http://jhmi.sums.ac.ir
Health Man & Info Sci
2026, 13(4), 263–273

HMIS
Health Management and Information Science

Review Article

War Shelter Preparedness as a Public Health and Governance Challenge: A Scoping Review

Mahmoudreza Peyravi[1], Milad Ahmadi Marzaleh[1, 2], Jahanbakhsh Vahdatnejad[3], Fatemeh Nematollahi[3], Samaneh Dehghan Abnavi[3], Majid Dejbakht[3,*]

[1] Department of Health in Disasters and Emergencies, School of Health Management and Information Sciences, Shiraz University of Medical Sciences, Shiraz, Iran
[2] Clinical Education Research Center, Shiraz University of Medical Sciences, Shiraz, Iran
[3] Student Research Committee, Shiraz University of Medical Sciences, Shiraz, Iran

Abstract:

Introduction: The evolving nature of armed conflicts—particularly their increasing concentration in urban areas—has heightened the need to reassess systems designed to protect civilian populations. War shelters represent a core component of civil defense and are expected to support not only physical safety but also public health and psychosocial well-being. However, in many countries, preparedness remains limited and fragmented, especially in relation to governance structures and health-oriented planning. This scoping review aimed to synthesize existing evidence on strategies, challenges, and health-related outcomes of war-shelter preparedness in settings with insufficient or uneven levels of readiness.

Methods: This scoping review followed the PRISMA-ScR guidelines. A systematic search was conducted in PubMed, Scopus, Web of Science, ScienceDirect, and Google Scholar for studies published between 2005 and 2025. Nineteen studies met the inclusion criteria. Data were extracted using a structured form and analyzed through thematic synthesis.

Results: Five overarching themes were identified: governance and policy; structural and technical design; public health and mental health; community engagement and education; and coordination and operations. Additional emerging themes included spatial equity in access, emerging technologies (including digital and sensor-based tools), and social adaptive capacity. Major gaps across the literature involved inadequate integration of public-health standards, limited provision of mental-health and medical services within shelters, and unequal spatial distribution of shelter infrastructure.

Conclusion: War-shelter preparedness should be conceptualized as a multidimensional, health-oriented system rather than a purely technical intervention. Strengthening shelter systems requires integrated governance, public-health planning, community participation, and institutional coordination to enhance civilian protection and public-health resilience.

Keywords: Armed Conflicts; Emergency Shelter; Civil defense; Public health; Urban Health

Article History:
Received: 2 February 2026
Accepted: 24 May 2026

Please cite this paper as:
Peyravi M, Ahmadi Marzaleh M, Vahdatnejad K, Nematollahi F, Dehghan Abnavi S, Dejbakht M. War Shelter Preparedness as a Public Health and Governance Challenge: A Scoping Review. Health Man & Info Sci. 2026; 13(4): 263-273. doi: 10.30476/jhmi.2026.110564.1361.

***Correspondence to:**
Majid Dejbakht,
Student Research Committee, Shiraz University of Medical Sciences, Shiraz, Iran **Email:** dejbakht@gmail.com

Introduction

In recent years, the nature of armed conflicts and security threats in urban areas has changed substantially. Air, drone, and missile attacks, together with increasing urban population density, have placed civilian populations at greater risk of direct exposure to warfare than in the past (1, 2). These developments underscore the urgent need to reconsider the principles of civilian protection, particularly the role of shelters in countries that lack standardized infrastructure

Copyright: ©Health Management and Information Science. This is an open-access article distributed under the terms of the Creative Commons Attribution-No Derivatives 4.0 International License. This license allows reusers to copy and distribute the material in any medium or format in unadapted form only, and only so long as attribution is given to the creator. The license allows for commercial use

and formal preparedness plans for war shelters, which are settings lacking formal shelter construction standards, integrated health-oriented emergency planning, and coordinated crisis response systems (3, 4).

Historical experiences -from World War II shelters in Spain and the United Kingdom to urban defense structures during the Cold War- indicate that shelter effectiveness depends on technical standards, accessibility, and coherent management systems (5). Nevertheless, many older shelters lacked adequate ventilation, sustainable energy supply, emergency exits, or basic public health facilities, a limitation that has also been documented in more recent studies (6, 7).

From a public health perspective, shelters are not merely physical structures but critical infrastructures for safeguarding physical, mental, and social health during crises (8). Historical and contemporary evidence shows that overcrowding, inadequate ventilation, air pollution, limited access to basic services, and the absence of psychosocial support may lead to serious outcomes, including respiratory diseases, anxiety, post-traumatic stress disorder, and increased secondary mortality (9, 10). Findings from recent urban crises, such as the war in Ukraine and conflicts in the Middle East, further emphasize the importance of health-oriented shelter planning (11, 12).

