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Research Article

Impact of Search-and-Rescue Activities on Migrant Death Rates in the Mediterranean Sea: A Systematic Review

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Abstract

Background: Increasing migration across this European region has resulted in significant loss of life, raising debates about whether SAR operations act as a "pull factor" or serve a purely humanitarian role. The aim is to evaluate the effectiveness of SAR operations in reducing mortality and to explore the broader structural factors influencing migrant deaths and decision.

Objectives: To examine the impact of Search and Rescue (SAR) operations on migrant mortality rates in the Mediterranean Sea.

Methods: A systematic approach to the literature was adopted through a structured search of the academic databases PubMed, ScienceDirect, and Scopus to identify relevant quantitative studies. Following screening for relevance and alignment with the research aim, twelve studies were selected for inclusion. Owing to heterogeneity in study designs and reported outcomes, a narrative synthesis approach was employed to analyse patterns in mortality rates, health outcomes, and migration dynamics.

Results: The findings indicate that SAR operations play a critical lifesaving role by reducing mortality during sea crossings. Rescued migrants often present with severe physical and psychological health conditions, reflecting the dangers of the journey. Importantly, there was limited evidence to support the claim that SAR operations act as a primary pull factor. Instead, migrant mortality and movement patterns were more strongly influenced by structural drivers such as conditions in countries of origin, policy restrictions and the adaptative strategies of smuggling networks.

Conclusion: This study suggests that SAR operations are essential humanitarian interventions that mitigate, rather than contribute to, migrant mortality. Effective reduction in deaths requires not only strengthened and coordinated SAR efforts but also policy reforms addressing the root causes of migration and ensuring safe, legal pathways. Enhancing SAR capacity and removing operational barriers are critical to improving migrant survival and health outcomes in the Mediterranean region.

Keywords: Rescued migrant, Search and rescue operation, Mediterranean Sea, Smuggling route, Migrant health, Central Mediterranean, Migrant mortality.

Abbreviations: CASP: Critical Appraisal Skills Programme; COVID-19: Coronavirus Disease 2019; EU: European Union; HIV: Human Immunodeficiency Virus; IOM: International Organization for Migration; JBI: Joanna Briggs Institute; MSF: Médecins Sans Frontières; NGO: Non-Governmental Organisation; NOS: Newcastle–Ottawa Scale; OHCHR: Office of the United Nations High Commissioner for Human Rights; PICO: Population, Intervention, Comparison, Outcome; PRISMA: Preferred Reporting Items for Systematic Reviews and Meta-Analyses; SAR: Search and Rescue; UNHCR: United Nations High Commissioner for Refugees; WHO: World Health Organization.

Introduction

Search and Rescue (SAR) operations in the Mediterranean involve both state authorities and non-governmental organisations (NGOs). Following gaps in state-led efforts, particularly after Italy ended the Mare Nostrum operation in 2014, NGOs such as Médecins Sans Frontières (MSF) and SOS Méditerranée became central SAR actors [1,2]. Migration from countries affected by

conflict, political instability, and economic hardship including Syria, Afghanistan, Bangladesh, Mali, and Sudan has increased over the past decade [3], driving displacement towards Europe via the Central Mediterranean route. These journeys often involve dangerous transit through countries such as Libya [4]. Since 2014, the Mediterranean has remained the world's deadliest migration corridor, with approximately 34,000 recorded deaths, predominantly due to drowning during unsafe sea crossings [5]. Survivors often present severe physical and psychological health conditions associated with prolonged time at sea, requiring urgent and coordinated healthcare responses [6,5].

Despite the persistent loss of life in the Mediterranean Sea, Search and Rescue (SAR) activities have increasingly been subjected to legal and political restrictions imposed by coastal states and the European Union (EU) [7]. This is illustrated by Italian Law 1/2023, which restricts NGO rescue vessels by assigning distant ports, forcing them to travel unnecessary additional kilometres, and by imposing vessel detentions, as experienced by ships such as the Geo Barents and the Ocean Viking [8]. These measures have had a direct negative impact on the number of rescue operations, significantly reducing the capacity of civil SAR actors to save lives at sea. Beyond their direct effects, these restrictions also generate significant indirect consequences. By reducing operational capacity and increasing the pressure placed on SAR missions, they result in more constrained and time-limited interventions, thereby contributing to heightened vulnerability among migrants and to an underestimation of the true health burden among rescued populations.

