Investigating Musculoskeletal Disorders and Risk Factors in Selected Bakeries: A Case Study in Sylhet Bangladesh

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Abstract

Bakery is a major and important business in Bangladesh. By addressing the global concern of musculoskeletal disorders (MSDs) in the workplace, with a specific focus on their impact on bakery workers, who face heightened risk due to the physically demanding nature of their tasks. The study, conducted in Sylhet, Bangladesh, delves into the prevalence of MSDs and their associated risk factors within a selected bakery. It systematically explores the frequency of MSDs among bakery workers, emphasizing regions such as the back, shoulders, hands, wrists, and knees etc. Furthermore, it investigates the connection between occupational risk variables. A questionnaire-based interview was conducted to collect data from determined sample size as it was a cross-sectional study. Data were analysed using SPSS 26.0 version software and Microsoft Excel. The Chi-square test was employed to determine the significant association between multiple parameters and several musculoskeletal effects during various production operations Findings revealed distinct pain patterns across various job categories, with cleaning workers experiencing higher rates of neck and lower back pain, while dough preparation staff reported elevated shoulder and wrist/hand pain. Age emerged as a significant factor, impacting the nature of discomfort among younger and older workers. These findings stress the need for proactive measures to address the prevalence of MSDs and improve workplace conditions in the bakery industry.

Keywords
Musculoskeletal disorders, Bakery workers, Occupational health, Ergonomic assessment

1. Introduction
Musculoskeletal disorders form a significant source of morbidity within the workforce (Bernard 1997; Lang et al. 2012; Woolf & Pfleger 2004). Globally, a large amount, over 40%, of workplace-related injury and illness expenses are ascribed to musculoskeletal problems (Abledu et al. 2014; Sharples & Shorrock 2014). This problem has been identified as ubiquitous across both low- and high-income nations (Choobineh et al. 2009; Shahnavaz 1987). In high-income countries, approximately 30% of the workforce contends with working conditions that either trigger or exacerbate musculoskeletal issues, while in Global South countries, this percentage rises to an alarming 50% to 70% (Kang et al. 2014; Landry et al. 2008). Notably, musculoskeletal discomfort has been observed across numerous occupational categories, including industrial employees, clerks, data processors, and bakery workers, underlining its pervasive impact (Idler & Benyamini,1997; Melhorn 1998).

Given its pervasiveness, musculoskeletal discomfort presents a serious concern, resulting to chronic pain, absenteeism, and protracted impairment (Lang et al. 2012; Woolf & Pfleger 2004). The physical features of employment are well-established contributors to the occurrence of musculoskeletal discomfort. Rapid work pace, substantial physical workload, repetitive and forceful manual actions, extended periods in awkward postures, and exposure to whole-body vibration have all shown positive correlations with the occurrence of musculoskeletal pain (Neupane et al. 2013).

Over the past two decades, research into the relationship between psychosocial factors and the manifestation and severity of musculoskeletal pain has flourished, identifying these associations across diverse occupational contexts (Bongers et al. 2002; Neupane et al. 2013; Waters et al. 2007). Karasek (1979) job strain model presents a theoretical framework clarifying the link between occupational psychosocial pressures and musculoskeletal discomfort. In instances of high strain, typified by heightened levels of control, severe psychological and physiological effects,

including musculoskeletal discomfort, occur (Christensen et al. 2018; Huang et al. 2002; Karasek 1979). Research by Waters et al. (2007) has indicated that a combined impact of physical job elements and work-related stress leads to the occurrence of musculoskeletal problems. Furthermore, psychological distress has been connected with musculoskeletal pain, heightened pain severity, and multimodal pain experiences (Bongers et al. 2002; Smith et al.2004).

In the area of public health, self-rated health is commonly applied as a population-based metric for health status and morbidity, while self-reporting acts as a vital assessment tool for pain, somatization, and health beliefs (Coggon et al., 2017). The cultural predisposition to chronic non-specific musculoskeletal ailments within specific populations has demonstrated that individual risk is considerably influenced by a tendency to report and worry about common somatic symptoms (Carugno et al. 2012; Coggon, 2005; Coggon et al. 2013; Palmer et al. 2005). This inclination, known as "somatising tendency," can be gauged using select questions from the Brief Symptom Inventory (BSI) (Bergström et al., 2014) pertaining to symptoms such as faintness, dizziness, nausea, upset stomach, and difficulty (Coggon et al. 2013; Derogatis & Melisaratos 2012). Studies have underlined the relationship between somatization and the incidence of musculoskeletal complaints, even demonstrating that somatization is an independent risk factor for the persistence of musculoskeletal pain (Farioli et al. 2014).