Beyond health and infrastructural considerations, appropriate shelter location represents a fundamental challenge. Studies suggest that decision-making processes lacking spatial analysis, population behavior modeling, and risk assessment can render shelters ineffective, even when structurally adequate facilities are available (13). Moreover, spatial inequalities in access to shelters -observed in many cities in low-income and middle-income countries- may exacerbate mortality and health disparities within communities (14, 15).

Despite the growing relevance of this topic, previous research has often focused primarily on engineering aspects, site selection, or historical analyses, with limited attention to health-oriented and multisectoral approaches to shelter systems. A major gap in the existing literature is the absence of a comprehensive framework that integrates engineering design, governance, public health, mental health, and social participation.

Accordingly, this study aims to: 1. identify strategies and models adopted by countries that have improved shelter performance despite limited preparedness; 2. analyze the structural, managerial, and health-oriented challenges of war shelters; and 3. provide practical lessons to strengthen urban shelter systems globally, with specific considerations for contexts with similar governance and infrastructure challenges

By integrating historical, engineering, and health-oriented evidence, this study seeks to present a comprehensive, realistic, and actionable perspective for policymakers, disaster health professionals, and urban planners.

Materials and Methods

Study Design

This scoping review was conducted between January and June 2025 and includes evidence published up to the end of September 2025. It was performed in accordance with the PRISMA extension for Scoping Reviews (PRISMA-ScR) guidelines (16). The purpose of this approach was to identify, describe, and synthesize existing evidence on the preparedness of war shelters, particularly in countries that lack adequate infrastructure or where existing systems are inefficient. A scoping review methodology was selected due to the broad scope of the topic, the diversity of available evidence, and the multidisciplinary nature of effective shelter development. Rather than evaluating the effectiveness of the intervention, this review focused on mapping the current state of knowledge, identifying evidence gaps, and extracting policy-relevant insights.

Research Question and PCC Framework

The scope of the review was defined using the Population–Concept–Context (PCC) framework (17). Based on this framework, the main research question was formulated as follows:

What strategies, challenges, and outcomes related to war shelter preparedness have been

reported in countries with inadequate infrastructure, and what lessons do these findings provide for health systems and crisis management?

Search Strategy

A systematic search was conducted using a combination of controlled vocabulary (e.g., MeSH terms where applicable) and free-text terms across major databases. The detailed search strategy, including the conceptual scope of keywords, Boolean logic, and limits applied, is presented in Table 1. Studies published between 2005 and 2025 were reviewed to capture the emerging threats, urban warfare patterns, and modern approaches to shelter design. The databases searched included PubMed, Scopus, Web of Science, ScienceDirect, and Google Scholar, and grey literature sources were also consulted. The relatively limited number of eligible studies reflects the still emerging and fragmented nature of the evidence base on war shelter preparedness.

Eligibility Criteria

Inclusion Criteria

Studies were considered eligible if they:

- addressed war shelters or shelters applicable in armed conflict settings;
- examined public health elements such as ventilation, overcrowding, crisis management, technical design, or community participation;
- were based on empirical data, modeling, document analysis, or qualitative methods;
- had full-text availability and were published in English;
- had direct or applicable relevance to shelter preparedness.
- Studies addressing disaster-related shelters (e.g., storm or seismic shelters) were included when their structural or preparedness principles were applicable to civilian protection in armed conflict settings.

Exclusion Criteria

Studies were excluded if they:

- focused solely on engineering aspects without relevance to civilian defense;
- addressed animal shelters, homelessness, or non-conflict-related social housing;
- lacked empirical data (e.g., opinion pieces or letters to the editor);
- had no direct relevance to human populations or public health considerations.

Table 1. Search Strategy Applied in the Scoping Review based on the PCC Framework

Search Component	Description
Population (P)	Civilian populations exposed to war-related threats and attacks
Concept (C)	War shelters, including design, management, location planning, and health-related outcomes
Context (C)	Countries with inadequate preparedness, aging or insufficient shelter infrastructure, or fragmented governance systems
Databases	PubMed, Scopus, Web of Science, ScienceDirect, and Google Scholar (grey literature)
Search approach	Comprehensive search using a combination of controlled vocabulary (MeSH, where applicable) and free-text terms
Core shelter terms	"war shelter", "air-raid shelter", "civil defense shelter", "emergency shelter"
Public health terms	"public health emergency preparedness", "health preparedness", "civilian protection"
Conflict-related terms	"conflict zone", "armed conflict", "urban warfare"
Boolean logic	AND / OR operators were used to combine search concepts
Limits applied	English language; no restriction on study design

Study Selection Process

All retrieved records were compiled into a single database using EndNote X8 to manage references and remove duplicates. The study selection process followed the PRISMA-ScR framework.

A total of 88 records were identified through database searching. After removal of 23 duplicate records, 65 records remained. Following title and abstract screening, 17 records were excluded, leaving 48 records for further assessment.

