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Review Article

A systematic review of burn-related mortality and morbidity along with preventive strategies existing in the Arabian Peninsula over the last 5 years

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Abstract: This systematic review looks at burn injuries in the Gulf region over the past five years, focusing on how often they occur, their survival and complication rates, and current prevention efforts. To gather the data, two reviewers independently searched five major databases and checked article reference lists to make sure no relevant studies were missed. The team then used the Newcastle-Ottawa Scale (NOS) to evaluate the quality and potential bias of the gathered research. The following sections present these regional findings and discuss the need for better burn management systems and stronger prevention strategies across the Gulf countries. Objectives: (1) To examine burn epidemiology. (2) To assess morbidity and mortality. (3) And to cover preventative strategies in the gulf countries (Qatar, UAE, Oman, Bahrain, Saudi Arabia) over the past 5 years. Methods: (1) Data extraction was performed independently by two reviewers utilizing a standardized form. To ensure data integrity, this instrument was initially piloted on three studies, with iterative modifications implemented as necessary before full-scale deployment. (2) A systematic literature search was conducted across five major electronic databases: PubMed, Embase, Google Scholar, Web of Science, and Scopus. To ensure literature saturation, the reference lists of all relevant articles were manually screened to identify additional eligible studies. Results: (1) A quantitative meta-analysis was precluded by substantial heterogeneity in study methodologies, patient cohorts, and outcome assessments. Regarding methodological quality, twelve trials (60%) exhibited a moderate risk of bias, while two demonstrated a low risk and four presented a high risk. Evaluation via the Newcastle-Ottawa Scale (NOS) indicated that nine to ten studies maintained high transparency in both data collection and methodological reporting. (2) Highest rate of mortality was found in saudi arabia (17.6%) and second highest in Kuwait (10.9%). Conclusions: (1) There is a high degree of variation in burn epidemiology, mortality, and prognosis among various Gulf countries. Which emphasizes a need for a uniform burn management system. (2) To effectively reduce burn-related morbidity and mortality, a comprehensive escalation of current preventative strategies is required.

Keywords: Burn, gulf countries, MDRO, mortality, morbidity

Introduction and literature review

There are numerous burn injuries worldwide that cause a lot of morbidity and mortality among all communities on an annual basis. About 180,000 people die from burns annually. Most of these cases occur in low- and middle-income countries. Many serious health problems can be traced back to non-fatal burn injuries. Burns happen mostly at home and in workplaces, although they can be prevented [1]. These conditions result from injuries to both the skin and tissues triggered by heat, chemicals, electric current, or radiation. On the basis of tissue damage, burns are classified as first-degree (causing redness and pain in the

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superficial layers), second-degree (causing blisters and severe pain), and third-degree (affecting the epidermis and the full depth of the dermis, with a painless white or black eschar). In addition, the fourth-degree burn involves muscles and bones. Different types of burns, such as those caused by hot liquids, flames, harmful chemicals, electricity, or contact with hot objects (contact burns), have been described in the literature by cause [2].

Burns lead to a high number of deaths and potentially avoidable health problems among children as well. Morbidity and disability are closely linked to the cohort's demography and to the clinical factors that determine the outcome. The important prognostic parameters are the patient's gender, the depth and extent of the burn, and the duration of hospital treatment [3].

The burn injuries have a unique presentation among the populations of Saudi Arabia and Oman because of cultural, environmental, and socioeconomic reasons. Studies reviewed till 2019 in Saudi Arabia have found that young children aged 10 to 12 made up more than half of all burn cases, and males were seen more often than their female counterparts by a ratio of 1.42:1. Most of these home injuries involved scald burns from hot liquids (62.4%), while flame burns were next at 28.7% [4].

A 2019 study in Northern Saudi Arabia reported burn statistics among adult patients. Most cases (58.5%) occurred due to hot water, and fire was the second major cause (32.1%). The majority (nearly 6 out of every 10) of burns occurred on the hands, and of these, 71.7% were first-degree burns. Women experienced burns (79.4%) far more regularly than men (20.6%). Among skin injuries, skin disfigurement was most common (17%), followed by secondary bacterial infections (9.3%). More than half (61%) of the burns happened in summer, and cases improved in 79.9% of children. Various studies have shown that recovery from burns depends on age, the location and extent of the burn, and whether proper assessment and treatment are provided [5].

