced. However, the prevalence of skeletal-muscular injuries due to the inappropriate physical condition of bakery workers, who traditionally perform several frequent activities in the bread baking system, has been reported in the four areas of the neck, shoulder, waist, and hand at a higher rate than in other areas.

Some suggested strategies to reduce musculoskeletal disorders in bakery workers are considering rest time during working hours, adjusting the height of the oven to prevent excessive bending of the baker, redesigning the entire traditional bread baking system, considering the work table suitable for the work needs and physical dimensions of the bakers, and using anti-slip flooring. Use of anti-fatigue flooring, using proper and ergonomic tools such as an ergonomic cutter when cutting the dough, and training bakers about skeletal-muscular disorders and their prevention methods. Considering a suitable work desk with the work needs and body dimensions of the baker, using anti-fatigue flooring, using an electric shutter machine, using suitable and ergonomic tools such as using an ergonomic spatula when cutting the dough in a baguette bakery, training bakers (on MSDs and methods to prevent) and using management methods such as taking into account work rotation or placing short breaks between long work meals.

With the advancement of technology and the expansion of the bread-baking machine industry in industrialized countries, the prevalence of MSDs in bakers is expected to decrease significantly. However, traditional bread baking is still widespread in developing countries, and being in poor working conditions is an ergonomic risk factor that is an important reason for accelerating the development of these disorders.

4.1. Limitations

In the present systematic review, several limitations must be considered when interpreting the findings. One of them is not including written studies
in languages other than English and Persian. This may indicate bias, and it is always possible that some studies have been missed, even if extensive text searches have been performed. Second, there is insufficient data to make definitive conclusions about ergonomic risk factors and musculoskeletal disorders in bakers, as there can be many other factors, including psychosocial factors that negatively affect the musculoskeletal system. The third was the lack of valid and reliable assessment tools in most studies. No studies have been found in other countries that have mechanized the baking system, and it is not possible to say how widespread WRMSDs are among these bakers. Another methodological limitation was that 4 studies were not included because the full text was not available online.

5. Conclusion

Several tasks and activities are performed manually using the physical force of the worker in traditional systems. In the traditional system, workers are exposed to biomechanical risk factors and other contributing factors to the occurrence of WRMSDs, and it is natural that under such conditions, these disorders are more prevalent and incident. The results showed that the several tasks and activities of bakers during the day can be a factor in the prevalence of MSDs. Musculoskeletal disorders in bakers are associated with different parts of the body, including shoulders, hands, wrists, elbows, neck, upper back, and hips. However, the evidence is somewhat limited, as these data are generally from low-quality cross-sectional and intervention studies. A better explanation of risk factors unrelated to the prevalence of WRMSDs in bakers requires a lower risk bias and higher-quality prospective studies.

Ethics statement

No ethical issues, including plagiarism, misconduct, data fabrication and/or falsification, double publication and/or submission and redundancy, have been reported by the authors. Due to the nature of the study, informed consent and ethical approval were not necessary and thus not obtained.

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Conflicts of interest

The authors declare that there is no conflict of interest.

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