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Country Report

Heatwaves and occupational health and safety in Italy: the role of trade unions and social dialogue

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Abstract: This study examines the role of trade unions and social dialogue in shaping the Italian prevention system for occupational health and safety (OHS) risks associated with heatwaves. Drawing on the European project Adaptheat, it addresses a research gap on the short-term impacts of climate change on the workforce and the interventions of social actors to address them. The methodology combined literature review, documentary analysis, and qualitative interviews with different stakeholders, including workers, in Apulian agriculture and in logistics warehouses. Findings show that trade unions have been pivotal in translating scientific evidence—particularly from the Worklimate project—into institutional measures and into collective bargaining agreements. Despite regulatory progress, the system relies mainly on regional ordinances, resulting in fragmented and reactive prevention rather than integrated and proactive planning. Compared with international benchmarks, the Italian case underscores the need to strengthen the regulatory framework, linking heatwave related OHS protection with broader labour and social rights.

Key words: Heatwaves, Occupational health and safety (OHS), Workplace climate adaptation, Social dialogue, Trade unions, Agricultural and logistics workers, Extreme heat prevention policies, Labor regulations and climate change

Introduction

This paper analyses the role of trade unions and social dialogue in protecting workers against the occupational health and safety (OHS) effects of heatwaves[1)] in Italy. The study originates from the European research project Adaptheat, in which the authors took part as members of the research team. Here, social dialogue refers to all types of negotiations, consultations and exchange of information, between or among, representatives of governments, employers and workers on issues of common interest relating to economic, employment and social policy. According to the European Commission, it exists as bipartite relations between labour and management, including collective bargaining, or as a tripartite process, with public authorities as an official party to the dialogue.

In recent decades, especially since the beginning of the new century, global warming has caused 86–91% of extreme weather-related accidents in Europe[2)]. Heatwaves multiply overall risk exposure to other OHS risks[3)]. Partial or late reforms of prevention systems also add to these risks[4)]. The increase of injuries and deaths related to heatwaves is higher in Southern Europe countries, such as Italy[5)]. Heatwaves have shifted from being an emergency limited to some days in the summer months, to a structural

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and widespread problem for a significant part of the year, requiring permanent solutions to protect the workforce[6, 7].

Studies on OHS and heatwaves have focused on outdoor activities, especially on construction[8–10] and agriculture[11, 12]. Other studies have focused on factories[13] and remote working[14]. Among workers, heatwaves-related OHS risks disproportionately affect the most vulnerable groups—such as precarious, irregular or migrant workers[11] often employed in smaller firms without trade union representatives[4–6, 10]. Research has also outlined the relationship between the growing scientific evidence of health impacts of heatwaves, protests to claim protections, and their formal recognition as occupational risks[15].

At the European level, the first research project was HeatShield (2016), aiming to address impacts of heat stress on health and productivity of workers of five industries—namely manufacturing, construction, transportation, tourism and agriculture. The results led to the creation of action protocols and forecast maps for risk prevention and promoted project replication by Member States. In Italy, 2019 marked the start of the first national project Worklimate, coordinated by the National Research Centre (CN-IBE) and Italian workers compensation authority (INAIL). This project was crucial to provide guidelines and standards to establish regulations at different levels to cope with heatwaves. It developed a heat risk forecasting system for different work settings and exposures, based on the wet bulb globe temperatures (WBGT) indicator, integrated with the MOLOCH meteorological model, providing three-day forecasts for each location. By 2025, all Italian regions (except two) have implemented worker protection measures based on the results and maps of Worklimate, which represents a significant model for integrating scientific research and public health policies. Furthermore, on July 2, 2025, the social partners signed a "Framework Protocol for the Management of Climate Emergencies in the Workplace", with the aim of providing binding shared indications for addressing exceptional situations related to climate change. Alongside these research projects, literature on climate change and related prevention systems usually focus on long-term impacts[16, 17] on population[18, 19] and labour force's health[20–22], on monitoring systems and institutional interventions to manage them[4, 15, 23]. On the contrary, it rarely heeds short-term impacts of heatwaves on the workforce and considers the role of trade unions and social dialogue for effective prevention policies and interventions[6, 24, 25]. Our study aims to fill this gap, employing documentary analysis (regulations, collective agreements and ordinances) and comparative case-studies in agriculture and logistic warehouses in Italy. This study shows how trade unions and social dialogue help enhance prevention measures to cope with heatwaves, contributing to the debate on the short-term impacts of climate change on workplaces and providing transferable solutions and benchmarks for other countries.

