

Invisible risks in women's labour in agriculture: Product-based assessment of seasonal and resident labour force in Turkey

Tarımda kadın işçiliğinde görünmeyen riskler: Türkiye'de mevsimlik ve yerleşik işgücünün ürün bazlı değerlendirmesi

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Abstract

This study examines the working conditions and occupational health and safety (OHS) risks faced by women workers in the agricultural sector in Türkiye, with a focus on the production, harvesting, and product processing stages, and adopts a product-based approach. A systematic literature review was conducted, focusing on annual (wheat, cotton, corn, tobacco, rice) and perennial (grape, fig, tea, hazelnut, orange, almond, walnut, rose) products. It was determined that women workers are exposed to severe physical (musculoskeletal disorders), chemical (exposure to pesticides and nicotine), biological (plant sap, insect bites), and climatic (heatstroke, dehydration) risks not only during the harvest process but also during the product processing stages. In addition to challenges such as access to adequate shelter, hygiene facilities, and health services, especially during seasonal migration, gender-based risks faced by women workers (sexual harassment, discrimination, poor hygiene conditions, reproductive health problems, and social exclusion) further exacerbate their health and safety vulnerabilities. In the study, concrete policy recommendations were presented for developing product-based protective measures, improving seasonal migration conditions, expanding health screenings, and integrating women workers into the social security system.

Keywords: Female Agricultural Labour, Occupational Health and Safety, Agricultural Sector, Seasonal Work, Product Processing Stage

Jel Codes: J16, J43, Q12, Q18

Öz

Bu çalışma, Türkiye'de tarım sektöründe çalışan kadın işçilerin üretim, hasat ve ürün işleme aşamalarındaki çalışma koşullarını ve maruz kaldıkları sağlık ve güvenlik risklerini ürün bazlı bir yaklaşımla analiz etmektedir. Araştırmada yıllık (buğday, pamuk, mısır, tütün, pirinç) ve çok yıllık (üzüm, incir, çay, fındık, portakal, badem, ceviz, gül) ürünler temelinde sistematik bir literatür taraması yapılmıştır. Kadın işçilerin yalnızca hasat sürecinde değil, ürün işleme aşamalarında da ciddi fiziksel (kas-iskelet sistemi zorlanmaları), kimyasal (pestisit ve nikotin maruziyeti), biyolojik (bitki öz suları, böcek sokmaları) ve iklimsel (sıcak çarpması, susuzluk) risklere maruz kaldıkları tespit edilmiştir. Özellikle mevsimlik göç sürecinde barınma, hijyen ve sağlık hizmetlerine erişim gibi ek zorlukların yanı sıra, kadın işçilerin maruz kaldığı cinsiyet temelli riskler (cinsel taciz, ayrımcılık, hijyen eksikliği, üreme sağlığı sorunları ve sosyal dışlanma) sağlık ve güvenlik durumlarını daha da kırılgan hale getirmektedir. Çalışmada, ürün bazlı koruyucu önlemler geliştirilmesi, mevsimlik göç koşullarının iyileştirilmesi, sağlık taramalarının yaygınlaştırılması ve kadın işçilerin sosyal güvence sistemine dahil edilmesi yönünde somut politika önerileri sunulmuştur.

Anahtar Kelimeler: Kadın Tarım İşçiliği, İş Sağlığı ve Güvenliği, Tarım Sektörü, Mevsimlik İşçilik, Ürün İşleme Aşamaları

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Introduction

The agricultural sector is of critical importance in Türkiye and worldwide, both in terms of economic production and employment. Within this production chain, women's labour has traditionally played a central role, participating in all stages, including land preparation, planting, maintenance, harvesting, and product processing (FAO, 2011). However, women's contributions are often rendered invisible and remain insufficiently recognised in terms of both occupational health and safety (OHS) risks and social protection mechanisms (Candan & Özalp, 2013). The existing literature particularly highlights the challenges faced by seasonal migrant women workers (such as access to shelter, sanitation, and healthcare services (Etiler & Kaşıkçı, 2016; Uyan-Semerci & Erdoğan, 2022) as well as specific health risks, including pesticide exposure or nicotine poisoning in tobacco farming (Arcury & Quandt, 2007; Dhananjayan & Ravichandran, 2018). Nevertheless, comprehensive comparative analyses that systematically examine risks across different product groups remain limited.