Of the 48 records identified for potential full-text assessment, 25 articles were obtained as full-text reports and proceeded to eligibility assessment. Full-text could not be retrieved for the remaining 23 records (e.g., conference abstracts, inaccessible grey literature, or broken links), and they were therefore excluded from further assessment.

Subsequently, 25 full-text articles were assessed for eligibility. Six articles were excluded due

to lack of health-oriented focus, limited relevance to civilian defense, or insufficient applicability to urban conflict contexts.

Ultimately, 19 studies were included in the final scoping review.

Data Extraction

Data extraction was performed using a structured, predesigned form. Extracted variables included country, year, and study context. Information on shelter type or civilian protection mechanisms and the nature of threats examined -such as aerial, explosive, urban, or chemical threats- was also recorded. Public health considerations, including ventilation conditions, levels of overcrowding, access to medical services, and mental health dimensions, were systematically extracted. In addition, reported challenges, implemented strategies, and key outcomes and lessons learned from each study were documented and analyzed.

Data Analysis: Thematic Analysis

Qualitative data were analyzed using a thematic analysis approach based on the framework proposed by Braun and Clarke (18). This process involved six main stages: data familiarization, initial code generation, code clustering, development of preliminary themes, theme review, and final definition and naming of themes.

To enhance analytical rigor and credibility, two independent reviewers conducted the initial coding process. Discrepancies were resolved through discussion and consensus.

Ethical Considerations

As this study relied exclusively on published secondary data, ethical approval was not required. Nevertheless, principles of scientific integrity, transparency in reporting, and accurate citation were strictly observed.

Results

Study Selection

The study selection process was conducted in accordance with the PRISMA-ScR guidelines. The PRISMA flow diagram (Figure 1) illustrates the stages of identification, screening, eligibility assessment, and final inclusion of studies in this scoping review.

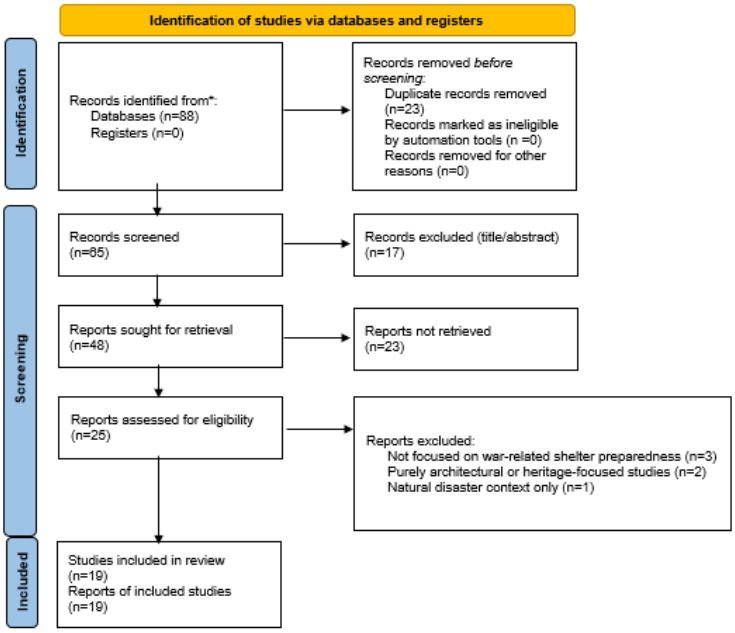


Figure 1. PRISMA-ScR flow diagram illustrating the study selection process for this scoping review

As a result of the thematic analysis, five main themes were identified: governance and policy; structural and technical design; public health and mental health; community engagement and education; and coordination and operations. In addition, three emerging themes were identified: spatial equity in access; emerging technologies (including digital and sensor-based tools); and social adaptive capacity. A detailed breakdown of themes, subthemes, and supporting studies is presented in Table 3.

This scoping review included 19 studies encompassing historical, technical, governance-related, and public health perspectives on war shelters and emergency sheltering. Of these, 7 (36.8%) addressed governance and policy, 6 (31.6%) focused on structural and technical design, 7 (36.8%) examined public health and mental health, 4 (21.1%) explored community engagement, 4 (21.1%) addressed coordination and operations, and 3 (15.8%) identified emerging themes such as spatial justice, technology, and social cohesion. Because some studies contributed to more than one theme, percentages are not mutually exclusive. The body of evidence reflects diverse geographical contexts and methodological approaches, including qualitative analyses, document reviews, GIS-based modeling, engineering assessments, and health-oriented research.

Collectively, these studies provide a multidimensional understanding of shelter preparedness.

Governance and Policy

Governance emerged as a foundational determinant of shelter effectiveness. The synthesis indicates that shelter systems embedded within coherent legal frameworks and long-standing civil defense structures demonstrate greater operational stability, sustained maintenance, and higher levels of public trust. In contrast, fragmented governance arrangements and the absence of binding mandates were associated with reactive planning, unclear institutional responsibilities, and reduced readiness during crises.