The paper structure is the following: the next section details the methodology. The results section presents the main findings of the analysis of the regulatory framework and the comparative case studies. Finally, the discussion includes the interpretation of the findings, focusing on the role of trade unions and social dialogue within the Italian prevention system against heatwaves as well as suggestions to improve regulations.

Methods

Our paper adopts a qualitative methodology combining a documentary analysis of the regulatory framework and ten semi-structured interviews with key stakeholders from different sectors and a focus group. First, we conducted a documentary analysis on the evolution of regulations dealing with heatwaves impact on OHS. With the support of the Cgil repository, we collected and analysed relevant documents signed from the heatwave of 2003 until 2025. Among these, we distinguish national agreements between government and social partners, ordinances of regional or local governments (sometimes with social partners and health authorities), and site or company collective agreements between trade unions and social partners.

Then we conducted ten semi-structured interviews with key informants from several areas (public health agencies, scientists, workers and employers' representatives) involved in heat stress prevention, ensuring in this way the diversity of perspectives and enhancing the representativeness of the collected data (see the complete list of key informants in Appendix Table 1). The interviews were used to supplement and triangulate the information collected at the documentary review and allowed for a deeper interpretation of the results. They were performed between April 2023 and February 2024. For the interviews with workers, we focused on two strategic sectors facing different challenges regarding occupational heat stress namely, agriculture and logistic warehouses. Agriculture and logistic warehouses' relevance rely on different reasons: their workplace characteristics (indoor or outdoor), and their differences in terms of the maturity of social dialogue and OHS protection systems. We also conducted a focus group with thirty logistic workers on November 15th, 2023.

Interviews were conducted remotely via video conferencing tools (Teams and Google Meet) and lasted between thirty and ninety minutes each. They dealt with the following topics: job quality and working conditions; industrial relations, social dialogue and prevention systems; criticality and strength of monitoring and protection systems for OHS during heatwaves; role of social partners and prevention networks; power relations, conflicts, and trade union action. With the participants' consent, we recorded and transcribed qualitative materials and carried out thematic content analysis. Coding followed a hybrid inductive-deductive approach: the main coding framework was based on the research aims and literature review, but it was refined throughout the process to incorporate emergent themes from the data[26]. Codes were organised around key dimensions such as regulatory frame, collaboration between prevention actors, role of trade unions and social dialogue, strength and limits of the Italian prevention system to cope with OHS risks of heatwaves. To ensure the internal validity of findings, we applied data triangulation, combining literature review, documentary analysis, comparative case studies, interviews and a focus group. This enabled cross-checking of actors' interpretations and the identification of both convergences and divergences between sectors and territories. Although the number of interviews was limited, the integration of multiple data sources and levels of analysis enabled a comprehensive, context-sensitive understanding of the governance of heatwave OHS risks.

Results

Documentary analysis

The Italian OHS prevention system relies on the Legislative Decree 81/08, which is grounded in three core principles: the promotion of workers' well-being and preventive measures, the mandatory and participatory evaluation of all workplace risks (including heat), and the universal protection of all workers. It involves multiple actors such as safety and health authorities, governments, labour inspectors, OHS worker representatives at firm or territorial level, social partners engaged in bilateral bodies, and the scientific community. These engage at different levels—company, territorial, site, sectoral—to evaluate risks, define prevention standards and protocols, and monitor their implementation OHS. Within the prevention system each plays a complementary role: scientific community and health and safety authorities collect data and provide evidence and solutions to mitigate OHS risks. Governments set the regulatory context for their implementation, while labour inspectors, joint bodies, OHS workers representatives collaborate to collect data, build empirical knowledge about climate change risks and adaptation, claim institutional intervention, and monitor the application of standards and protocols to protect the workforce. Given this framework, social partners operate under a two-tier bargaining system, whereby national level agreements set universal standards, and second level bargaining—at the company, site, territorial or sectoral level—defines specific arrangements.