The assessment of SAR operations in the Mediterranean Sea is crucial for understanding the role of NGOs in current migration flows. Analysing these efforts can clarify whether SAR activities act as a pull factor, influencing irregular migration, or if they are mainly limited to saving lives and providing healthcare for rescued individuals [9]. Additionally, examining the health risks faced onboard SAR vessels offers a chance to evaluate whether these efforts help reduce the spread of infectious diseases and meet urgent medical needs, which has implications for public health in areas where migrants disembark. This review of empirical evidence could also guide policy decisions, which are often based on assumptions, public opinion, or political interests [10]. By filling these knowledge gaps, this study aims to build a solid, evidence-based understanding of the effectiveness, humanitarian impact, and operational importance of SAR efforts in the Mediterranean migration scene. Therefore, this study aims to synthesise empirical research to determine whether the presence and intensity of SAR missions in the Mediterranean Sea are linked to changes in migrant mortality rates. The research objectives were:

a) to measure the effectiveness of SAR operations in the Mediterranean in terms of reducing migrant mortality.

b) to identify high-risk periods and locations for migrant mortality in the Mediterranean and determine priority rescue and care needs.

c) to assess evidence on the potential "pull factor" of SAR operations and their influence on migrants crossing the sea.

Material and Methods

Research Question Formulation

Formulating a research question is essential since it supports the scientific method and clarifies the topic [11]. In a systematic review, keywords derived from the research question guide the literature search [12]. In fact, a poorly defined research question can lead to selecting the wrong studies and missing important findings [13]. The PICO framework (Population, Intervention, Comparison, Outcome) was selected for this study since it is particularly well suited to quantitative reviews that emphasise measurable. Thereby supporting evidence that is directly relevant to policymakers and non-governmental organisations (NGOs) [14]. The PICO framework, as shown in Table 1, was used to formulate the research question below:

Table 1: PICO Framework.

PICO framework	Description
Population (P):	Migrants
Intervention (I):	SAR operations
Comparison (C):	Periods or regions with limited, reduced, or no SAR operations
Outcome (O):	Improving migrant's health

To what extent do Search and Rescue (SAR) operations in the Mediterranean, compared with periods or regions with limited, reduced, or no SAR operations, influence migrant mortality and decisions to undertake maritime crossing?

Databases Selection

In the context of systematic review, the use of a combination of bibliographic databases is essential to ensure the comprehensiveness of the search strategy [15]. Relying on a single database is insufficient, as no individual source can cover the full scope. Consequently, additional databases and complementary resources are required to minimise the risk of missing relevant evidence and to reduce potential selections bias [16]. The present study drew upon three major databases: PubMed [17], Scopus [18] and ScienceDirect [19]. Together these databases provided access to a wide range of peer reviewed literature related to Search and

Rescue operations, enabling comprehensive and focused searches, while minimising the risk of missing key studies.

Search Strategy

The development of a search strategy is a crucial step in carrying out a systematic literature review. It determines the understanding, transparency and reproducibility of systematic reviews, helps to address the complexity of databases and differences in search syntax across platforms [20]. The research question was translated into key concepts, from which relevant keywords and synonyms were identified, as presented in Table 2. These keywords and their synonyms were then combined using Boolean operators (AND, OR) to develop a search strategy [21] as presented below:

Table 2: Keywords and Synonyms Used.

Main Keywords	Synonyms/Alternative Terms
Population	"migrant" OR "refugees" OR "asylum seeker" OR "rescue operation"
Intervention/Exposure	"Search and rescue" AND "SAR" OR "search and rescue operation" OR "saving migrant"
Outcome	"mortality" OR "death" OR "maritime crossing" AND "migrant health" OR "migrant rescued" OR "migrant health status"
Location	"Mediterranean Sea" OR "Central Mediterranean"

"migrant" OR "refugees" OR "asylum seeker" OR "rescue operation" AND "Search and rescue" AND "SAR" OR "search and rescue operation" OR "saving migrant" AND "mortality" OR "death" OR "maritime crossing" AND "migrant health" OR "migrant rescued" OR "migrant health status" AND "Mediterranean Sea" OR "Central Mediterranean".

Eligibility criteria

In a systematic review, Inclusion and exclusion criteria are crucial as they ensure only relevant, high-quality studies are selected [22]. Indeed, poorly defined criteria may introduce bias, reduce the overall quality of the review, and compromise its reproducibility [23]. The criteria were developed in line with the research question and aimed to select evidence that was both rigorous and contextually pertinent. As shown in Table 3, the systematic review includes studies published between January 2014 and January 2026, written in English, and focused exclusively on migrant populations in the Mediterranean Sea. Eligible studies address public health issues, social sciences, or maritime law. All studies that did not meet this eligibility criteria were excluded from this review

Table 3: Inclusion and exclusion Criteria.

Inclusion Criteria	Exclusion Criteria
Studies published between January 2014 and 2026	Studies before January 2014
Peer-reviewed empirical studies in English	Non-English or non-peer-reviewed studies
Research addressing public health, social sciences or maritime law	Studies focusing exclusively on clinical medical data or non-SAR activities related to COVID-19
Studies involving migration populations	Studies focusing on other form of mobility (e.g. tourism or non-migrant population)
Studies focusing on the Mediterranean Sea	Studies examining other migration route
Journal research articles	Books, book chapter, reports
Quantitative studies	Qualitative studies

Data Extraction

Data extraction is a structured methodological process that links primary studies to the final synthesis and requires clearly defined procedures to avoid errors or inconsistencies [24]. All analyses, comparisons, and interpretations rely on extracted data from the included studies [25]. One author extracted data from the included articles utilising a custom-made extraction form, as illustrated in Table 4. The extraction table provides information about the author and year of publication, the study design, sample size, participant age, setting and location, study duration, the measured outcomes and key findings.