1.1. Objectives
The objective of this study is to explore the associations between particular risk variables and the occurrence of musculoskeletal illnesses among bakery workers involved in several production tasks, including mixing, dough preparation, baking, packaging, and cleaning.

2. Literature Review
A series of studies conducted by different authors have examined musculoskeletal issues among bakery workers and proposed potential solutions. Bonsu et al. (2020) explored the exposure to occupational hazards and coping mechanisms among Ghanaian bakers. Chen et al. (2020) surveyed Taiwanese bakery workers and highlighted high prevalence rates of musculoskeletal discomfort, particularly in the hands and wrists. Sahu et al. (2013) found strenuous working postures among sweet makers, emphasizing the need for better workstation design. Nwachukwu & State (2023) assessed health accidents and knowledge of hazards among Nigerian bakery workers. Indriati et al. (2022) examined musculoskeletal disorders in corn noodle makers. Majid Motamedzade Torghabeh1, Javad Torkaman2, Seyed Qavamedin Attari3, Bahman Golzar Khojasteh4, Mohammad Ebrahim Ghafari5, (2018) studied traditional bread bakers in Hamadan, emphasizing the need for ergonomic interventions. Habib et al. (2019) conducted a national survey in Lebanon, revealing associations between work environment, somatization, and musculoskeletal pain. Sojobi et al. (2023) found a high prevalence of musculoskeletal pain among bakery workers in Nigeria and identified specific risk factors. Bidiawati et al. (2018) designed ergonomic tools to reduce musculoskeletal disorders in bread production. Wang & Lin, (2011) aimed to address musculoskeletal disorders through human factors engineering in the food and baking industry. Mehrizi et al. (2014) assessed cumulative trauma disorders and risk factors in different body zones among bakery workers. Peng et al. (2021) conducted a large-scale cohort study among food and beverage service industry workers in Taiwan, revealing elevated risks of musculoskeletal disorders.

Tan et al. (2021) examined the high prevalence of musculoskeletal disorders among pastry chefs in Malaysia and their work-related risk factors. Eivazi et al. (2012) investigated musculoskeletal disorders among traditional bread bakers in Iran, highlighting the importance of risk assessment. Javad Torkaman, (2014) evaluated the Örebro Musculoskeletal Pain Screening Questionnaire for predicting long-term sick leave and disability pension. Ekawati et al. (2022) explored the impact of work posture on musculoskeletal issues in bakery workers. Mohammad Hossein Beheshti, (2015) focused on biomechanical risk factors for musculoskeletal disorders in bakers. (Mehrizi et al., 2014) examined cumulative trauma disorders in various body zones among bakery workers. Peng et al. (2021) assessed gender-specific and site-specific risks of musculoskeletal disorders among food and beverage service industry workers. Denis et al. (2008) studied musculoskeletal health among supermarket employees, revealing a high prevalence of musculoskeletal disorders. Denis et al. (2008) also identified that bakers ranked among the groups most likely to experience musculoskeletal pain.

It summarizes that research is essential for understanding the unique challenges and MSD problem faced by bakery workers, such as the physical demands of their jobs and the need for ergonomic improvements. Various authors conducted research in different regions, highlighting high prevalence rates of musculoskeletal discomfort and the need for ergonomic interventions. The studies emphasize the significance of addressing the physical demands of bakery

work and the impact on worker health. Furthermore, the research underlines the importance of tailored interventions to improve workplace conditions, especially in semi-automatic industrialized bakery settings.

3. Methods

To ensure a systematic and successful outcome for the research, a well-defined research design is essential once the research problem is identified. This design incorporates various methodologies aimed at yielding productive research outcomes. The visual representation of the action plan is illustrated in Figure 1.
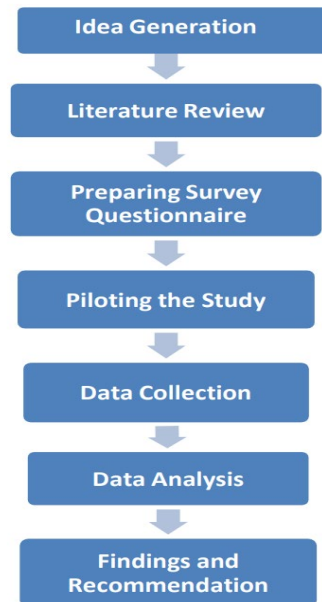

Figure 1. Action plan of this research.