According to a report from Oman, 67% of the cases admitted to the four burn units over a five-month period were children under five years of age, and most of these had scald burns (53%) in the home (59.6%) [6]. They showed that pediatric and domestic burn injuries were the most common ones in the region.

Early resuscitation can improve the chances of survival and enhance the chances of full recovery, reducing the risk of death. Researchers found that accurately administering fluid based on total body surface area led to better outcomes than using a higher total volume [7].

The WHO clearly defines approaches to reduce burn injuries, including safe fireplaces to make home fire burning more secure and stove fueling with precautions. Furthermore, safety practices have been advocated for housing plans to ensure that cookstoves are well-designed and efficient, preventing harm to children. The water temperature from faucets and showers should be kept at lower settings. Higher levels of fire safety training, along with the addition of smoke detectors, fire sprinklers, and fire escape systems in homes, should be encouraged. People should be educated about mechanical security directions and choosing sleepwear for kids that resists fire. Bedroom smoking should be discouraged, and special safety lighters are preferred to reduce children's risk of burn injuries. Laws must be enacted to encourage the production of fire-safe cigarettes. Moreover, progress in the treatment of epilepsy (mainly in developing countries), improved burns management-involving expert advice for health-care providers in managing and triaging patients with burns, is also recommended. The idea of using fire-resistant overskirts while cooking near an open fire or lamp fuel stove should be publicized [1].

As per WHO guidelines, prevention and ensuring good burn care can reduce both the number of burn deaths and the level of disability. Generally, people can use primary, secondary, or tertiary prevention in this regard. Various studies have reported their results on primary burn prevention, showing how it has made a difference for the aware population. A study in Jazan, Saudi Arabia, revealed a better understanding among most adults of the causes and prevention of burns [8]. Secondary preventive measures are especially used for first-aid techniques. Results from an Australian research study demonstrate that flushing the burn wound with running water for 20 minutes within a 3-hour window alleviates the burning

sensation, expedites healing, and decreases the need for skin grafts for wound resurfacing [9]. In another study, the burn was considered a burden on the global economy. The researchers analyzed the data from almost 30 years and showed that age-specific burn incidence and death rate decreased with time, but the number of total reported burn cases kept increasing. After thorough analysis of various factors, they deduced that burn prevention depends not only on a country's per capita income, but also on its healthcare performance and the educational achievements of its population [10].

Despite the high incidence of burn injuries, there is a paucity of comprehensive data on burn-related mortality, morbidity, and the effectiveness of preventive strategies in the Arabian Peninsula over the past five years. Understanding these trends is crucial for developing targeted interventions and allocating healthcare resources effectively. This systematic review aims to bridge this knowledge gap by analyzing recent studies from 2019 to 2024, focusing on burn-related outcomes and evaluating the preventive measures implemented in the region. The objectives are to collect epidemiological data on burn injuries, assess the impact of existing prevention programs, and provide evidence-based recommendations to enhance burn care and prevention strategies in the Arabian Peninsula.

Methods

Eligibility criteria

Inclusion criteria: (1) This systematic review is a quantitative and qualitative research study reporting mortality, morbidity, and preventive strategies associated with burn injuries within the Arabian Peninsula (Saudi Arabia, United Arab Emirates, Oman, Kuwait, Qatar, Bahrain), published in English between January 2019 and December 2024. (2) If a study reported at least one case of burn-related mortality, total hospital days, case-related complications, extent of surgical treatment, or outcomes of prevention strategies, it was deemed eligible for inclusion. (3) Observational studies (the cross-sectional, cohort, and case-control types). (4) The randomized controlled trials. (5) The case series with 10 or more cases. (6) Surveys using questionnaires and qualitative studies were also included. All literature on burn causes, the different burn depths of its victims, and preventive measures ranked highest in our consideration. (7) The review of articles on knowledge- and skill-based workplace or home-based prevention, and psychosocial support were accepted for inclusion. (8) Surveys of at least 48 people and qualitative research with at least 10 participants focused on prevention through knowledge evaluation, public awareness, or the effectiveness of intervention were also included in this analysis. (9) Through Clinical assessment by experienced clinicians, the causative agent, depth (severity), and TBSA were evaluated.