As of 2025, the Italian public health system has significantly evolved since the first major heatwave in 2003, which prompted the adoption of a national plan aimed at protecting the health of the most vulnerable social groups (such as the elderly, children, and pregnant women), as well as the establishment of a national heatwave forecasting (bulletin) and health surveillance system. Specific legal measures to protect the workforce against heat, however, were first introduced in 2016, when the mayor of Nardò—a small town in Apulia—issued the first local ordinance suspending agricultural work between 12:30 and 16:00 during periods of "high temperature alert" as indicated by the national heatwave bulletin. This ordinance represented an initial blueprint for an occupational health and safety (OHS) protection system designed to address heatwaves and was subsequently followed by other key local ordinances and territorial agreements.

Table 1 summarises the main documents that marked this historical evolution. The analysis shows the shift from unilateral decision-making by governmental actors (e.g. Nardò and Apulia) towards more participatory models (e.g. Genoa, the Conference of Regions, and the National Protocol). These documents established the pillars of the actual prevention strategy adopted at national and territorial level. It is also worth noting that, following the Worklimate project (2019), all subsequent measures refer to its territorial forecasting maps and operational guidelines. This highlights the growing collaboration between institutions, social partners, and the scientific community within the Italian prevention system. Furthermore, there has been a gradual extension of preventive measures from the suspension of activities in a single sector—agriculture—to other sectors, accompanied by increasingly detailed protocols for prevention and risk management aimed at protecting the workforce. Finally, both the Genoa and the national agreements acknowledge the key role of social dialogue and the social partners, not only in training and informing all prevention stakeholders, but also in implementing and

Table 1. Evolution of ordinances and protocols addressing OHS risks from heatwaves in Italy (2016–2025)

Year	Territory	Type and issuing authority	Sector	Work suspension/ Reference source	Main preventive and organisational measures
2016	Nardò (Apulia)	Municipal ordinance (Mayor)	Agriculture	Work stopped 12:30–16:00; National temperature bulletin	–
2021	Apulia (Region)	Regional ordinance (President of the Region)	Agriculture	Work stopped 12:30–16:00 (June 23 – Aug 31); Worklimate risk map	–
2025	Genoa (Liguria)	Tripartite protocol (Region, Municipality, OHS institutions, employers' and workers' associations)	All sectors	Worklimate risk map; institutional website	Work organisation; information and training; hydration, diet and acclimatisation; adequate workwear; breaks; consideration of OHS representatives' input; institutional monitoring
2025	All regions and autonomous provinces	Inter-regional guidelines (*Conference of Regions*)	All sectors	Worklimate risk map; Heat Index (HI); Wet Bulb Globe Temperature (WBGT)	Rescheduling of working hours; acclimatisation; rest spaces; adequate workwear, hydration, and diet; training; health surveillance; OHS management; buddy system
2025	Italy (national)	National protocol (*Ministry of Labour*, employers' and trade unions)	All sectors	Institutional website of the Ministry of Health	Redundancy funds; PPE; training; inspections; rescheduling of shifts; rest/shade areas; water access; heatwave-specific evaluation in company DVR; establishment of territorial/sectoral bargaining tables and local health authority working groups

OHS: occupational health and safety; PPE: personal protective equipment; DVR: risk assessment document.

monitoring the application of the guidelines.

The system of regional ordinances has become the predominant framework regulating work activities and determining eligibility for redundancy funds. Employers are required to specify, in the technical report included in or attached to their application, the details of the local ordinance ordering the suspension or reduction of work activities to access such funds. While regional ordinances allow for more context-specific measures, they produce a certain degree of fragmentation in terms of content, sectoral and temporal scope, and the level of social partner involvement.

Table 2 presents the current regional ordinances (2025), providing a comparative synthesis of the main regulatory instruments adopted. It summarises key features such as the territorial scope, the type and proponent of each agreement, the sectors concerned, the provisions on work suspension and related references, as well as additional preventive or adaptive interventions. Only two regions, Valle d'Aosta and Trentino-Alto Adige, currently lack regional ordinances regulating working conditions during heatwaves. The commonalities of the regional ordinances are related to the criteria to stop the working activities (working hours and temperature based on the Worklimate risk map) and to the sectors (with a focus on agriculture, quarries and construction). On the contrary, only few ordinances provide additional indications on the management of the risks and the engagement of the social partners.