Methodological Quality Assessment

Quality assessment is a critical component of systematic reviews, as it enables accurate interpretation of results and evaluation of the strength of the available evidence. In the absence of rigorous quality assessment, conclusions may be misleading and may fail to reflect the true effects of SAR interventions [26]. A range of methodological quality assessment tools is available; however, the selection of an appropriate tool should be guided by the type of study design. Commonly used instruments include those developed by Cochrane, the Joanna Briggs Institute (JBI) [27], the Critical Appraisal Skills Programme [28] and the Newcastle–Ottawa Scale

(NOS) [29]. However, the methodological quality of all included studies was appraised by two authors using the appropriate JBI checklist for different study designs, as show in Tables 5 to 8. The two authors met to resolve any disagreements. For each item on the respective checklists, studies were scored as Yes, No, Unclear, or Not applicable. Total scores were calculated for each study, and methodological quality was categorised as poor quality, moderate quality or high-quality studies. This systematic approach ensured a transparent, rigorous, and reproducible evaluation of methodological quality across all included study designs.

Table 4: Data extraction table showing the characteristics of the included studies.

Author/ Year	Study Design	Number of participants	Age of participants	Country/ Settings	Study duration	Outcome Measured	Key findings
(Trovato et al., 2016)	PS	2593 migrants who consulted the clinic	All ages	Italy/ clinic in Sicily	August 1 to December 31, 2014	• Clinical characteristics by nationality and demographics	Two distinct migrant profiles were identified: • Middle Eastern migrants: include families, women, children, and elderly individuals; higher prevalence of chronic and cardiovascular conditions; greater health-seeking behaviour. • African migrants: Predominantly young males; higher proportion of unaccompanied minors; greater burden of acute conditions, particularly skin diseases such as scabies.
(Angeletti et al., 2020)	PS	190 migrants rescued by the Italian coast guard ship	All ages	CMR on rescue boat Ubado Dicotti	2019–2020	• Nutritional status (blood analysis) among migrants from Eritrea • Psychological status of migrants from Eritrea • Prevalence of infectious diseases among migrants from Eritrea	• Migrants were clinically stable but biologically vulnerable (malnutrition and nutritional deficiencies). • There were few cases of active tuberculosis and no HIV infections. • There was significant psychological distress linked to living conditions and experienced violence. • Some individuals were hospitalized for acute illnesses requiring urgent care and support.
(Cañardo et al., 2020)	PS	22,234 people rescued by NGO Open Arms	All ages	CMR	1 July 2016 – 31 December 2018	• Number of rescue events in relation to migration and rescue policies • Epidemiological characteristics of rescued migrants Sociodemographic characteristics of rescued migrants	• Most rescued migrant from: Sub-Saharan Africa particularly from Nigeria and Eritrea • Medical condition: scabies, respiratory infections, and febrile illnesses • Vulnerable populations: unaccompanied minors and women. • Most of women experienced sexual assault during the migration journey.

(Van Boetzelaer et al., 2022)	CS	22,966 rescued migrants by MSF	All ages	CMR on boats of MSF ('Aquarius' and 'Ocean Viking')	November 2016 – December 2019	• Sexual and gender-based violence (SGBV) • Mortality onboard • Clinical conditions by demographic population, age and gender	• High prevalence of sexual violence among women aged • ≥ 15 years and originating from Nigeria and Cameroon • Five deaths on MSF board due to asphyxiation and hypothermia • Common clinical conditions were journey-related, mainly skin diseases (including scabies), dehydration, and injuries, with higher vulnerability among women and children.
(Theodosopoulou et al., 2021)	CSS	N/A	All ages	CMR	2014-2020 period	• Location and time periods according to mortality rates • Origin and demographic profile of migrants • General health status • Onboard medical organization • Medico-legal framework	• CMR is the deadliest migration route compared to the Eastern Mediterranean route. • Migrants generally arrive in good health but develop mainly dermatological, respiratory, gastrointestinal, traumatic, and psychological conditions due to extreme travel conditions. • Effective maritime rescue operations rely on structured organization, trained personnel, adequate equipment, and rapid triage of life-threatening emergencies. • The criminalization of NGOs hinders rescue operations and indirectly increases mortality in the Mediterranean.
(Milia et al., 2025)	CS	91 migrant patients admitted with burn injuries	25 ± 9.84 years	Italy/ Burn Center of ARNAS Civico Hospital	2015–2025	• Clinical characteristics and outcomes of burn injuries among migrants	• Most burns were chemical from seawater–fuel mixtures, with flame burns, and other burns rare. • Higher rates of complications (inhalation pneumonia, sepsis) and required more surgical interventions, with some fatalities observed.
(Rodríguez Sánchez et al., 2023)	QES	N/A	N/A	CMR	2011-2020	• Causal effect of maritime policies (NGOs, state-led operations, pushbacks) on the number of attempted crossings • Mortality rate • Structural factors of migration flows (conflicts, economic)	• Rescue policies do not increase migration attempts, whereas deterrence policies lead to a reduction in crossings. • Rescue operations affect survival more than migration levels • Migration flows are mainly driven by external structural factors, not rescue presence.