In addition, regulatory approaches toward public–private collaboration appeared to influence the expansion and sustainability of shelter networks. Contexts with structured coordination mechanisms showed more integrated and resilient shelter systems. Further thematic details are summarized in Table 3.

Structural and Technical Design

Technical and structural characteristics were consistently identified as critical determinants of both safety and habitability. Key design dimensions included blast resistance, ventilation capacity, environmental control, accessibility, evacuation routes, and multi-purpose functionality. The evidence suggests that deficiencies in airflow management, humidity control, and spatial layout may compromise indoor environmental quality and increase health risks during prolonged sheltering.

At the same time, findings indicate that older shelters may remain functional when systematically maintained and retrofitted, whereas the absence of maintenance frameworks often results in structural deterioration and limited usability. Updated design approaches emphasize inclusivity, environmental safety, and adaptability. A comprehensive overview of structural subthemes is provided in Table 3.

Public Health and Mental Health

Health-related considerations were among the most prominent gaps identified across the reviewed studies. Overcrowding, inadequate ventilation, poor lighting, sleep disruption, and limited access to medical and psychosocial services were frequently associated with adverse physical and mental health outcomes. The synthesis suggests that sheltering conditions can amplify stress responses, anxiety, and longer-term psychological consequences when not supported by appropriate management and health services.

Conversely, contexts in which mental health support, risk communication, and targeted care for vulnerable groups were integrated into shelter systems demonstrated more protective outcomes. These findings underscore the importance of embedding public health planning within shelter governance and design. Detailed thematic mapping is presented in Table 3.

Community Engagement and Education

Community-level preparedness emerged as a significant mediator of shelter effectiveness. Structured education programs, regular drills, and accessible communication channels were associated with improved shelter use, reduced operational disorder, and safer behavioral responses during emergencies. Familiarity with shelter locations, procedures, and internal organization appeared to strengthen collective resilience.

In contrast, weak communication infrastructures and low institutional trust were linked to delayed sheltering and uncoordinated responses. These findings highlight the importance of integrating community engagement into broader civil defense strategies. Supporting subthemes are summarized in Table 3.

Coordination and Operations

Shelters function most effectively when managed within coordinated, multi-level institutional systems. The evidence indicates that unified command structures, cross-agency collaboration, and integrated information systems enhance operational efficiency, resource allocation, and public communication. Conversely, fragmented authority and unclear role delineation were associated with delays, confusion, and reduced shelter performance.

Technological tools, including geospatial mapping and digital databases, were frequently described as enablers of improved planning and decision-making capacity. Additional details are provided in Table 3.

Emerging Themes

Beyond the primary thematic domains, three cross-cutting issues were identified. First, spatial equity emerged as a recurrent concern, with unequal distribution of shelters across urban areas carrying implications for social justice and population health. Second, technological innovation—including environmental monitoring, intelligent ventilation, and adaptive design—was described as increasingly influential in shaping future shelter systems. Third, social adaptive capacity and community cohesion appeared to enhance shelter performance even in resource-constrained settings.

Overall, the synthesized evidence indicates that shelter preparedness extends beyond engineering adequacy and is shaped by the interaction of governance quality, health integration, social participation, structural design, and institutional coordination. Effective models reflect multidimensional and health-oriented approaches, whereas fragmented systems remain vulnerable to recurring operational and public health challenges.

Table 2. Characteristics of the Included Studies (n = 19)