The role of trade unions and social dialogue

This section presents the findings from semi-structured interviews and focus groups conducted at both the national level and within the two case studies. The findings are organized in four interrelated dimensions emerging from the content analysis of the interviews: mobilisation and political advocacy, institutional reform and workplace adaptation, compensatory mechanisms and governance fragmentation, and knowledge co-production and adaptive capacity.

Mobilisation and political advocacy

According to respondents, trade unions acted as catalysts of mobilisation and public awareness, particularly in the early stages of institutional recognition of heatwave as an OHS risk. Interviews recalled protests and strikes—either organised directly by trade unions or supported

Table 2. Regional ordinances against heatwaves approved in Italy (2025)

Region	Sector(s)	Working hour restrictions and reference	Other measures or notes
Abruzzo	Agriculture Horticultural Construction and similars	12:30–16:00 (Jun 30–Aug 31) Worklimate risk map	–
Basilicata	Agriculture Horticultural Construction and similars Quarries Logistics Urban Delivery (Excluded: Public administrations, public utilities for civil defense or public safety interventions)	12:30–16:00 (Jun 23–Aug 31) Worklimate risk map	Reference to the Guidelines of the Conference of Regions. Temporary exemption from noise regulations to allow work to be rescheduled to cooler hours.
Calabria	Agriculture Horticultural Construction outdoor sites and similars	12:30–16:00 (Jun 10–Aug 31) Worklimate risk map	–
Campania	Agriculture Horticultural Construction and similars	12:30–16:00 (Jun 18–Aug 31) Worklimate risk map	Reference to the Guidelines of the Conference of Regions.
Emilia-Romagna	Agriculture Horticultural Construction sites Logistics (open spaces)	12:30–16:00 (Jul 2–Sep 15) Worklimate risk map	Introduction of organisational, technical, and procedural measures (such as the rescheduling of working hours, the provision of fixed or mobile shade canopies, regular rotation of exposed workers, frequent breaks in shaded areas, and the use of industrial equipment) developed also in consultation with OHS representatives.
Friuli- Venezia Giulia	All sectors for outdoor activities and indoor activities without adequate ventilation	12:30–16:00 only for agriculture, horticultural, construction and road construction sites, quarries (Excluded: Public administrations, public utilities for civil defense or public safety interventions) (Jul 3–Sept 15) Worklimate risk map	
Lazio	Agriculture Horticultural Construction sites Quarries Logistics (open spaces) Urban delivery (Excluded: Public administrations, public utilities for civil defense or public safety interventions)	12:30–16:00 (Jul 4–Sep 15) Worklimate risk map	
Liguria	Agriculture Horticultural Construction sites (outdoor and indoor)	12:30–16:00 (Jun 26–Aug 31) Worklimate risk map	Reference to the Guidelines of the Conference of Regions.
Lombardia	All sectors for outdoor activities and indoor activities without adequate ventilation	12:30–16:00 only for agriculture, horticultural, construction outdoor sites, quarries (Excluded: Public administrations, public utilities for civil defense or public safety interventions) (Jul 2–Sep 15) Worklimate risk map	Reference to the Guidelines of the Conference of Regions.
Marche	Agriculture Horticultural Construction sites Road construction sites Logistics (Excluded: Public administrations, public utilities for civil defense or public safety interventions)	12:30–16:00 (Jul 4–Aug 31) Worklimate risk map	

Table 2. (continuation)