Exclusion criteria: (1) Articles that do not focus on Arabian Peninsula populations and are related to other regions were excluded. (2) Other articles published before or after our study period, as well as preclinical (animal) studies, were excluded. (3) Case series with a sample size < 10 and studies containing inconsistent data were also not considered in this systematic review. (4) Any review that either lacked a clear methodology or did not provide necessary epidemiological data was not reviewed.

Studies have been sorted into four types: those emphasizing mortality, morbidity, prevention, and those with mixed goals. The research focused on all six target countries to achieve regional coverage and was dedicated to the regional populations.

Information sources

Five major electronic databases were systematically searched: PubMed, Embase, Google Scholar, Web of Science, and Scopus. All articles were assessed by analyzing their reference lists. All databases were searched from 15th March 2025 to 15th April 2025.

Search strategy

The search strategy combined three major concepts: (a) burn-related terms (thermal injuries). (b) geographical terms (Arabian Peninsula, Saudi Arabia, UAE, Oman, Kuwait, Qatar, Bahrain). (c) outcome terms (mortality, morbidity, prevention).

The PubMed search strategy was: (1) burn/burns/burn injury/thermal injury; (2) Arabian

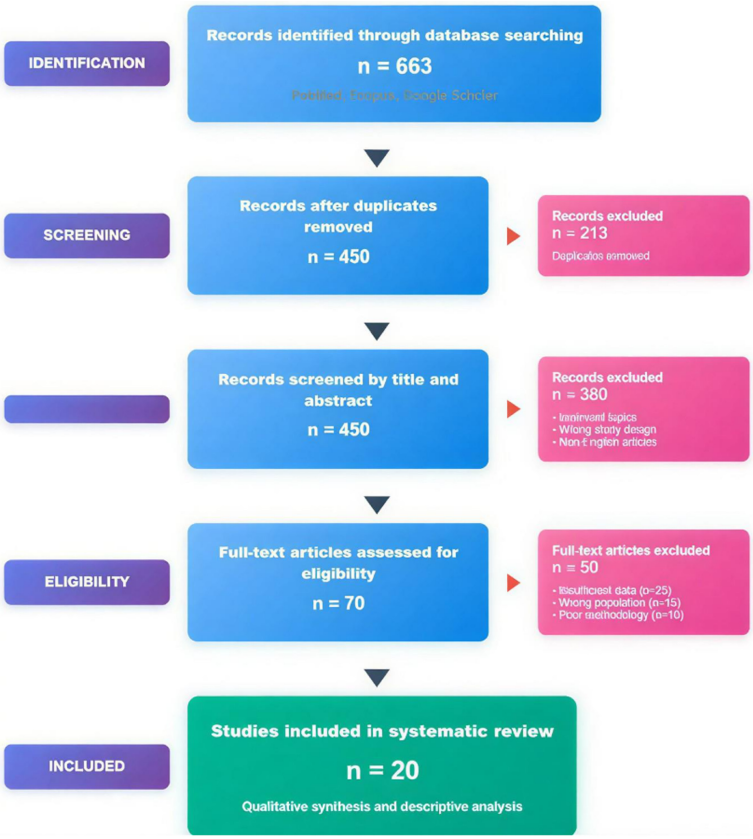

Figure 1. PRISMA flow diagram.

Peninsula/Saudi Arabia/United Arab Emirates/UAE/Oman/Kuwait/Qatar/Bahrain/Yemen; (3) mortality/death/morbidity/outcome/prevention/intervention.

Filters included: publication date (January 2019 to December 2024) and language (English). Similar strategies were adapted for other databases.

Selection process

All titles and abstracts were initially filtered by two reviewers together. After that, each article's full text was scrutinized by the same reviewer team. Both researchers on either side discussed or used arbitration with a third expert to settle their differences. Using Elicit, an AI-supported tool, we handled the screening process and removed duplicates. The study's selection process is shown in the PRISMA flow diagram below as can be ascertained through the Prisma flow diagram (**Figure 1**).

Data collection process

Two reviewers used a standardized form to extract data, which they compared independently. The form was first used in three studies, and modifications were made as needed. If the results were not the same, the authors discussed them and, if necessary, consulted with a third reviewer. If we found that essential details were missing, we sent the corresponding authors an email with a note to follow up.