A comprehensive exploration was conducted using the following search engines to gather relevant scientific publications concerning musculoskeletal disorders in bakery workers:

  i.   ResearchGate (https://www.researchgate.net/)
  ii.   Google Scholar (https://scholar.google.com/)
  iii.   ScienceDirect (https://www.sciencedirect.com/)
  iv.   PubMed (https://pubmed.ncbi.nlm.nih.gov/)
  v.   Springer (https://springer.com/)

Since it was a cross sectional survey study, a set of Nordic Musculoskeletal Questionnaire was utilized to collect data and then the data was analysed using Microsoft Excel and IBM SPSS (26th version). A Chi square test have also been done to identify significant associations between parameters.

4. Data Collection

Employing the survey method, data were gathered from specific factories located in Sylhet district, Bangladesh. The determination of the sample size was achieved using Slovin's formula, which considers the population size and a desired error margin of 5%. The sample size was found to be 212 out of 448 number of workers in three different Bakery factories. Participants were informed of the survey's purpose, and participation was entirely optional. The Nordic Musculoskeletal Questionnaire was utilized to collect data, and participants were interviewed.

5. Results and Discussion

5.1. Demographic Characteristics of The Respondents

The respondents in this study are primarily distributed across various job categories within the bread production industry. The majority of participants are engaged in "Dough Preparation" (43%), followed by "Packaging" (18%) and

"Ingredient Mixing" (16%). A notable portion of the workforce is also involved in "Cleaning" (11%) and "Baking" (12%). This distribution indicates a diverse representation of job roles in the industry (table 2).

The study includes a mix of both male (94%) and female (6%) workers. While males constitute the majority of the workforce, it's essential to recognize and consider the experiences and perspectives of female workers, who, although a smaller proportion, play a significant role in the industry.

Table 1. Demographic characteristics of the respondents.

Demographic Variables	Category	Frequency	Percentage%
Job Category	Cleaning	24	11
	Dough Preparation	92	43
	Ingredient Mixing	34	16
	Packaging	39	18
	Baking	25	12
Gender	Female	12	6
	Male	202	94
Age group	18-24	154	72
	Below 18	48	22
	Over 24	12	6
Height	Below 5 feet	19	9
	5 feet to 5 feet 8 inches	184	86
	More than 5 feet 8 inches	11	5

The age distribution of the respondents highlights that the majority fall within the "18-24" age group (72%), indicating that a significant portion of the workforce is relatively young. Additionally, "Below 18" (22%) and "Over 24" (6%) age groups are also represented. This distribution suggests that the industry attracts a range of age demographics, including young workers and those with more experience.

Respondents' height information reveals that the majority of workers (86%) fall within the "5 feet to 5 feet 8 inches" category. A smaller proportion, 9% of workers, are "Below 5 feet" in height, while 5% are "More than 5 feet 8 inches" tall. This data adds an additional dimension to the demographic characteristics, highlighting the height distribution among workers in the industry.

5.2. Distribution of Pains Among Workers
Table 2 offers a complete summary of the frequency distribution of occupational pains among bakery workers. This analysis is based on data received from the respondents in the survey, representing their experiences with various occupational health and injury categories.
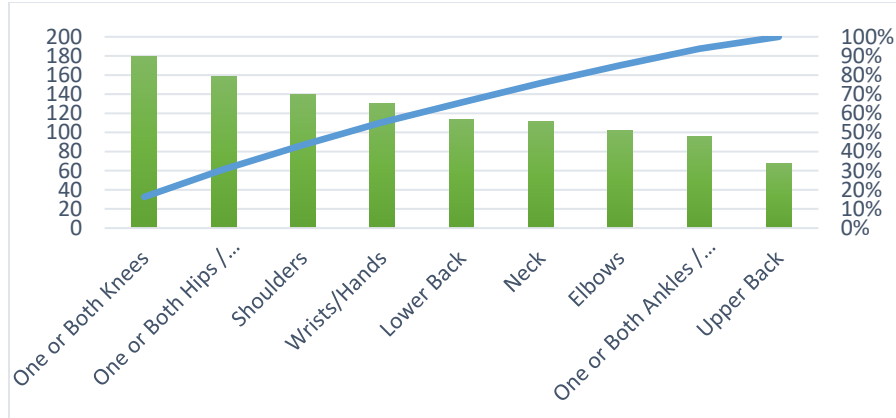
Figure 2. Frequency Distribution of occupational Pains.