Region	Sector(s)	Working hour restrictions and reference	Other measures or notes
Molise	Agriculture Horticultural Construction and similars (Excluded: Public administrations, public utilities for civil defense or public safety interventions)	12:30–16:00 (Jul 2–Aug 31) Worklimate risk map	Suggestion to apply for redundancy funds.
Piemonte	Agriculture Horticultural Construction outdoor sites and similars (Excluded: Public administrations, public utilities for civil defense or public safety interventions)	12:30–16:00 (Jul 2–Aug 31) Worklimate risk map	Reference to the Guidelines of the Conference of Regions.
Puglia	Agriculture Horticultural Forestry Quarries Construction sites Urban delivery	12:30–16:00 (Jun 18–Sep 15) Worklimate risk map	Following trade union requests, the measures should also cover sectors where, if risk-reduction measures cannot be applied, work under direct and prolonged sunlight is prohibited
Sardegna	Agriculture Horticultural Construction (Excluded: Public administrations, public utilities for civil defense or public safety interventions)	12:30–16:00 (June 26–Aug 31) Worklimate risk map	
Sicilia	Agriculture Horticultural Construction Quarries (Excluded: Public administrations, public utilities for civil defense or public safety interventions)	12:30–16:00 (Jun 26–Aug 31) Worklimate risk map	Recommendation to establish joint bilateral bodies comprising employers and trade union representatives.
Toscana	Agriculture Horticultural Construction outdoor sites Quarries (Excluded: Public administrations, public utilities for civil defense or public safety interventions)	12:30–16:00 (June 25–Aug 31) Worklimate risk map	
Trentino Alto-Adige	–	–	–
Umbria	Agriculture Horticultural Construction outdoor sites (Excluded: Public administrations, public utilities for civil defense or public safety interventions)	12:30–16:00 (June 13–Aug 31) Worklimate risk map	–
Valle d'Aosta	–	–	–
Veneto	Agriculture Horticultural Construction sites Quarries (Excluded: Public utilities for civil defense, or public safety interventions)	12:30–16:00 (Jul 3–Aug 31) Worklimate risk map	–

through grassroots movements—demanding institutional intervention, including the introduction of regulatory measures and access to redundancy funds (economic compensation for workers in the event of a reduction or suspension of work activities).

A landmark episode was the unions' support for the grassroot protests of agricultural workers in Nardò in 2011, which called for improved working conditions and denounced gang mastering and labour exploitation. This mobilisation contributed to the first municipal ordinance in Italy regulating work during heatwaves, setting a precedent for subsequent local and regional initiatives. These findings confirm earlier research[4–7] emphasising the OHS vulnerabilities of outdoor workers, in sectors characterised by informal labour and exploitative practices.

Institutional reform and workplace adaptation

Interviewees described how, over the past decade, trade unions have gradually shifted from mobilisation to institutional engagement, seeking to move heatwaves-related protections upstream in the Italian OHS framework. National-level union representatives have advanced proposals addressing both regulatory frameworks and workplace-level practices aimed at extending protection to all categories of workers. Respondents expressed satisfaction with the proposal submitted to the Ministry of Labour in July 2023, which laid the groundwork for the "Framework Protocol for the Management of Climate Emergencies in the Workplace" signed in 2025. The initiatives and priorities identified by union representatives included: broader information and training campaigns to enhance preventive culture; improved access to personal protective equipment (PPE); adaptation of working hours, activities, and physical environments; systematic integration of heatwave related OHS risks into company risk assessments, in collaboration with workers' safety representatives; reinforcement of labour inspections and monitoring mechanisms; extension of the redundancy funds' eligibility to ensure uniform income protection across sectors; establishment of sectoral, territorial, and company-level agreements and working groups with local health authorities and institutions. This multi-level engagement reflects an effort to move from reactive interventions to structural and preventive governance, embedding the issue of heatwaves into the broader system of labour protection and social dialogue.

Compensatory mechanisms and governance fragmentation

Trade unions played a central role in institutionalising compensatory mechanisms for income protection during work interruptions caused by heatwaves. A key achievement identified by respondents was the approval by the National Social Security Institute (INPS) of the redundancy funds, the wage supplementation fund (economic compensation for employees of firms excluded by redundancy funds), and bilateral solidarity funds (joint fund established between employers and trade unions to provide financial support in response to heatwaves), which allow workers to be fully or partially compensated for income losses during work suspensions. Eligibility is recognised when actual or perceived temperatures exceed 35°C and a "high-risk" alert is issued by the ministerial national bulletin. However, despite these advances, interviewees consistently noted the persistence of a reactive and compensatory governance model. They argued that government interventions still tend to treat heatwaves as temporary, seasonal phenomena rather than structural consequences of climate change requiring preventive interventions, both in the short and in the long-term.