Country/Setting	Study Type	Focus of Study	Shelter Type / Context	Public-Health Findings	Operational / Technical Findings	Key Challenges	Key Recommendations
UK	Conflict archaeology	WWII air-raid shelters	Underground brick/concrete shelters	Poor ventilation; crowd stress	Structural degradation	Limited preservation	Structural upgrading; documentation
Sweden	Conflict archaeology	Cold War civil defense shelter	Residential building shelter	Lack of modern safety standards	Obsolete engineering	Aging infrastructure	Restoration with modern standards
Sweden	Media analysis	Civilian perception of shelters	Public shelters	Public anxiety; low trust	–	Weak communication	Improve risk communication
Sweden	Historical analysis	Urban civil defense	Public shelters	Stress, fear during raids	Mass sheltering strategies	Overcrowding	Better planning of access routes
USA	Public health	Emergency shelter health workforce	Storm shelters	Infectious disease risk; chronic disease gaps	Staffing shortages	Limited PH preparedness	Workforce training
Spain	Heritage architecture	Civil War shelters	Urban underground shelters	Temperature/humidity issues	Structural conservation	Aging design	Modern retrofitting
China	Engineering design	Emergency field lodging	Temporary emergency shelters	Environmental health factors	Structural layout	Thermal discomfort	Design optimization
China	Historical—WWII	Wartime civilian sheltering	Natural + built shelters	Heat stress; CO_2 accumulation	Underground adaptation	Poor sanitation	Improve ventilation
Spain	Architectural analysis	Private air-raid shelters	Residential shelters	Limited capacity	Architectural constraints	Poor access	Standardization
Multi	Urban crisis planning	Passive defense	Future urban shelters	PH vulnerabilities	Resilience planning	Lack of integrated planning	Ecosystem-based planning
Spain	Architecture	New entrance to shelter	Historical shelter	Accessibility issues	Entrance redesign	Narrow access routes	Improve circulation
UK	Psychology	Civilian morale	Wartime shelters	Anxiety, fear	–	Overcrowding	Psychological support
UK	Psychology	Civilian morale WWII	Public shelters	PTSD-like symptoms	–	Panic	Public mental health planning
Europe	Engineering guidelines	Civilian shelters	Purpose-built shelters	Environmental safety	Blast resistance	Insufficient standards	Unified design guidelines
Japan	Public health	Disaster preparedness	Special needs schools	Vulnerable groups	Evacuation issues	Poor accessibility	Inclusive design
China	GIS + field assessment	Seismic emergency shelters	Earthquake shelters	Hygiene gaps	Site selection	Mis location	GIS-based optimization
Poland	Urban planning	Repurposing WWII shelters	Abandoned shelters	Community health benefits	Structural viability	Urban decay	Regeneration
Global	PH preparedness	Emergency sheltering	Mixed shelter types	Disease outbreaks; PH system gaps	Governance failures	Weak coordination	PH frameworks
Israel	Anthropology	Civilian wellbeing	Wartime shelters	Psychosocial stress	–	Social inequality	Community-based approaches

Table 3. Thematic Analysis: Main Themes and Sub-Themes

Main Theme	Sub-Themes	Supporting Studies	Summary of Extracted Meaning
Governance and Policy	Legal framework; inter-sector coordination; funding	1,2,3,4,8,14,18	Countries with national shelter laws perform better; lack of governance → fragmented response
Structural and Technical Design	Ventilation; energy; blast resistance; multi-use design	1,2,7,9,11,14	Structural quality determines health + safety outcomes; old shelters inadequate
Public Health and Mental Health	Medical care; hygiene; vulnerable groups; psychosocial support	5,8,12,13,15,18,19	Main gap: mental health, sanitation, chronic disease management in shelters
Community Engagement and Education	Training; drills; public awareness; trust	3,4,10,15	Drills reduce casualties; risk communication crucial
Coordination and Operations	Unified command; cross-agency communication; logistics	10,14,16,18	Lack of operational framework → delays, chaos
Emerging Themes	Spatial Equity in Access; Emerging Technologies; Social Adaptive Capacity	11,17,19	Inequitable access; tech improves monitoring; community cohesion protects wellbeing

To enhance transparency and establish a direct linkage between the review findings and the research objectives, we mapped the extracted evidence to the review research questions. The table below illustrates how each research question was supported by the included studies.

Table 4. Mapping of Included Evidence to the Review Research Questions

Research Question	Evidence from Included Studies	Synthesized Interpretation
Strategies used by underprepared countries	1–4, 6–12, 14–18	Mixed strategies: heritage shelters, improvised shelters, GIS-based location, multi-use design
Challenges in implementation	1,2,5,8,10,12,15,18	Technical failures, poor ventilation, mental health gaps, poor governance
Public health implications	5,8,12,13,15,18,19	Mental health = biggest deficit; sanitation and vulnerable groups require priority

To enable a comparative assessment of war shelter conditions, management approaches, and health-related considerations across different countries, the findings were categorized by country of study. The following table presents a comparative overview of key similarities and differences.

Table 5. Country Comparison Matrix

Country	Strengths	Weaknesses	Public-Health Impact
UK	Historical experience; community shelters	Overcrowding	High psychological stress
Sweden	Strong civil defense heritage	Aging shelters	Moderate stress
Spain	Underground shelter network	Poor ventilation	Temperature/humidity issues
USA	Strong PH preparedness	Staffing gaps	Disease outbreaks
China	GIS-based planning	Poor sanitation in old shelters	Heat stress
Japan	Inclusive design; special-needs planning	Accessibility gaps	Vulnerable groups at risk
Poland	Adaptive reuse	Urban decay	Minimal PH infra
Israel	Strong community cohesion	Inequality of access	High psychosocial stress

Discussion

This scoping review shows that the effectiveness of war shelters cannot be explained solely by technical specifications or construction quality. Rather, it emerges from a complex interaction among policy-making, public health, social culture, technical infrastructure, and institutional coordination. Countries that have integrated civil defense into their urban governance structures over several decades - such as Sweden, Finland, and Japan- have succeeded in establishing integrated and

sustainable systems that function effectively not only during armed conflict but also in non-military crises. This finding is consistent with historical and archaeological studies from Spain and the United Kingdom, which demonstrate that systematic policy-making, even in earlier periods, contributes to the development of resilient and reliable shelter infrastructures (19-21).