This gap is critical because risks are not homogeneous. For example, prolonged bending in tea and rice production increases musculoskeletal strain, while tobacco production exposes workers to nicotine poisoning; fig latex and orange oil cause dermatological problems; pesticide residues are prevalent in grapes and cotton; hazelnut harvesting involves biological risks through soil contact; and rose cultivation leads to pollen allergies and thorn injuries (WHO, 2020; Handal et al., 2025). While these risks are acknowledged in product-specific studies, the literature lacks integrative analyses that compare them systematically across annual and perennial crops, and that simultaneously incorporate gender-specific challenges.

The purpose of this study is to analyse the working conditions and OHS risks faced by women agricultural workers (resident or seasonal migrants) in Türkiye during production, harvest, and product processing stages, adopting a product-based perspective. Annual crops (wheat, cotton, corn, tobacco, rice) and perennial crops (grape, fig, tea, hazelnut, orange, almond, walnut, rose) are examined as separate categories. The risks encountered by women workers are classified under six headings: physical, chemical, biological, climatic, psychosocial, and gender-specific. This allows for a comprehensive evaluation of the health and safety challenges across both harvesting and processing stages.

The contribution of this study to the literature is threefold: (i) it provides a product-based comparative perspective that integrates fragmented approaches, (ii) it enriches the OHS literature by incorporating the dimension of gender and making women's invisible labour visible, and (iii) it generates policy-oriented recommendations that may inform the development of protective and socially inclusive strategies. In this way, the study aims to make women's agricultural labour visible, systematically analyse the risks they face, and contribute to social protection policies aligned with sustainable agrarian development goals.

Theoretical framework and literature review

Women constitute the backbone of agricultural production worldwide; however, their contribution is often categorised as invisible labour within both academic research and policy debates. According to FAO (2011), approximately 43% of the global agricultural workforce consists of women. In Türkiye, the proportion of women's agrarian employment exceeds 30%, yet this labour remains informal and is mainly excluded from social security systems (TÜİK, 2021). In addition to their central roles in sowing, planting, and field maintenance, women workers carry out a significant share of post-harvest product processing, including drying, sorting, and packaging (FAO, 2011). These repetitive and ergonomically inappropriate tasks frequently lead to musculoskeletal disorders, circulatory problems, and dermatological conditions (Arcury & Quandt, 2007). Moreover, women are exposed to biological risks such as fig latex, walnut shell allergens, and citrus oils, which may trigger skin reactions and occupational dermatitis (WHO, 2020).

Gender roles strongly determine the division of labour in agriculture. In the labour-intensive, low-status stages of production—such as hoeing, harvesting, drying, and sorting—women's participation is predominant, while men dominate mechanised processes, market access, and land ownership (Deere & León, 2001). This asymmetry renders women physically overburdened and socially vulnerable. Seasonal migration further deepens these challenges. In Türkiye, intensive migration occurs from Southeastern and Eastern Anatolia and the Black Sea regions toward Çukurova, the Aegean, and Marmara (Etiler & Kaşıkçı, 2016; Uyan-Semerci & Erdoğan, 2022). Women migrants often reside in temporary shelters or tents with poor sanitation, while unsafe transport conditions increase accident risks. Access to healthcare, especially for pregnancy and breastfeeding, remains critically limited (UN Women, 2021). Although migration amplifies women's vulnerabilities, focusing exclusively on mobility

is insufficient; their risks must be analysed across all agricultural processes and contexts (Candan & Özalp, 2013).

In this study, risks are systematically grouped under six headings: **physical, chemical, biological, climatic, psychosocial, and gender-specific risks**. This framework captures the multifaceted nature of hazards in agriculture and reflects the intersection of occupational exposure with structural gender inequalities.