Knowledge co-production and adaptive capacity

Respondents highlighted that formal unions' support to grassroot protests and public information campaigns served not only to increase the visibility of OHS risks linked to heatwaves but also to exert pressure on policymakers to institutionalise preventive measures. The interviews revealed a shared perception that institutions and employers tend to prioritise outdoor workers exposed to solar radiation, while preventive attention remains limited in less visible indoor workplaces such as logistics warehouses.

Union representatives emphasised that reinforcing protections requires continuous information and training for all prevention stakeholders, especially workers, OHS worker representatives. Drawing on scientific guidelines and outputs from the Worklimate project, unions have implemented awareness campaigns at both sectoral and territorial levels. In the Apulian agricultural sector, they disseminated multilingual materials to reach migrant workers, who represent most of the sectoral labour force.

To mitigate territorial and sectoral disparities, trade unions have reinforced second-level bargaining and established joint bilateral observatories with employers' associations at both sectoral and territorial levels. In Apulia—where the discussion on working conditions and heatwaves is more consolidated than in the logistic warehouses—respondents expressed satisfaction with the establishment of Cimala Ebat and Faila Ebat (bilateral bodies between employers and trade unions in charge of

monitoring working conditions in the agricultural sector at territorial level). Conversely, focus group participants from the logistics sector noted that the absence of monitoring bodies and limited empirical data hinder the design of targeted interventions for indoor workers. Although some regional ordinances mention workplaces lacking adequate ventilation, such as logistics warehouses, no specific protocols are yet in place.

Discussion

The study traces the evolution of the Italian regulatory framework for the prevention of occupational health and safety (OHS) risks associated with heatwaves, highlighting the gradual evolution of the institutional measures, and the role played by trade unions and collective negotiation. The documentary analysis shows that the Italian system has evolved incrementally rather than through structural reform, with early national policies focusing primarily on public health impacts rather than on workers' specific OHS risks. Over time, territorial ordinances—mostly regional or municipal—together with national agreements and sectoral protocols have become the key institutional tools for preventive action. However, the system still relies on a formal risk-management model that largely excludes workers and their representatives from decision-making, reflecting a reactive rather than preventive culture. Protocols are frequently adopted as emergency measures during the summer months, while permanent and uniform risk prevention frameworks remain limited.

The documentary analysis reveals that the evolution of the protection system addressing OHS risks associated with heatwaves has largely stemmed from emergency responses by institutional actors, rather than from long-term preventive approaches. This reactive dynamic has led to the adoption of specific sectoral protocols and territorial ordinances, primarily targeting outdoor workers in agriculture and construction—sectors widely examined in the literature—while often neglecting other categories of workers who may also be exposed to heat-related illnesses. Moreover, reliance on regional ordinances was described as a key source of fragmentation and inequality, as the level of protection depends heavily on the strength of social dialogue and the prevention culture of regional administrations. This results in uneven implementation of measures and differentiated access to protections among workers, sectors, and territories. In sum, this model has resulted in fragmentation regarding both the scope of measures—for instance, ranging from the suspension of work activities to the provision of information and training for preventive actors, including workers—and, consequently, inequalities across workers, sectors, and territories. Moreover, the analysis shows that redundancy funds, wage supplementation fund, and bilateral solidarity funds, although constituting an important tool for income protection, function mainly as a compensatory rather than preventive instrument. Proactive strategies—such as acclimatisation procedures, mandatory risk assessments, and heat-stress training—are not systematically implemented, and OHS monitoring is limited, particularly in sectors most exposed to heatwaves. Scientific guidelines, notably those developed through the Worklimate project, have been partially integrated into regulations and ordinances, yet their implementation is inconsistent and varies regionally.

Overall, results revealed that trade unions and social dialogue play a crucial role in addressing complex OHS risks related to heatwaves and, more broadly, in responding to the health and safety implications of climate change. National protocols negotiated with unions have helped to define shared standards based on scientific evidence, while second-level bargaining and local agreements have addressed specific risks at sectoral and territorial levels. The quality of collaboration among prevention actors—governments, employers, local health institutions, the scientific community, and labour inspectorates—proves to be decisive in determining the effectiveness of protection systems and in shaping whether existing inequalities are reduced or reinforced, as well as in recognising heatwaves as an occupational health issue and in shaping related interventions. Institutional action still tends to intensify in response to union pressure or social mobilisation, rather than through proactive governance.