In contrast, countries with repeated experiences of war but lacking stable governance models have consistently faced structural and institutional challenges. These challenges include fragmented authority, the absence of routine maintenance programs, a lack of unified standards, and ineffective communication systems with the public (22, 23). Such differences suggest that the capacity of a country to develop effective shelters is less dependent on financial resources and more closely linked to the quality of governance and institutional coherence.

From a public health perspective, the findings highlight that ventilation quality, population density, access to basic services, and environmental design directly influence both physical and mental health outcomes. Several studies associated poor shelter ventilation with a higher prevalence of respiratory conditions and reduced indoor air quality (24). At the same time, the mental health literature -spanning both World War II and contemporary conflicts- consistently emphasizes that sheltering experiences can intensify anxiety, stress, and psychological disorders unless supportive services, transparent communication, and effective crowd management are provided (25, 26). These findings underscore the necessity of integrating public health considerations into shelter design and management.

Community participation and sheltering culture also play a critical role in shelter effectiveness. Studies examining Swedish and Finnish media demonstrated that effective public communication and widespread civic education could strengthen public trust in civil defense systems and improve sheltering behaviors (27). Conversely, in contexts characterized by low trust in institutions or the absence of structured educational programs, shelters may fail to function effectively during crises even when technically well designed. These findings reinforce the importance of effective communication and community integration throughout the planning cycle.

One of the emerging themes identified in this review is spatial justice. The analysis revealed that shelters are often concentrated in more affluent areas or private buildings, while disadvantaged neighborhoods -frequently exposed to higher urban risks and wartime casualties- have more limited access to standard shelters. This spatial disparity, documented in cities across Spain, the United Kingdom, China, and parts of the Middle East, carries serious implications for public health equity and social inequality. These patterns suggest that national shelter programs must adopt equity-oriented approaches and prioritize areas with the greatest vulnerability.

Another key theme concerns the role of emerging technologies in reshaping future shelter systems. GIS-based modeling studies in Ukraine and China showed that integrating hazard maps, demographic data, and decision-support models could significantly improve shelter location planning (15). In addition, smart ventilation systems, energy management technologies, air-quality sensors, and modular design approaches have been identified as essential components of twenty-first-century shelters. Together, these findings suggest that shelters can evolve from passive protective structures into active and intelligent systems (24, 28, 29).

In terms of governance, the findings emphasize that shelters operate most effectively when managed within a coordinated, multi-level governance framework. Japan provides a prominent example of coordination among local governments, municipalities, ministries of education and health, and civil defense institutions. This coordination enables schools, metro stations, sports halls, and public spaces to be rapidly converted into functional shelters during crises (30). The absence of such coordination has been a major contributor to shelter inefficiency in some Middle Eastern contexts, where delays in communication, institutional confusion, and the lack of a unified command structure have contributed to increased casualties.

This review also reveals important gaps in the existing literature. First, most studies have focused on technical design or historical dimensions, while relatively few have comprehensively examined public health, mental health, social, and institutional dimensions together. Second, much of the available evidence originates from high-income countries, with limited research conducted in low-income settings or regions affected by ongoing conflicts, potentially introducing bias and limiting generalizability. Third, detailed data on mental health outcomes associated with sheltering remain scarce, highlighting a critical area for future research.

Taken together, the findings of this scoping review reinforce the view that war shelters should not be conceptualized solely as physical protective structures, but rather as integral components of public health and disaster risk management systems. The evidence suggests that shelter effectiveness is shaped by governance quality, health-oriented design, institutional coordination, and societal engagement, rather than by financial investment alone. As contemporary threats become increasingly urban, rapid, and hybrid in nature, shelter preparedness emerges as a strategic public health priority. This perspective underscores the need for multisectoral, evidence-informed approaches that embed shelters within broader frameworks of civilian protection, mental health preparedness, and urban resilience.

Policy and Practice Implications

Drawing on the interpretive synthesis of the reviewed studies, this section outlines key policy- and practice-oriented implications for improving war shelter and emergency accommodation systems. Rather than reiterating empirical findings, the following points summarize actionable insights relevant to diverse national and urban contexts.

Key policy and practice implications include:

Strengthening governance and coordination: Effective shelter systems require coordinated, multi-level governance frameworks with clear command structures and nationally binding standards. Evidence from countries with established civil defense systems suggests that intersectoral coordination between health authorities, municipalities, and civil defense agencies is essential for operational effectiveness and crisis responsiveness (21, 28).