(Deiana, Maheshri & Mastrobuoni, 2024)	QES	N/A	N/A	CMR	From 2013 onwards	• Number of crossings per period • Type of vessel used for the crossing • Number of deaths or disappearances during the crossing • Behaviour of smugglers during the crossings	• Search and rescue operations at sea increase the total number of crossing attempts. • Strengthening search and rescue efforts leads to a shift toward inflatable boats, which are cheaper but much more dangerous than traditional vessels. • Despite rescue operations, the actual risk of dying at sea does not decrease.
(Amenta, Di Betta & Ferrara, 2021)	QES	N/A	N/A	CMR	January 2011 – July 2018	• Number of migrant departures • Mortality rate at sea • SAR operations (periods with/ without operations • Smuggling networks	• Departures rise during SAR operations; SARs do not attract migrants, but criminal networks adapt. • Mortality risk remains stable despite increased crossings. • Structural factors in countries of origin are the primary determinants. • Targeting smuggling networks reduces migrant flows. • Repatriation from transit countries (e.g., Libya) is ineffective due to ongoing instability since 2011.
(Hoffmann Pham & Komiyama, 2024)	QES	N/A	N/A	MS	2014–around 2020	• Number of crossings • Type of boat • Interceptions/ Rescue operations • Mortality/Risk for migrants • Origin country factors (violence, economy) • Total migration flows	• Migrants respond to chances of success, but risks can rise even with fewer departures due to limited rescues and unnoticed boat sinkings. • Smugglers constantly adapt changing prices, boats, distances, and passenger numbers. • Policies have complex effects: some deter, others redirect migration. Blocking one route rarely stops it; it usually shifts elsewhere. • Migration is a dynamic system where all actors continuously adapt.

(Irene Tafani & Massimo Riccaboni, 2025)	QES	N/A	N/A	ECMSR	April–December 2016	• Monthly number of irregular border crossings • Number of deaths and missing • ATT (Average Treatment Effect on the Treated) • GDP per capita in country of origin • Number of deaths related to violence.	• Decrease in crossings on the Eastern route, significant increase on the Central route • Increase in the risk of death (positive correlation between the diversion effect and the number of deaths at sea) • No significant global reduction of migration flow.
(Camarena et al., 2020)	QES	N/A	N/A	MS	January 2016 – April 2018	• Migrant arrivals in Italy • Riots around Libyan • Wave height in the Mediterranean • Data on deaths/ missing people at sea	• Migration across the Central Mediterranean is mainly shaped by conditions in transit countries, not just migrants' countries of origin. • Riots and unrest near Libyan ports increase departures to Italy. • Rough seas reduce crossings and raise the risk of death. • Italy's 2017 intervention against Libyan militias and smugglers significantly cut arrivals. • Policies that alter transit actors' incentives can effectively influence migration flows.

Abbreviations: CMR:; CS: Case series; CSS: Cross-sectional study; ECMSR: MS:; N/A: Not available; PS: Prevalence study; QES: Quasi experimental study

Table 5: Prevalence Studies using the JBI checklist.

Authors	Q1: Was the sample frame appropriate to address the target population?	Q2: Were study participants sampled in an appropriate way?	Q3: Was the sample size adequate?	Q4: Were the study subjects and the setting described in detail?	Q5: Was the data analysis conducted with sufficient coveraujhge of the identified sample?	Q6: Were valid methods used for the identification of the condition?	Q7: Was the condition measured in a standard, reliable way for all participants?	Q8: Was there appropriate statistical analysis?	Q9: Was the response rate adequate, and if not, was the low response rate managed appropriately?	Study quality
Trovato et al. (2016)	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	High quality
Cañardo et al. (2020)	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	High quality
Angeletti et al. (2020)	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	High quality

Table 6: Case series Studies using the JBI checklist.

Authors	Q1: Were there clear criteria for inclusion in the case series?	Q2: Was the condition measured in a standard, reliable way for all participants included in the case series?	Q3: Were valid methods used for identification of the condition for all participants included in the case series?	Q4: Did the case series have consecutive inclusion of participants?	Q5: Did the case series have complete inclusion of participants?	Q6: Was there clear reporting of the demographics of the participants in the study?	Q7: Was there clear reporting of clinical information of the participants?	Q8: Were the outcomes or follow up results of cases clearly reported?	Q9: Was there clear reporting of the presenting site(s)/ clinic(s) demographic information?	Q10: Was statistical analysis appropriate?	Study quality
Van Boetzelaer et al. (2022)	Yes	Yes	Yes	Yes	No	Yes	Yes	Yes	Yes	Yes	High quality
Milia et al. (2025)	Yes	Yes	Yes	Yes	No	Yes	Yes	Yes	Yes	Yes	High quality

Table 7: Cross-sectional studies using the JBI checklist.