1. Physical Risks: Women workers are disproportionately exposed to heavy lifting, repetitive motions, and prolonged bending, resulting in high rates of musculoskeletal strain and joint disorders (Mishra et al., 2024; Kostareva, 2023). Comparative studies show that female farmworkers in Spain, India, and Türkiye report musculoskeletal symptoms more frequently than men, highlighting the ergonomic mismatch between tools and women's physiology (Briones-Vozmediano et al., 2024; Yadav et al., 2023).

2. Chemical Risks: Agrochemical exposure constitutes a critical health hazard. Women frequently come into contact with pesticides, herbicides, and fertilisers, particularly during planting and harvesting. In tobacco production, the absorption of nicotine through wet leaves leads to Green Tobacco Sickness, with acute symptoms such as dizziness, nausea, and skin irritation (Arcury et al., 2003; Handal et al., 2025). Long-term exposure has been associated with chronic respiratory and neurological outcomes (Nguyen et al., 2018; Dhananjayan & Ravichandran, 2018). Notably, women often lack adequate training or protective equipment, which exacerbates vulnerability (Adibelli et al., 2021).

3. Biological Risks: Direct interaction with plants and soil exposes women to allergens and infections. Fig latex and citrus oils frequently cause dermatitis, while walnut shells trigger allergic responses (WHO, 2020). Fieldwork also involves risks from insect stings, snake bites, and microbial pathogens in humid environments. Seasonal and migrant women, especially those involved in drying and storage, are highly susceptible to fungal and bacterial infections due to insufficient workplace hygiene (Jehouani & Meryem, 2023; Handal et al., 2025).

4. Climatic Risks: Agricultural labour is conducted in outdoor environments, where women are particularly vulnerable to climatic extremes. Prolonged exposure to sunlight and high temperatures results in dehydration, heat stress, and heatstroke (ILO, 2020; Mishra et al., 2024). In crops such as rice, where prolonged water immersion is required, women experience foot infections and chronic joint pain (FAO, 2011). Seasonal migration often coincides with summer harvests, further intensifying climatic exposure (Yıldırım & Karakoyun, 2023).

5. Psychosocial Risks: Precarious employment structures create psychosocial burdens, including long hours, low wages, and social isolation. Women report limited bargaining power and frequent exclusion from decision-making processes (Meenakshi & Panneer, 2020). Additionally, gender-based harassment and violence are well-documented risks, with significant psychological impacts such as stress, anxiety, and depression (Baumeister & Leary, 1995; Flocks et al., 2012; Orhan & Koçak, 2024). Studies emphasise that unmet needs for belonging and security exacerbate mental health vulnerabilities (Baumeister & Leary, 1995).

6. Gender-Specific Risks: Women face unique health risks that intersect with their biological and social roles. Lack of access to clean water and sanitary facilities particularly affects menstrual hygiene, increasing the prevalence of urinary tract infections (Handal et al., 2025; Kumar & Nagalingam, 2023). Inadequate working conditions during pregnancy pose severe health risks for both mother and child (Kostareva, 2023). Responsibilities for childcare and household labour, coupled with agricultural workloads, restrict women's economic participation and reinforce inequality (Adibelli et al., 2021).

By synthesising these six categories of risks, the study highlights the multifactorial vulnerabilities of women in agriculture. This framework not only integrates diverse hazards across crops and stages but also emphasises how gender-specific challenges compound occupational risks.

Methodology

This study employs a descriptive and comparative systematic literature review to analyse the working conditions and occupational health and safety (OHS) risks faced by women workers in the agricultural sector, adopting a product-based approach. Risks were systematically categorised according to product type and agricultural process stages. As no primary data were collected, the analysis relied exclusively on secondary sources, including peer-reviewed academic articles, institutional reports, and official statistical databases.