Adopting a health-centered and human-centered approach:

Shelter planning and management should prioritize public health considerations, including adequate ventilation, sanitation, lighting, crowd management, and accessibility for vulnerable populations. These elements are critical to minimizing physical and psychological harm during prolonged sheltering (22, 26).

Promoting adaptive and multi-purpose shelter strategies:

In resource-constrained or densely populated settings, adaptive reuse of existing public infrastructure—such as schools, parking facilities, metro stations, and sports halls—offers a feasible and cost-effective alternative to large-scale new construction (25, 34).

Ensuring spatial equity in shelter distribution: Equitable access to shelters should be recognized as a core planning principle. The use of GIS-based hazard mapping and demographic analysis can support fairer distribution of shelter capacity based on population risk and vulnerability, reducing health and security disparities (15).

Institutionalizing maintenance and monitoring mechanisms:

Regular inspection, maintenance schedules, and dedicated funding streams are necessary to sustain shelter functionality and readiness over time, particularly with respect to ventilation, sanitation, and structural safety (23, 24).

Enhancing community preparedness and public engagement:

Public education, evacuation drills, and community participation play a decisive role in improving shelter utilization and trust during emergencies. Integrating these elements into national civil defense strategies can promote safer behaviors and institutional legitimacy (21).

Leveraging emerging technologies:

The integration of smart technologies—such as air-quality monitoring, intelligent ventilation systems, renewable energy solutions, and

modular designs—represents a forward-looking policy option to enhance safety, resilience, and sustainability in shelter systems (22, 31).

Taken together, these implications suggest that countries facing varying degrees of institutional capacity, urban density, and resource availability may benefit from phased, context-sensitive approaches to shelter system development. Aligning governance structures, public health principles, spatial equity, technological innovation, and community participation appears central to strengthening preparedness and resilience in emergency sheltering systems across diverse settings.

Limitations

Despite adherence to the PRISMA-ScR guidelines, this scoping review has several limitations that should be considered when interpreting the findings. First, the fragmented and multidisciplinary nature of the war shelter literature -encompassing historical, engineering, urban planning, and public health studies- poses challenges for direct comparison and contributes to heterogeneity in health-related data. Second, a substantial proportion of the available evidence is based on qualitative or historical studies, with relatively limited quantitative and epidemiological data. As a result, some health-related interpretations rely on inferential and interpretive analysis. Third, restricting the review to English-language publications and accessible academic sources might have introduced language bias and led to the exclusion of relevant field-based evidence from contemporary conflict settings. Nevertheless, despite these limitations, the study provides a comprehensive overview of the current evidence, key challenges, and knowledge gaps related to war shelters through a structured methodology and thematic analysis.

Conclusion

This scoping review demonstrates that war shelter preparedness is a multidimensional challenge shaped by the interaction of governance, technical design, public health, social participation, and institutional coordination. Evidence from 19 studies indicates that countries with systematic and coordinated civilian protection frameworks achieve more effective shelter performance, extending beyond structural safety to include population management, public education, and health-related preparedness.

Overall, the findings underscore that war shelters should be considered as components of public health and disaster preparedness systems rather than solely as physical protective structures. As contemporary threats become increasingly urban and complex, adopting health-centered, multisectoral, and evidence-informed approaches to shelter planning and governance is essential for enhancing civilian protection and long-term societal resilience.

Declarations

Authors' Contribution:

MP, JV, FN, SDA, and MD contributed to the conception and design of the study. MP, JV, and MD performed the literature search and study selection. All authors contributed to data extraction and synthesis, drafting the manuscript, critical revision for important intellectual content, and approval of the final version.

Conflict of Interest:

The authors declare that they have no competing interests.

Informed Consent:

Not applicable.

Funding/Support:

None declared.

Financial Disclosure:

None declared.

References:

1. Milutinović MS. Significance of the change of physiognomy of armed conflicts for the education of armed forces personnel. Vojno delo. 2024;(4):51-66.
2. Jones E. Air raids and the crowd: citizens at war. Psychologist. 2016;29(6):486-7.
3. Matsola A. Terms and concepts of civil defense facilities in the residential architecture. Urban Development and Spatial Planning. 2025:169-76.
4. Ryacudu R, Putra IN, Purwantoro SA. The role of reserve component in supporting total people's defense and security system (Sishankamrata) to confront the threat of the sixth generation warfare. Jurnal Pertahanan. 2021;7(1):37-49.
5. Mushynsky J. Don't talk about your fallout shelter: civilian perceptions of threat and structural responses during the Cold War in Regina, Saskatchewan between 1958 and 1963. Canadian Military History. 2019;28:1.