Data extraction protocol

Data items: The following data were derived from the included studies: (1) Study characteristics: A study includes information about the country where it was done, its design, period, and the number of participants involved. (2) Population demographics: Median age, the subgroup of participants by gender, and vulnerable groups involved (such as children and the elderly, domestic and industrial workers). (3) Burn characteristics: Features of a burn include the type of burn (flame, scald, chemical, electrical, contact), depth of tissue injury (superficial, partial thickness, full thickness), and the total body surface area involved. (4) Healthcare context: Consideration of burn management setup, a specialized burn unit, or burns treated in a general hospital. (5) Quantitative outcomes: (a) Mortality: mortality rate (%), case fatality rate (%), length of survival (days). (b) Morbidity: mean hospital length of stay (days), ICU admission rate (%), infection rate (%), and number of surgical interventions (%). (c) Prevention: Prevention includes considering. (d) Prevention program attended by a specific public group (number of individuals who benefit from the awareness course). (e) Rates of burn incidence among the target population before and after the program. (f) Reduction in burn cases among various target cohorts (such as the general public or the groups at risk). (g) Common loca-

tions of burn incidents (such as houses, schools, or workplaces) are used for prevention strategies.

Study risk of bias assessment

Each of the following tools was used by two reviewers to assess the potential risk of bias in the selected studies: the Cochrane Risk of Bias 2.0 tool for RCTs, the ROBINS-I tool for non-randomized studies, and the Newcastle-Ottawa Scale for observational studies. Each study received a numerical quality score or a categorical rating (low, moderate, or high risk) according to the respective tool criteria.

Effect measures

Outcomes such as death (mortality) and disease (morbidity) were reported in the same way as in the original studies (percentages, rates, and means with standard deviations). In preventive studies, strategies were classified by their approach and target group, and the effective measures were deduced from the reports (e.g., a drop in burn cases, changes in incidence rates, and the number of people reached by the program).

Synthesis methods

Study eligibility for data synthesis: Studies that met the criteria were divided by outcome (mortality, burn severity, length of hospitalization, and surgical procedures performed) and by the location in the Arabian Peninsula where they were conducted. Further information was collected regarding the cause of injury (flame, scald, electrical), injury severity (superficial, medium, deep), patient age, and the type of hospital (basic vs. specialized burn center).

Data preparation: The original studies reported outcomes in numbers. Mortality statistics were also included, along with length of hospital stay in days and TBSA as a percentage. To ensure consistency and reliability, the reporting of central tendency measures, whether medians or means, must adhere to a uniform format suitable for data synthesis. In cases where statistical accuracy is lacking, or results are presented solely as ranges, the data will be integrated narratively rather than subjected to quantitative transformation or pooling.

Tabulation and visual display: All findings are presented in tables grouped by country and outcomes. Whenever data permits, the causes and affected groups are marked in easy-to-see tables and figures. To represent the findings across studies, charts and tables illustrate the types of burns, the extent of burn severity, and how often precautions were taken. Different Types Will Be Presented Using Simple Descriptions.

Synthesis strategy: Due to variations in the included study designs, a meta-analysis could not be performed. A systematic approach to summarizing the research was used. Reported estimates of mortality rates, TBSA, and lengths of stay, presented as ranges and frequencies, were included. Methods of prevention reported across all included studies were systematically reviewed to identify common patterns and trends in their implementation.

Heterogeneity consideration: Subgroup analysis was performed by country, population type (pediatric or adult), burn type, and the site of treatment (hospital or clinic). The comparative analysis focused on interpreting and explaining differences in outcomes and preventive approaches, rather than relying solely on numerical data to identify variations.

Sensitivity considerations: As we were not conducting a meta-analysis, we did not plan statistical sensitivity analyses. Studies with different numbers of participants, dissimilar risk of bias, or non-identical methodologies were analyzed and compared in the narrative synthesis. Results from studies with unusual outcomes (especially mortality) were analyzed after considering both study design and the groups involved.

Reporting bias assessment: Where appropriate, selective outcome reporting was noted for studies that did not report mortality or length of stay. Since a meta-analysis was not possible, graphical and statistical tools such as funnel plots and Egger's tests were omitted.