The comparative findings among bakery workers reveal a substantial prevalence of musculoskeletal issues. Neck pain, affecting 10.11% of respondents, is the most widespread concern, indicating a significant problem in this occupation. Shoulder discomfort follows closely at 12.75%, emphasizing the physical demands bakery workers face, potentially leading to shoulder soreness. Elbow pain, reported by 9.29%, demonstrates a notable but slightly lower prevalence. Wrists and hand issues, impacting 11.84%, underscore the strain of repetitive manual tasks. Upper back discomfort at 6.19% and lower back pain at 10.38% show significant proportions experiencing these problems. Pain in one or both hips/thighs is a concern for 14.39% of bakery workers, and knee pain affects 16.30%, indicating a substantial incidence of knee discomfort. Finally, 8.74% report pain in one or both ankles or feet, signifying another sizeable fraction grappling with ankle and foot issues.

5.3. Distribution of occupational Musculoskeletal Pains over Job Category

In the analysis of musculoskeletal pain among bakery workers, several patterns emerge based on job categories. Neck pain is most prevalent among workers involved in cleaning and packaging, with rates of 79.2% and 56.4%, respectively, potentially due to postures or activities associated with these roles. Shoulder pain is notably high among those in dough preparation, at 73.5%, suggesting the demands of this task may contribute to shoulder discomfort. Elbow pain is most common among those engaged in ingredient mixing, with 61.8%, indicating that such activities may impact the elbow joint.
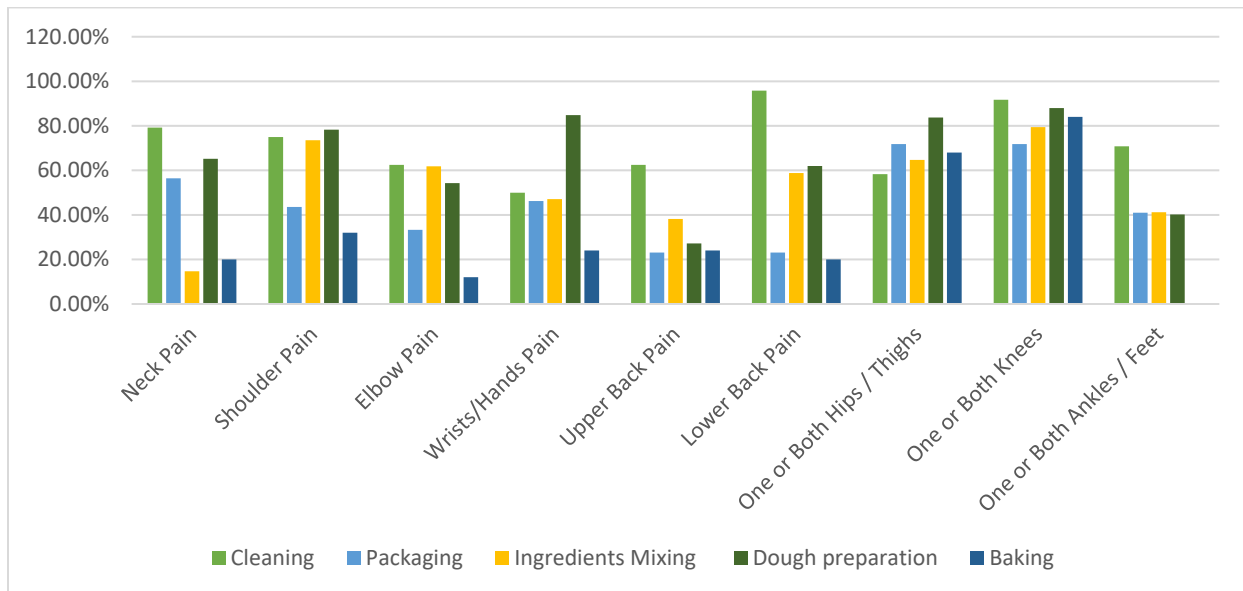

Figure 3. Occupational Musculoskeletal Pains over Job Category.

Workers in dough preparation also exhibit the highest prevalence of wrist and hand pain at 84.8%, likely due to the manual dexterity required for dough-related tasks. Cleaning workers report the highest prevalence of upper back pain at 62.5%, possibly linked to the physical demands of cleaning tasks. Lower back pain is most frequently reported by cleaning workers at 95.8%, emphasizing the strain associated with this job role. Dough preparation and baking employees experience a high percentage of hip and thigh pain, at 83.7% and 68.0%, respectively, indicating that the physical demands of these roles may impact the lower extremities. Knee pain is most prevalent among workers in dough preparation and baking, with rates of 91.7% and 84.0%, respectively, suggesting tasks in these categories may be associated with knee discomfort. Packaging workers report the lowest prevalence of ankle and foot pain at 41.0%, indicating that the tasks in this category may be less physically demanding on the lower extremities compared to other job roles.