Authors	Q1: Were the criteria for inclusion in the sample clearly defined?	Q2: Were the study subjects and the setting described in detail?	Q3: Was the exposure measured in a valid and reliable way?	Q4: Were objective, standard criteria used for measurement of the condition?	Q5: Were confounding factors identified?	Q6: Were strategies to deal with confounding factors stated?	Q7: Were the outcomes measured in a valid and reliable way?	Q8: Was appropriate statistical analysis used?	Study quality
Theodosopoulou et al. (2021)	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	High quality

Table 8: Quasi-experimental Studies using JBI checklist.

Authors	Q1: Is it clear in the study what is the "cause" and what is the "effect" (i.e. there is no confusion about which variable comes first)? Bias related to selection and allocation	Q2: Was there a control group?	Q3 Were participants included in any comparisons similar?	Q4 Were the participants included in any comparisons receiving similar treatment/ care, other than the exposure or intervention of interest?	Q5: Were there multiple measurements of the outcome, both pre and post the intervention/exposure?	Q6: Were the outcomes of participants included in any comparisons measured in the same way?	Q7: Were outcomes measured in a reliable way?	Q8: Was follow-up complete and if not, were differences between groups in terms of their follow-up adequately described and analysed?	Q9: Was appropriate statistical analysis used?	Study quality
Rodríguez Sánchez et al. (2023)	Yes	No	No	Yes	Yes	Yes	Yes	Yes	Yes	Moderate quality
Deiana, Maheshri & Mastrobuoni (2024)	Yes	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes	High quality
Amenta, Di Betta & Ferrara (2021)	Yes	No	No	Yes	Yes	Yes	Yes	No	Yes	Moderate
Hoffmann Pham & Komiyama (2024)	Yes	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes	High quality

Data Analysis

Data analysis facilitates the transformation of raw data into meaningful and interpretable information. Furthermore, it enables the organisation and synthesis of information in a structured manner that effectively addresses the research question [30]. A meta-analysis is regarded as the gold standard, as it estimates an overall effect of all the studies under review [31]. However, due to the heterogeneity among the studies included in this review, it was not feasible to conduct a meta-analysis. Consequently, a narrative synthesis was considered more appropriate, as it allows for structured and contextual interpretation of findings.

Ethical consideration

Ethical consideration is fundamental in research to protect human participants [32]. Although systematic reviews do not involve direct interaction with participants, they carry a significant ethical responsibility, as their findings can directly influence health policies and research directions, particularly in sensitive context such as health of migrants at sea, a population considered especially vulnerable. The ethical issues were addressed using the four ethical principles of autonomy, beneficence, non-maleficence, and justice [33]: autonomy through informed consent in included studies [34]; beneficence by contributing to migrant health knowledge [35]; non-maleficence by carefully reporting findings in such a way as to avoid misinterpretation that could harm employees of NGOs involved in SAR and the migrant population; and justice by including diverse populations [35]. Ethical approval was granted by the Coventry University Ethics Committee (Project Reference No: P191097).

Results

Characteristics of the Included Studies

Twelve studies published between January 2014, and January 2026 were included. Seven focused on the Central Mediterranean route between Libya and Italy, including four conducted onboard SAR vessels operated by the Italian Coast Guard, NGOs, and Médecins Sans Frontières [36-39], and three focused on aggregated data examining departures, crossings, and mortality without individual clinical follow-up [9,40,41]. In addition, two studies were conducted in Italian hospital settings, including a specialised burn care centre for migrants [42,43], while three studies adopted a broader Mediterranean comparative perspective across migration routes [44,45,41]. Out of the 12 studies, six employed quasi-experimental study designs primarily assessing the impact of migration policies and SAR operations on maritime crossings and mortality [9,40,41,44], three used prevalence study design [42,36,37], two used case series study design [38,43] and one used cross-sectional study design [39]. Participant numbers ranged from 91 migrants [43] to 2,593 migrants [42]; however, seven studies based on aggregated data did not report participant numbers [9,39-41,44-46]. The populations across the 12 studies included migrants, refugees, and asylum seekers of all ages, with specific representation of vulnerable groups, such as pregnant women, children under five, unaccompanied minors, persons with disabilities, and older adults. Finally, outcomes measured primarily included clinical and epidemiological indicators, such as infectious and dermatological conditions, nutritional disorders, burns, and psychological distress [36-38,42,43]. Several studies also assessed the effects of migration policies and search and rescue operations on maritime crossings and mortality rates along the Central Mediterranean route [9,39-4, 44,45].