Research design

The research followed a **qualitative descriptive design**. Women's roles within agricultural production processes were examined in relation to specific health and safety risks associated with **production, harvest, and product processing stages**. A core classification was developed to distinguish between **annual crops** (wheat, cotton, corn, tobacco, rice) and **perennial crops** (grape, fig, tea, hazelnut, orange, almond, walnut, rose). In addition to stage- and product-specific risks, **psychosocial and gender-related challenges**—including hygiene, reproductive health, and social exclusion—were systematically integrated into the analysis.

Data collection and analysis method

The literature review was conducted using keywords such as "*female workers in agriculture*," "*female labour in agriculture*," "*seasonal agricultural work*," "*occupational health and safety*," and "*health problems in agricultural workers*." Searches were performed across multidisciplinary academic databases and organisational repositories, including the International Labour Organisation (ILO), World Health Organisation (WHO) reports on agricultural workers' health, Food and Agriculture Organisation (FAO) gender and labour reports, Turkish Statistical Institute (TÜİK) employment data, and field reports from the Seasonal Agricultural Workers Association (METİDER).

Data were coded and organised on a product basis. For each crop, risks were analysed under the headings of work stages (production, harvest, processing), working conditions (work hours, environment, equipment use), and OHS risk categories. These categories were consistently aligned with the six headings of the study: physical, chemical, biological, climatic, psychosocial, and gender-specific risks. The findings were synthesised into systematic tables, enabling comparative risk profiles for annual and perennial products. Furthermore, a policy-oriented perspective was adopted to link the identified risks to actionable recommendations, with particular attention to gender-specific vulnerabilities in agricultural labour.

Findings

Occupational health and safety (OHS) risks in agriculture

This section presents the health and safety risks encountered by women agricultural workers, organised by crop type and production stage. The analysis distinguishes between annual crops (wheat, cotton, corn, tobacco, rice) and perennial crops (grape, fig, tea, hazelnut, orange, almond, walnut, rose). For each product, risks are identified during production, harvest, and processing stages. The evidence is categorised under the six headings outlined in the theoretical framework—physical, chemical, biological, climatic, psychosocial, and gender-specific risks—to ensure consistency across findings.

Annual products

Wheat: Wheat cultivation requires prolonged standing and heavy manual labour. During production and harvest, women face **physical risks** such as musculoskeletal strain, back and knee pain, and injuries from machinery (WHO, 2020). **Climatic risks** include heat stress and dehydration due to harvesting in high summer temperatures. In the processing stage, dust exposure is a significant **biological and respiratory hazard**, leading to acute and chronic pulmonary conditions (FAO, 2011).

Cotton: Cotton is predominantly handpicked under hot, humid conditions. During harvest, women are exposed to **chemical risks** through pesticides and herbicides (WHO, 2015) and to **physical strain** from repetitive bending and carrying loads. Skin irritation and allergic reactions are frequent **biological outcomes**. In processing, continuous contact with fibres causes dermatological problems (ILO, 2015), while handling heavy bales results in musculoskeletal injuries. Regional studies from Türkiye, India, and Pakistan highlight women's vulnerability to both pesticide residues and heat-related illness (FAO, 2011).

Corn: Harvesting corn involves manual sorting in dusty environments, exposing women to **cuts, abrasions, and ergonomic strain**. In both the harvest and processing stages, **biological risks** include exposure to aflatoxin and fungal spores, which contribute to respiratory disease (FAO, 2011). Comparative findings from Mexico and Türkiye reveal similar hazards: pesticide exposure, poor hygiene, and respiratory infections among women workers (Arcury & Quandt, 2007).

Tobacco: Women engaged in tobacco harvesting face **chemical risks** through dermal absorption of nicotine, leading to Green Tobacco Sickness (Arcury & Quandt, 2007; Arcury et al., 2003). Symptoms include headaches, nausea, and skin irritation. **Physical strain** from non-ergonomic postures and heavy bundles is common, while poor sanitation elevates dermatological problems. In the drying stage,

exposure to nicotine vapours poses additional respiratory hazards. Evidence from Kentucky and Türkiye confirms similar patterns among female workers.