6. Bondarenko A, Yurchenko Y. Method of instrumental assessment of the infiltration indicator. Ukrainian Journal of Construction and Architecture. 2021;(1):64-72.
7. Mavrouli M, Mavroulis S, Lekkas E, Tsakris A, editors. An emerging health crisis in Turkey and Syria after the earthquake disaster on 6 February 2023: risk factors, prevention and management of infectious diseases. Healthcare (Basel). 2023. (Published by MDPI.)
8. Gautier L, Quesnel-Vallée A. Health and social needs of unprotected unaccompanied minors in Paris in the context of COVID-19. Eur J Public Health. 2020;30(Suppl 5):ckaa166.296.
9. Manafe N, Ismael-Mulungo H, Ponda F, Dos Santos PF, Mandlate F, Cumbe VF, et al. Prevalence and associated factors of common mental disorders among internally displaced people by armed conflict in Cabo Delgado, Mozambique: a cross-sectional community-based study. Front Public Health. 2024;12:1371598.
10. Brahmbhatt D, Chan JL, Hsu EB, Mowafi H, Kirsch TD, Quereshi A, et al. Public health preparedness of post-Katrina and Rita shelter health staff. Prehosp Disaster Med. 2012;24(6):500-5.
11. Shaikh Y, Hamouda MO, Elnakib S. Architecture of systems affecting disease trajectories in a conflict zone: a community-centered systems inquiry in North Gaza. PLOS Glob Public Health. 2025;5(9):e0004450.
12. Kokori E, Olatunji G, Yusuf IA, Isarinade T, Akanmu AM, Olatunji D, et al. A mini-review on safeguarding global health amidst a "pandemic" of armed conflicts. Medicine (Baltimore). 2024;103(20):e37897.
13. Zhu W, Xing H, Kang W. Spatial layout planning of urban emergency shelter based on sustainable disaster reduction. Int J Environ Res Public Health. 2023;20(3):2127.
14. Abdi YH, Abdi MS, Bashir SG, Ahmed NI, Abdullahi YB. Understanding global health inequality and inequity: causes, consequences, and the path toward justice in healthcare. Public Health Challenges. 2025;4(4):e70156.
15. Pomortseva O, Kobzan S, editors. Geospatial modeling of the location of bomb shelters in residential areas of the city. IOP Conf Ser Earth Environ Sci. 2023. (Published by IOP Publishing.)
16. Tricco AC, Lillie E, Zarin W, O'Brien KK, Colquhoun H, Levac D, et al. PRISMA extension for scoping reviews (PRISMA-ScR): checklist and explanation. Ann Intern Med. 2018;169(7):467-73.
17. Aromataris E, Munn Z. JBI manual for evidence synthesis. Adelaide: JBI; 2020.
18. Braun V, Clarke V. Thematic analysis: a practical guide. London: SAGE; 2021.
19. Andersson A. Preparation for the war which never came: the examination of a shelter inside an apartment building from the 1960's. J Conflict Archaeol. 2021;16(1):46-63.
20. Broseta Palanca MT. Defence heritage of the Spanish Civil War: preservation of air-raid shelters in Valencia. Int J Herit Archit. 2017;1(4):624-39.
21. Ainsworth JT, Pringle JK, Doyle P, Stringfellow M, Roberts D, Stimpson IG, et al. Geophysical investigations of WWII air-raid shelters in the UK. J Conflict Archaeol. 2018;13(3):167-97.
22. Muhammedally S. A primer on civilian harm mitigation in urban operations. Center for Civilians in Conflict. 2022;27.
23. Hussein H. Planning and design strategies for enhancing passive defense in future cities during wartime. Int J Hum Cap Urban Manag. 2025;10(4).
24. Shi L, Wang J, Han X, Wei W, Guo Y, Liu J. Natural ventilation of underground shelters to improve indoor thermal and moisture environments in the various climates of China. Tunn Undergr Space Technol. 2024;153:105916.
25. Zafer-Smith S. A sheltered place, a sheltered person? Ordering wellbeing in a time between wars in the northern Galilee. Anthropol Med. 2021;28(1):28-46.
26. Jones E, Woolven R, Durodié B, Wessely S. Civilian morale during the Second World War: responses to air raids re-examined. Soc Hist Med. 2004;17(3):463-79.
27. Bennesved P. Shelter news: affordance, place and proximity in news media representations of civil defence artefacts. Crit Mil Stud. 2024;10(1):1-18.
28. Jörgen A, Łątka JF, Tarczewski R, Szcześniak Z, Pieńko B, Morales-Beltran M, et al. Design of shelters for civilians in the event of armed conflict: state of the art and contemporary design guidelines. Housing Environment/Środowisko Mieszkaniowe. 2025;52(3).
29. Xiong J, Wu J, Yang Q, Tang Y, Xiang M, Tian Z, et al. Emergency shelter design optimization in mountainous China: onsite field investigation and indicator modification practice. Energy Build. 2025;347:116312.
30. Kawasaki H, Cui Z, Kurokawa M, Sonai K. Current situation of disaster preparedness for effective response in Japanese special needs schools. Disaster Med Public Health Prep. 2023;17:e435.