Study selection process

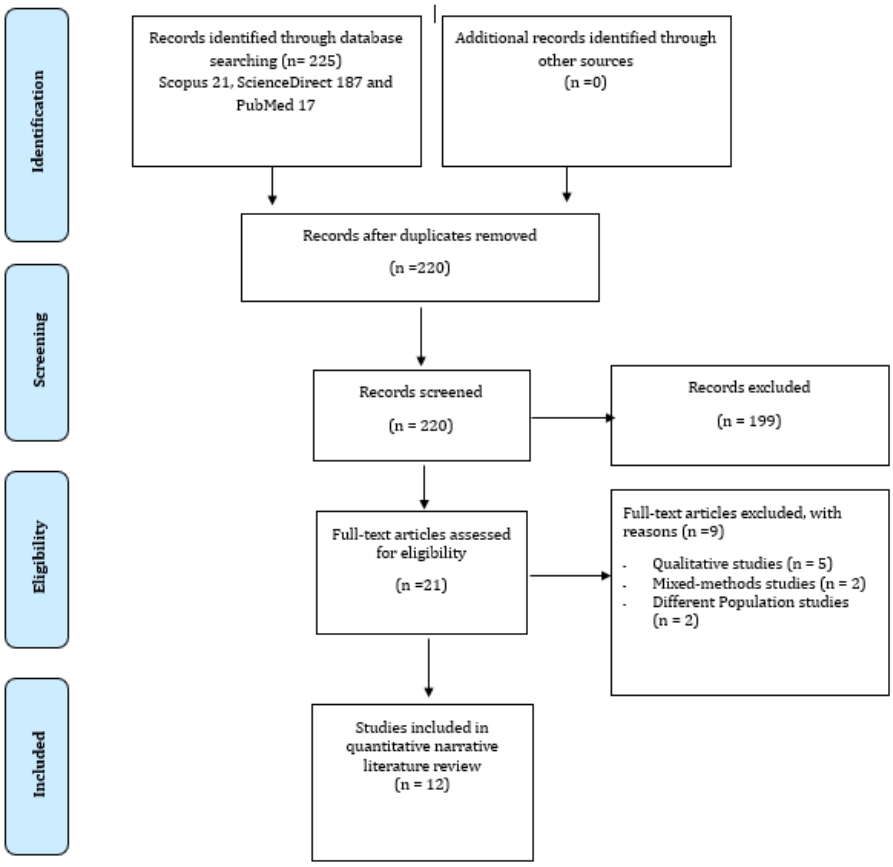

Figure 1: PRISMA flow diagram.

The Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) flow diagram was used to depict the screening process and reasons for excluding of some full-text articles as shown in Figure 1. The initial searches across selected databases identified a total of 225 records using pre-established keywords combined with Boolean operators. Following the removal of five duplicate records, the remaining articles were screened based on the study's inclusion criteria. During the screening process, 199 articles were excluded as they did not meet eligibility requirements or were outside the scope of the review. Of the 21 studies initially identified, nine did not meet the eligibility criteria and were thus excluded, with the remaining 12 articles included in this systematic review. Collectively, the included studies constituted a sufficient and coherent body of evidence to address the research question, meet the study objectives, and offer a comprehensive and complementary understanding of the impact of SAR in the Mediterranean Sea of migrant's health and decision-making.

Quality assessment results

All prevalence studies included in this review achieved high quality, indicating strong quality, clear reporting, appropriate sampling, valid outcome measurement, and suitable statistical analyses. The cross-sectional study also received the maximum score (8/8), demonstrating clear inclusion criteria and adequate reporting. All the case series studies achieved the highest quality rating (9/9), reflecting clear case definitions, detailed reporting of participant characteristics, valid outcome assessment, and appropriate analytical methods. However, the quality among the quasi-experimental studies ranged from moderate (6–7/9) to high (8/9). These moderate ratings did not indicate weaker methodology but rather reflected the complexity and multifactorial nature of migration contexts. Appraisal items related to control groups, blinding, and comparable conditions were often difficult to apply to policy-based research. Moreover, external contextual factors frequently interacted with migration policies, making it challenging to isolate the effects of a single intervention.

Summary of key findings

The following are the three key findings identified in this systematic literature review:

Health Burdens on Rescued Migrants

A key finding of this review is that the health burdens on rescued migrants along the Central Mediterranean Route are not primarily due to pre-existing illness but are largely attributed to unsafe migration conditions, transit violence, and maritime governance structures. SAR operations are recognised as playing an effective role in addressing acute health needs. All clinical studies indicate that migrants rescued along this route present health problems primarily related to exposures experienced during the journey rather than to imported diseases. The predominant clinical profile includes dermatological conditions such as scabies, reflecting overcrowded conditions aboard vessels, as well as chemical burns resulting from contact between seawater and fuel on inflatable boats. Gastrointestinal infections are associated with poor hygiene conditions on board, while malnutrition and dehydration are reflected in various deficiencies, including vitamin D and protein deficiencies.