Rice: Rice production is carried out in wetlands, requiring prolonged bending and immersion in water. **Physical risks** include back and knee strain, while **biological hazards** involve fungal and bacterial infections due to constant humidity (WHO, 2020). Women also encounter **climatic risks** such as sunstroke and dehydration (ILO, 2015). During processing, dust inhalation during drying and sorting contributes to respiratory illnesses (FAO, 2011). Comparative evidence from Bangladesh and the Philippines shows elevated rates of skin and respiratory disease among female rice workers, paralleling risks identified in Türkiye.

Perennial crops

Grapes: Vineyard work requires extended periods of bending and standing, resulting in **musculoskeletal strain**. Women face **climatic risks**, such as sunburn and dehydration, as well as **exposure to chemical residues from pesticides** (FAO, 2011). Processing stages add ergonomic and dust-related respiratory challenges.

Figs: Fig harvesting involves climbing trees or using ladders, creating a **physical risk** of falls. Contact with fig latex often results in **dermatitis and eczema**, while drying and storage expose women to fungal spores. Bees and snakes present additional **biological hazards**.

Tea: Tea harvesting, typically performed in humid regions, requires squatting or bending while carrying heavy baskets. These tasks impose **physical strain** on the lower back, knees, and shoulders (Etiler & Kaşıkçı, 2016). Processing stages expose workers to steam and heat, while high humidity increases the risk of fungal infections. Studies from India, Sri Lanka, and Türkiye show consistent patterns; however, a more substantial union presence in South Asia provides partial protection for women workers.

Hazelnuts: Collection by hand requires constant bending, leading to **back and knee problems** (Yıldırım & Karakoyun, 2023). During processing, **hand injuries** are common, alongside dust-related respiratory illness. Seasonal and precarious labour dominates this sector; women often work for low wages and without social security. Structural problems in hazelnut production, particularly in Georgia, exacerbate both productivity and worker health (ISET Policy Institute, 2021).

Oranges: Harvesting oranges entails working at height, exposing women to **falls** and **climatic risks** such as sunstroke. Contact with orange oils often results in **skin reactions**, while repetitive movements in sorting and packing create **musculoskeletal strain**.

Almonds and walnuts: These crops are harvested from trees, either manually or mechanically. Women face **fall risks**, heavy lifting injuries, and **cutting tool accidents** during shelling. Dust exposure during drying causes **dermatological and respiratory issues**. Insect and snake bites are additional **biological hazards**.

Rose: Rose harvesting occurs at dawn, requiring prolonged bending and handpicking. Women commonly suffer **back pain, spine injuries, and thorn-related injuries**. In processing areas, **pollen exposure** and skin irritation are frequent. Organic rose production, as seen in Bulgaria, demands more manual labour, amplifying ergonomic risks (Chalova, Manolov & Manolova, 2017).

Table 1: Working Conditions and Health and Safety Risks during Harvest and Product Processing Stages on a Product Basis

Product	Working Conditions	Production Risks	Harvest Risks	Processing Risks	Representative Sources
Wheat	Manual/machine tasks in summer heat	Postural strain, dust exposure	Heat stress, musculoskeletal injury, and machinery accidents	Dust inhalation, back strain during transport	FAO 2011; WHO 2020
Cotton	Handpicking in humid, pesticide-intensive areas	Pesticide exposure	Musculoskeletal skin irritation	Fibre-related dermatitis, heavy loads	WHO 2015; ILO 2015
Corn	Manual sorting in dusty fields	Ergonomic strain	Cuts, aflatoxin, pesticide contact	Respiratory illness from fungal spores	FAO 2011; Arcury & Quandt 2007
Tobacco	Manual picking/drying	Ergonomic load	Green Tobacco Sickness, nicotine absorption	Nicotine vapours, skin diseases	Arcury et al. 2003
Rice	Wetlands, prolonged bending	Joint infections	pain, Sunstroke, fungal/bacterial risks	Dust inhalation, respiratory illness	ILO 2015; WHO 2020
Grapes	Vineyard labour, heavy loads	Musculoskeletal strain	Sunstroke, exposure	pesticide Dust inhalation, ergonomic injuries	FAO 2011
Fig	Tree climbing, ladder use	Fall risk	Latex dermatitis, insect bites	Fungal spores, eczema	WHO 2020
Tea	Squatting, basket carrying in humid areas	Joint strain	Musculoskeletal disorders	Heat/humidity-related fungal risks	Etiler & Kaşıkçı 2016
Hazelnut	Ground collection, repetitive bending	Back/knee pain	Insect/snake bites	Hand injuries, dust exposure	Yıldırım & Karakoyun 2023
Orange	Ladder climbing, sun exposure	Musculoskeletal strain	Falls, sunstroke, and orange oil dermatitis	Repetitive strain, skin reactions	FAO 2011
Almond	Manual/mechanical tree harvesting	Back pain	Fall risk	Dust-related respiratory issues	FAO 2011
Walnut	Tall tree harvesting	Fall, joint strain	Musculoskeletal injuries	Hand/finger injuries, dust	FAO 2011
Rose	Early handpicking morning	Ergonomic strain	Spine injuries, thorn pricks	Pollen allergy, skin irritation	Chalova et al. 2017