Experts interviewed in the study stressed that collaboration with trade unions is crucial to bridge the gap between scientific evidence and practical application in workplaces, as unions translate technical recommendations into operational practices. Therefore, unions act as intermediaries between scientific knowledge and workplace practice. At the same time, researchers rely on unions to access informal data and co-develop adaptive solutions grounded in workers' direct experiences. This collaborative role positions trade unions as key actors in monitoring the implementation of scientific guidelines—alongside labour inspectorates—and in generating contextual knowledge and short-term adaptive strategies to cope with the risks of heatwaves. Such collaboration has fostered the emergence of agreements at territorial, company, and sectoral levels,

which complement general regulations with context-specific interventions.

Developing an effective prevention system requires coordinated engagement not only among actors, but also among key dimensions such as regulatory recognition of heatwave related OHS risks; technical and organisational adaptation of workplaces; temporal rescheduling of work; adequate economic protection; provision of PPE; training for prevention actors; and active worker participation[25]. To promote a culture of safety, joint monitoring protocols should assess temperatures (including humidity), work intensity, exposure duration, and individual vulnerability[6, 10, 27].

When benchmarked against international standards such as the ILO guidelines[20] and the other countries participating in the Adaptheat project[28], the Italian system presents both strengths and critical weaknesses. Italy distinguishes itself for its robust integration of scientific knowledge into prevention instruments, and its early warning infrastructure, with Worklimate risk maps and National Bulletin closely aligned with ILO recommendations on early warning systems, as previously explained. Yet significant gaps persist: a fragmented territorial implementation, uneven social dialogue among sectors, and an enduring focus on emergency response rather than structural prevention. The system still treats heatwaves as episodic events, relying mainly on economic compensation instead of embedding prevention and adaptation into long-term OHS planning. Moreover, enforcement remains weak, particularly in small and medium-sized firms, due to limited labour inspectorate capacity.

To advance towards a comprehensive and equitable system, heatwave prevention must be integrated into broader climate adaptation and just transition policies. A preventive governance model should link environmental, labour, and social dimensions, recognising how climate change exacerbates inequalities in employment, income, and health. Strengthening multilevel collaboration—both vertically across governance tiers and horizontally among sectors—will be essential to ensure coherence between national standards and local implementation.

In conclusion, this study tries to contribute to understanding how institutional and social dynamics interact in shaping the prevention of climate related OHS risks at territorial and national level. The findings indicate that effective protection requires a shift from reactive and fragmented measures to adaptive, preventive, and participatory governance. Strengthening coordination between institutional levels, embedding scientific knowledge in regulation, and consolidating social dialogue across sectors are essential to ensure equitable and climate-resilient working conditions. As heatwaves intensify in frequency and duration, these insights may inform not only the evolution of Italy's prevention system but also broader European and international efforts to align occupational safety with the imperatives of a just and sustainable transition.

Conflict of Interest

None.

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Appendix Table 1.

Characteristics of key informants (in-depth interviews)

Role	Institution
Director of the Worklimate project	National Research Council (CNR), Institute of Bioeconomy (IBE),
Head of the Laboratory of Occupational and Environmental Epidemiology	National Research Council (CNR), Institute of Bioeconomy (IBE)
Director of the Environmental, Occupational Epidemiology and Cancer Registry Unit, and head of the national warning system for heatwaves	Department of epidemiology, Lazio health service (DEP Lazio)
Technical inspector at the Lecce territorial labor inspectorate	National Institute for Insurance against Accidents at Work (INAIL)
Union representative	Flai Cgil (national trade union, agriculture)
Union representative	Flai Cgil Puglia (regional Trade union, agriculture)
Employers' representative association	Confagricoltura Puglia (regional employers' association, agricolture)
Union representative	Filt Cgil (national trade union, logistic)
Union representative	Filt Cgil (national trade union, logistic)
National health and safety union representative	Cgil