5.4. Analysis Of Work Disruptions and Preventive Measures Among Bakery Workers in The Past 12 Months

The analysis of work disruptions and preventive measures among bakery workers in the last 12 months reveals several key findings. Approximately 34.1% of surveyed bakery workers reported experiencing neck and shoulder pain, with these issues equally prevalent across all job categories, highlighting the need for comprehensive interventions targeting these areas. Furthermore, 37.9% of workers reported elbow pain, and 49.5% reported wrist/hand pain, indicating the vulnerability of bakery employees to conditions in these areas, likely due to repetitive tasks. Upper back pain (46.3%) and lower back pain (32.2%) were also widespread, emphasizing the importance of addressing ergonomic aspects of bakery workstations and tasks to reduce the occurrence of back pain. Pain in hips/thighs (28%), knees (39.3%), and ankles/feet (44.9%) further underscores that musculoskeletal discomfort affects various parts of the body.
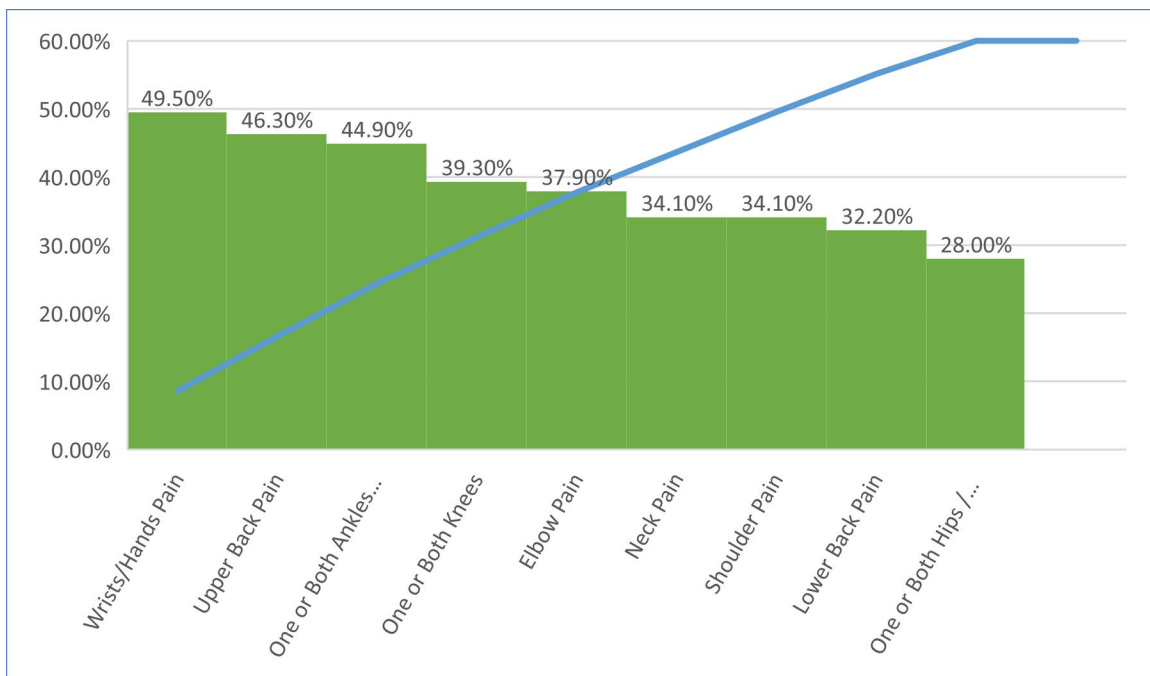

Figure 4. Analysis of workers who face disruptions while working in the past 12 months.

This data highlights a concerning prevalence of work-related pain and discomfort among bakery workers, necessitating proactive measures such as ergonomic improvements, regular breaks, and educational programs on safe work practices. Tailoring these interventions to specific job categories is crucial, ultimately enhancing worker well-being, productivity, and job satisfaction. In summary, the analysis emphasizes the need for a comprehensive approach to address work disruptions and preventive measures in the bakery industry.