Source: Compiled by the author based on a systematic literature review.

Psychosocial risks

Female agricultural workers face psychosocial vulnerabilities arising from **long hours, low wages, informality, and social isolation** (Handal et al., 2025; Mishra et al., 2024). Gender-based discrimination and harassment further undermine well-being (Jehouani & Meryem, 2023; Orhan & Koçak, 2024). Baumeister and Leary (1995) highlight that unmet needs for belonging exacerbate stress and psychological health risks, findings echoed in agricultural labour studies across Türkiye and beyond (Flocks et al., 2012).

Gender-specific problems

Women face unique risks due to insufficient **hygiene infrastructure, reproductive health concerns, and caregiving responsibilities**. Lack of sanitary facilities and menstrual hygiene resources increases urinary tract infections (Kumar & Nagalingam, 2023). Inadequate workplace adjustments during pregnancy elevate risks of miscarriage and complications (Kostareva, 2023). Furthermore, childcare responsibilities without institutional support restrict women's participation in agricultural labour and exacerbate inequality (Adıbelli et al., 2021). Comparative studies from developing contexts show that such gender-based health problems often become chronic due to weak policy frameworks (Meenakshi & Panneer, 2020; Vera-Avilés et al., 2024).

Table 2: Risks Faced by Female Agricultural Workers and Solution Suggestions

Risk Type	Definition & Explanation	Solution Suggestions	Representative Sources
Physical Risks	Prolonged bending, repetitive motions, and heavy lifting expose women to musculoskeletal disorders, spinal injuries, and chronic pain due to a lack of ergonomic adaptation in tools and workstations.	Introduction of ergonomic tools, provision of lumbar supports, scheduled rest intervals, task rotation, and worker-centred ergonomic training.	Mishra et al., 2024; Kostareva, 2023; Briones-Vozmediano et al., 2024; Yadav et al., 2023
Chemical Risks	Direct contact with pesticides, herbicides, and fertilisers leads to acute poisoning, skin irritation, and long-term respiratory and neurological effects. Nicotine absorption during tobacco harvest causes Green Tobacco Sickness.	Provision of personal protective equipment (PPE), strict regulation of pesticide use, education on safe handling, biological monitoring, and incentives for organic/alternative farming practices.	Arcury et al., 2003; Dhananjayan & Ravichandran, 2018; Handal et al., 2025; Adibelli et al., 2021
Biological Risks	Exposure to plant saps (fig latex, walnut shells, and citrus oils), fungal spores, and bacteria results in dermatitis, allergies, and infections. Insect and snake bites add further hazards.	Use of gloves and protective clothing, improved hygiene in drying/processing areas, vaccination and regular health screenings, and pest-control training.	WHO, 2020; Jehouani & Meryem, 2023; ISET Policy Institute, 2021; Handal et al., 2025
Climatic Risks	Women are highly vulnerable to extreme heat, humidity, and direct sunlight during outdoor agricultural labour, causing dehydration, heat stress, and skin burns. Flooded fields (rice) create additional infection risks.	Provision of shaded rest areas, access to clean drinking water and electrolytes, climate-adapted work schedules, and protective clothing.	FAO, 2011; ILO, 2015; WHO, 2020; Yıldırım & Karakoyun, 2023
Psychosocial Risks	Long working hours, low wages, informality, and job insecurity all contribute to chronic stress. Women face discrimination, harassment, and social isolation, which increase risks of anxiety and depression.	Strengthening of labour rights, gender-sensitivity training, establishment of complaint/reporting mechanisms, and provision of psychosocial support services.	Baumeister & Leary, 1995; Flocks et al., 2012; Meenakshi & Panneer, 2020; Orhan & Koçak, 2024
Gender-Specific Risks	Lack of sanitation, inadequate menstrual hygiene resources, and unsafe temporary housing increase reproductive health problems. Pregnancy-related risks are often neglected, and childcare responsibilities reduce participation in agricultural work.	Establishment of hygienic toilets and clean water facilities, adaptation of tasks for pregnant workers, provision of childcare support, and mobile health services for seasonal camps.	Kumar & Nagalingam, 2023; Kostareva, 2023; Handal et al., 2025; Adibelli et al., 2021