Search and Rescue Operations and Migration Dynamics

Another key finding, as suggested by several studies, shows a statistical association between the active presence of Search and Rescue (SAR) operations and an increase in the number of crossing attempts in the short term. This indicates that during periods when SAR assets, whether state-led missions or NGO vessels, operate in proximity to departure zones, recorded departures from North Africa tend to rise compared to periods characterized by limited or no rescue presence. However, SAR operations do not increase total migration but can shift when and where crossings occur, creating short-term fluctuations. Higher crossings during SAR presence usually reflect instability in transit countries, not a humanitarian "pull factor."

Policy Impacts on Smuggling Routes

Finally, another key finding indicates that smuggling networks play a central role in migrants' decisions and capacities to cross the Mediterranean, serving as the primary logistical infrastructure for irregular crossings. In the absence of legal pathways, these networks organise transport, select vessels and departure points, coordinate payments, and structure journeys, facilitating migration shaped by structural pressures and constrained by restrictive border regimes. These networks are highly adaptive; the expansion of search and rescue operations often leads smugglers to use less seaworthy and cheaper boats, adjust passenger numbers, reduce fuel, and modify pricing, directly affecting risk levels, mortality, injuries, and vulnerability.

Discussion

Health Burdens on Rescued Migrants

One key finding of this review indicated that individuals rescued at sea had two urgent health profiles, i.e., chronic conditions among families from the Middle East, and acute journey-related injuries among predominantly young men from sub-Saharan Africa. Despite these differences, both reflect harms produced by the migration route and carry a high risk of rapid deterioration without timely care [47]. For example, burn injuries cause progressive tissue damage until irrigated and treated [48], while hypoxia from near-drowning or compression can lead to irreversible neurological damage if oxygenation is not restored [49]. Survivors of sexual and gender-based violence require urgent interventions, including HIV post-exposure prophylaxis within 72 hours and emergency contraception within 120 hours, with effectiveness declining sharply over time [50]. In this context, delays have serious consequences for individuals; it transforms preventable morbidity into permanent harm. When political or administrative delays prolong time at sea, maritime containment priorities may conflict with medical imperatives, effectively shifting SAR vessels into improvised acute care settings without the infrastructure required for evolving emergencies [51]. To reduce the health burden of rescued migrants, States should strengthen and coordinate timely, well-resourced Search and Rescue (SAR) operations that prioritise

early intervention, rapid response, and safe disembarkation in line with human rights standards [52].

Search and Rescue Operations and Migration Dynamics

Another key finding of this review presented that SAR has an impact on the number of migrants crossing the sea. The role of Search and Rescue (SAR) operations as a "pull factor" in Mediterranean migration remains contested, yet closer methodological scrutiny reveals that much of the ambiguity arises from heterogeneity in research design rather than substantive contradiction [53]. Studies suggesting behavioural adaptation [54,55] often rely on aggregate departure data or indirect proxies of risk perception, whereas analyses finding no systematic increase in crossings [56,57] employ broader temporal comparisons or incorporate contextual controls. The divergence in findings is therefore less indicative of irreconcilable empirical realities and more reflective of variation in dependent variables (crossing attempts, mortality rates, rescue probability), identification strategies, and assumptions about migrant decision-making [58]. Many studies rely on aggregated data, risking ecological fallacy by inferring individual behaviour from group trends [59], which complicates comparisons and can suggest a causal link between SAR presence and crossings [60]. Framing SAR as an incentive may also obscure structural drivers of migration, such as smuggling economies and broader political and economic factors [61,62,57]. According to reports and articles between 2024 and 2025, migrants in Libya were subjected to systematic human rights violations including arbitrary detention, torture, sexual violence, and forced labour [63-65]. In this context, SAR functions less as a behavioural stimulus and more as a harm-reduction intervention operating within an established transnational mobility system [66]. From a public health perspective, restricting or criminalising SAR is unlikely to address upstream drivers of migration but may increase preventable mortality, trauma exposure, and pressure on emergency health systems [67].

Policy Impacts on Smuggling Routes

Finally, the final key finding of this review highlights the importance of considering smuggling in factors that affects migrants' health. Smuggling networks appear to be a key infrastructure in the organisation of irregular crossings of the Mediterranean, coordinating transport, vessels, and the logistics of the journey. Their central role largely reflects the lack of accessible and safe legal migration pathways to Europe, which leads many migrants to rely on these networks to reach European territory. As highlighted by the European Parliament research service [68], migrant smuggling often emerges in contexts where legal migration opportunities are limited and border controls are restrictive, creating demand for irregular facilitation. In this context, smuggling networks develop as a response to institutional barriers to mobility and become a central mechanism enabling irregular migration. As discussed in analyses of the EU Action Plan against migrant smuggling and the Protocol against the Smuggling of Migrants by Land, Sea and Air, policy responses largely frame smuggling as a form of transnational organised crime and prioritise prevention, surveillance, and criminal prosecution [69]. While these strategies aim to disrupt smuggling networks, they may also contribute to worsening conditions for migrants. Increased border controls and interceptions can push smugglers to use more dangerous routes, overcrowded or less seaworthy boats, and minimal fuel supplies, thereby heightening the risks of shipwreck, injury, and more death [70]. As a result, migrants often bear the direct consequences of these policies, facing greater physical danger and vulnerability during the journey [71]. Expanding safe and legal migration pathways, alongside adopting less restrictive border policies, would reduce migrants' reliance on smuggling networks and thereby minimise exposure to dangerous routes and associated health risks [72].