5.5. Chi Square Test

This statistical test serves as a powerful tool to help unravel critical insights into the relationships between various categorical factors and the prevalence of musculoskeletal disorders (MSDs) among bakery workers. we will now analyse the findings presented in the table, focusing on the prevalence and analysis of musculoskeletal disorders (MSDs) among bakery workers, considering various factors such as job position, gender, age range, heights, and work fatigue.

The data-driven analysis of pain prevalence among bakery workers, based on chi-square tests, reveals valuable insights. Neck and shoulder pain exhibit high prevalence ($p < 0.001$), indicating these are widespread issues regardless of gender, age range, height, or work fatigue. Elbow pain, although less prevalent, is still significant ($p = 0.026$), suggesting some workers experience this discomfort.

Wrists/hands pain is highly prevalent ($p < 0.001$), and work fatigue is significantly associated ($p = 0.011$), implying that repetitive hand movements contribute to this issue. Upper back pain is also highly prevalent ($p < 0.001$) with no significant variation based on the factors considered. Lower back pain is statistically significant ($p = 0.003$) and is influenced by both gender ($p = 0.047$) and age range ($p = 0.032$).

One or both hips/thighs pain is highly prevalent ($p < 0.001$) and significantly associated with gender, age range, and work fatigue, indicating multiple factors contributing to this discomfort. Knee pain is significant ($p = 0.001$) but not influenced by other factors studied. No statistically significant associations were found with ankle/foot pain. This analysis underscores the multifaceted nature of workplace discomfort among bakery workers, with different types of pain showing varying prevalence and associations with demographic and work-related factors.

Table 2. Chi square test summary for determining association between the factors and different effects.

Effects	P values of respective factors				
	Job Position	Gender	Age Range	Heights	Work Fatigue
Neck Pain	<0.001	N/S	N/S	N/S	N/S
Shoulders Pain	<0.001	N/S	N/S	N/S	N/S
Elbows Pain	.026	N/S	N/S	N/S	N/S
Wrists/Hands	<0.001	N/S	N/S	N/S	0.011
Upper Back	<0.001	N/S	N/S	N/S	N/S
Lower Back	.003	.047	.032	N/S	N/S
One or Both Hips / Thighs	<0.001	.016	.433	N/S	0.001
One or Both Knees	.001	N/S	N/S	N/S	N/S

One or Both Ankles / Feet	N/S	N/S	N/S	N/S	N/S

The comprehensive analysis of bakery workers' demographics, pain distribution, job category-based musculoskeletal pain prevalence, work disruptions, and the results of chi-square tests provide critical insights. It's evident that neck and shoulder pain are highly prevalent across all demographics, indicating these are widespread issues irrespective of gender, age, height, or work fatigue. Elbow pain, although less common, still deserves attention as it can disrupt work routines. The high prevalence of wrist/hand pain, significantly associated with work fatigue, underscores the impact of repetitive hand movements on this discomfort. Upper back pain, like neck and shoulder pain, is highly prevalent across the board. Lower back pain, influenced by both gender and age, indicates that it's essential to tailor preventive strategies based on demographic characteristics. Hip/thigh pain, knee pain, and ankle/foot pain demonstrate that musculoskeletal discomfort affects various body parts, with various contributing factors, including job position, age, and work fatigue.

Overall, the findings highlight a multifaceted challenge of work-related discomfort among bakery workers. A comprehensive approach, encompassing ergonomic improvements, regular breaks, and education on safe work practices, tailored to specific job categories and demographic factors, is crucial to enhance well-being, productivity, and job satisfaction in the bakery industry. The results of the chi-square tests further underline the significance of these concerns, showing how they are distributed among different demographic and work-related factors.

6. Conclusion

In summary, this research effectively reached its purpose of studying the link between particular risk factors and musculoskeletal problems among bakery employees in diverse production positions. The study gives crucial insights into the well-being of these employees, stressing the prevalence of musculoskeletal disorders, notably neck and shoulder, hips/knee discomfort, across all worker groups. It also emphasizes that lower back pain is impacted by gender and age, highlighting the significance of personalized therapies and intermediate rest to reduce work fatigue.

Additionally, the data-driven approach, notably via chi-square testing, confirms the relevance of these results. This study not only shows the urgent need for comprehensive solutions in the cleaning sector but also emphasizes the complexity of worker discomfort. The research makes a unique addition by exposing the varying frequency of pain categories and their relationships with demographics and work-related variables. This information offers industry stakeholders with the knowledge to build more successful methods for boosting worker well-being, productivity, and job satisfaction.

Acknowledgements

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