Source: Compiled by the author based on a systematic literature review.

Building upon the product-based analysis and the six risk categories identified, it is evident that women agricultural workers are exposed to multifactorial vulnerabilities that extend beyond single-crop or stage-specific hazards. These risks are deeply intertwined with systemic issues such as informal employment, limited access to social protection, and gender-based inequalities. To translate these findings into actionable strategies, Table 2 summarises the six main categories of risks together with evidence-based solution suggestions. By aligning each risk type with relevant protective measures and representative literature, the table provides a framework for both occupational health practitioners and policymakers to develop gender-sensitive interventions in the agricultural sector.

The following section synthesises these findings into broader conclusions and policy recommendations, explicitly linking product-based evidence with the six risk headings.

Conclusion and recommendations

This study systematically analysed the working conditions and occupational health and safety (OHS) risks faced by women agricultural workers in Türkiye across production, harvest, and processing stages, adopting a product-based and six-heading framework. The findings demonstrate that women are exposed to multifactorial and intersecting risks that vary by crop and stage but consistently converge around structural vulnerabilities linked to informality, gender inequality, and limited access to social protection.

Key findings can be summarised as follows:

- **Physical risks** such as musculoskeletal disorders (waist, back, and knee strains) are pervasive, particularly in tea, rice, and hazelnut harvesting, where extensive bending and repetitive tasks dominate (Mishra et al., 2024; Briones-Vozmediano et al., 2024).
- **Chemical exposures** remain acute in crops like cotton, grapes, corn, and tobacco, where pesticide residues and nicotine absorption significantly impact women's respiratory and dermatological health (Arcury et al., 2003; Handal et al., 2025).

- **Biological hazards** include plant saps (fig latex, walnut shells, citrus oils) and fungal spores in drying areas, contributing to occupational dermatitis and respiratory infections (WHO, 2020; Jehouani & Meryem, 2023).
- **Climatic risks** such as excessive heat and dehydration disproportionately affect women during summer harvests of wheat, cotton, rice, and oranges (ILO, 2015; Yıldırım & Karakoyun, 2023).
- **Psychosocial burdens** emerge from long working hours, low wages, social isolation, and exposure to discrimination and harassment (Flocks et al., 2012; Orhan & Koçak, 2024).
- **Gender-specific vulnerabilities** related to inadequate menstrual hygiene, reproductive health risks, and childcare responsibilities further compound women's fragility in agricultural labour (Kumar & Nagalingam, 2023; Kostareva, 2023).

Taken together, these findings highlight that risks are not isolated but often **co-exist and interact**—for example, prolonged bending under high temperatures in rice fields creates a physical–climatic synergy, while pesticide exposure combined with poor sanitation increases chemical–biological vulnerability.