Practical and Policy Implications

To reduce the loss of life and address these findings, several practical and policy measures should be implemented. First, SAR capacities must be strengthened and better coordinated among coastal states, European institutions, and humanitarian actors, through improved data-sharing systems and rapid responses to distress calls [73]. Removing disincentives to rescue, such as penalising those conducting rescues, and establishing regional mechanisms to ensure safe places of disembarkation are also essential. Second, systematic collection and analysis of data on deaths and missing persons at sea should be integrated into SAR strategies to identify high-risk areas and improve resource allocation. Rescue responses must also ensure humane treatment and the early identification of individuals with international protection needs, including refugees, asylum seekers, and victims of trafficking [74]. Third, the European Union should support the presence of state and multilateral SAR capacities near departure zones to compensate for the decline in large-scale state operations [75]. Cooperation with national coast guards, including Libyan authorities, should rely on clear protocols grounded in international maritime law and include safeguards against refoulement. Strengthened coordination among states, NGOs, and international organisations can significantly improve maritime rescue systems and reduce deaths along migratory sea routes [76].

Strengths and Limitations of the Study

A major strength of this study lies in its interdisciplinary perspective, which integrates evidence from public health and maritime law. This provides a more comprehensive understanding of SAR operation, considering both the health needs of recued migrants and political frameworks that shape rescue activities. The review utilised a well-defined protocol, i.e., PRISMA, thereby improving the replicability of this research. The use of stringent inclusion and exclusion criteria reduced the possibility of selective reporting. Firstly, although the research focuses on the Mediterranean region, and particularly contexts involving Italy, only studies published in English were included. This language restriction may have led to the exclusion of relevant research published in Italian or other regional languages. Secondly, migration dynamics are highly fluid and influenced by rapidly changing political and geopolitical conditions. As a result, the findings of this review reflect the evidence available during the study period and may evolve as new policies, migration routes, and SAR practices continue to develop.

Recommendations for Future Research and Practice

Research on maritime migration should adopt longitudinal and mixed methods design that combine quantitative data with qualitative insights from migrants. This would enable a more comprehensive understanding of the decision-making processes and factors influencing attempts to undertake sea crossings [77]. There is also a need to investigate the long-term health outcomes of migrants rescued at sea. Longitudinal studies tracking individuals after disembarkation could clarify the persistence of health conditions associated with the migration journey [78]. It may also be beneficial to examine the availability, accessibility, and effectiveness of legal migration pathways, because limited access to safe and regular routes may push migrants and asylum seekers toward hazardous journeys across the Mediterranean. Finally, research should explore the dynamics of migrant smuggling networks [79]. Greater empirical insight is needed into their organisational structures, recruitment strategies, financial mechanisms, and the routes used to facilitate irregular migration. Understanding how these networks adapt to changing enforcement and migration patterns could provide crucial knowledge on the safety and vulnerability of migrants undertaking maritime journeys [79].

Conclusion

We examined the impact of Search and Rescue (SAR) operations on migrant mortality in the Mediterranean Sea. Synthesising twelve high-quality studies, we found that SAR plays a vital lifesaving role, with rescued migrants often presenting serious physical and mental health conditions, showing SAR reduces mortality rather than causing harm. Mortality variations are not driven by SAR presence alone but by structural factors in countries of origin, smuggling network adaptations, and deterrence-focused policies shaping migration risks. Overall, our study shows that migrant mortality stems not from humanitarian rescue but from fragmented, deterrence-driven governance prioritising border control over human life. It highlights the need for European Union states to strengthen coordinated SAR capacity, remove barriers to civilian rescue, and ensure vessels can meet urgent health needs. Addressing the structural drivers of migration alongside well-resourced, protected SAR operations is essential for an effective public health and humanitarian response. Future research should prioritise longitudinal studies on post-disembarkation health outcomes and evaluations of onboard care models, alongside deeper exploration of migrant decision-making and lived experiences to better inform humane and sustainable policy.

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Conflict of interest

The authors declare that there are no conflicts of interest regarding the publication of this manuscript. All authors have approved the final version of the manuscript and agree with its submission. The research was conducted independently, and no external funding or influence affected the study's design, data collection, analysis, or interpretation.

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