Policy and practice recommendations derived from these findings are as follows (see Table 2 for detailed mapping):

1. **Product- and stage-specific protective measures:** Personal protective equipment (PPE) should be mandatory in pesticide-intensive crops (cotton, grapes, corn, tobacco), while ergonomic aids and lumbar supports should be prioritised in labour-intensive crops requiring repetitive bending (tea, rice, hazelnuts).
2. **Ergonomic design of workstations:** Harvesting and processing stations should be adapted to women's physiological characteristics, incorporating mechanical supports for tasks such as transportation, drying, and sorting (Alessandroni, 2023).
3. **Safe and healthy seasonal migration:** Transportation for migrant workers must comply with safety standards, while regular inspections should ensure adequate sanitation in temporary camps. Mobile health services (vaccination, pregnancy follow-up, screenings) are essential to reduce inequities (Yıldırım & Karakoyun, 2023).
4. **Institutionalised health screenings and training:** Seasonal pre-employment health checks and structured OHS training programs should be standardised across agricultural regions (ILO, 2015; FAO, 2011).
5. **Strengthened labour rights:** Legal frameworks should facilitate women's transition from informal to formal employment, ensure compliance with minimum wage laws, and integrate gender-sensitive inspection mechanisms (Candan & Özalp, 2013).
6. **Empowerment and organisation of women workers:** Unionisation, cooperative models, and participatory mechanisms should be promoted to strengthen women's collective bargaining power and ensure their voices in policy formulation (Meenakshi & Panneer, 2020).

Limitations and future research: This review relied exclusively on secondary sources, which may have introduced potential bias due to gaps in empirical data on women's agricultural health. Publication bias and the underrepresentation of informal labour in official statistics further constrain generalizability. Future studies should integrate quantitative exposure measurements (e.g., pesticide biomarkers, heat index monitoring) and intervention trials (e.g., ergonomic equipment, hygiene infrastructure) to validate and expand upon these findings.

Conclusion: Addressing the risks faced by women agricultural workers requires more than isolated technical measures; it demands a gender-sensitive, multi-stakeholder, and sustainable social protection approach. Policies should be embedded within Türkiye's agricultural modernisation strategies, aligning with international frameworks such as the ILO Decent Work Agenda and the UN Sustainable Development Goals. Making women's labour visible, ensuring safe and dignified working conditions, and institutionalising gender-responsive occupational health systems are indispensable to sustainable agricultural development.

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Appendix

Appendix 1: Literature Search and Selection Flow

The systematic review followed PRISMA guidelines. Searches were conducted in Scopus, Web of Science, PubMed, and institutional repositories (ILO, FAO, WHO, UN Women, TÜİK) for the period 2000–2025, in both English and Turkish. Keywords included: "female workers in agriculture," "female labour in agriculture," "seasonal agricultural work," "occupational health and safety," "health problems in agricultural workers." After removal of duplicates, records were screened by title/abstract and then full text. Inclusion criteria required explicit relevance to at least one of the six risk headings and to production/harvest/processing stages. Exclusion criteria comprised non-agricultural contexts, studies without gender-specific data, and insufficient methodological detail. Out of n=1142 records identified, n=214 were screened in full, and n=78 met inclusion criteria.

Appendix 2: Example Search Strings

Example Boolean search string (Scopus): ("female farmworker*" OR "women in agriculture" OR "kadın tarım işçisi") AND ("occupational health" OR "iş sağlığı" OR pesticide* OR musculoskeletal* OR ergonomic OR psychosocial) AND (Turkey OR Türkiye).

Appendix 3: Terminology Note

In this study, the categorisation of risks was standardised under six headings: physical, chemical, biological, climatic, psychosocial, and gender-specific. Working conditions (e.g., hours, environment, equipment) were primarily analysed under physical and climatic risks. Safety risks such as falls and accidents were included within physical risks. Dust exposure was classified as a physical risk when related to particulate matter, and as a biological risk when fungal contamination was dominant. This operationalisation was consistently applied in Tables 1 and 2.