Certainty assessment: A narrative assessment of the certainty of the evidence was done using GRADE, adapted to systematic reviews lacking a meta-analysis. Risk of bias, inconsistency, indirectness, imprecision, and publication bias helped determine how confident we should be in the evidence for each outcome. Burn etiology, where burns happened, and the types of prevention programs were looked at

while determining if burn-specific prevention was applied correctly.

Results

Study characteristics

A total of 20 studies from the Arabian Peninsula region were included in this systematic review, spanning the period from 2019 to 2024. These studies originated from Saudi Arabia (n=12), the United Arab Emirates (n=2), Qatar (n=2), Kuwait (n=1), Oman (n=2), and Bahrain (n=1). Across all studies, researchers included a total of 6,262 participants, with each study ranging from 10 to 2,437 participants. The research used retrospective analysis, randomized controlled studies, surveys, and one qualitative study. A table showing detailed information on all variables from all 20 studies is provided below.

Mortality rates

As per the data provided in **Table 1**. The mortality rate was reported in 6 publications, with a range of 0-17.6% across all studies. According to the data, the highest rate of mortality was found in Saudi Arabia (Saudi 4) [13], at 17.6% and the second highest rate was in Kuwait (10.9%) [26]. Since the studies were randomized controlled trials, zero deaths were surprisingly reported in Saudi Arabia [6-8, 14-16] because the studies were conducted on stable patients with minor burns either 10-15 percent TBSA involved or the area was healed before inclusion in these studies and similarly, Oman 1 questionnaire based cross-sectional survey was conducted on burn survivors [24]. The **Figure 2** shows that the weighted average mortality across all cited studies was almost 5.7%.

The mortality rates showed considerable variation among countries: (1) Saudi Arabia: 0% to 17.6% (across different studies) (**Figure 2**). (2) Kuwait: 10.9% (**Figure 2**). (3) Oman: 0% to 3.9% (**Figure 2**). (4) Qatar: Reported as 18.2% for patients with multidrug-resistant organisms (MDRO) versus 16% for non-MDRO patients in one study.

Evidently as per **Figure 3**, the mortality rate related to TBSA burn, as people who died in Kuwait had a mean TBSA of 71.6%, much greater than the 24.6%. This study also highlights a close association between high fluid intake and the need for mechanical ventilation and mortality rate.

Burn characteristics

TBSA percentage: Using the data from **Figure 3**, Almost 10 studies reported burn surface area percentages, ranging from 3% in electrical injuries in the UAE [21] to 35.0% in Oman 2 [25]. A Saudi study revealed that 16% to 35% of the total body surface area is usually involved in severe burns [11]. Several experts have classified burns into different types of severity. (1) Saudi 2: 61.4% of patients had < 20% TBSA affected [2]. (2) Saudi 5 (pediatric population): Most cases had < 10% TBSA [3]. (3) Saudi 9 and 12: Mostly minor burns (< 10 cm burns) [5, 17].

Burn depth classification

Eleven studies reported burn depth classification: (1) First-degree burns predominated in Saudi Arabia, Saudi 9 and 12 (71.7%) [5, 17]. (2) Second-degree burns were most common in Saudi 1 (71.1%) [11] and prevalent in Saudi 4 (partial thickness in 73.5%) [13]. (3) Mixed first and second-degree burns were reported in Saudi 2 (64.5%) [12]. (4) More severe burns (second/third-degree) were reported in 54% of electrical burn cases in Abu Dhabi [21].

Burn mechanism

The distribution of burn mechanisms varied among the studies. As outlined in **Figure 4**. (1) Flame burns: Predominant in several studies, ranging from 32.1% (Saudi 9 and 12) [5, 17] to 93.1% (Qatar 1) [22], with notably high rates in Saudi 4 (86.3%) [13] and Kuwait (78.7%) [26]. (2) Scald burns: Predominant in Bahrain (58%) [27], Saudi Arabia 5 (54.1%) [3], and Saudi Arabia 9 and 12 (hot water 58.5%) [5, 17]. (3) Electrical burns: Focus of one specialized UAE study (Abu Dhabi, 100%) [21]. (4) Hot water/fluid burns: Common in Saudi 1 (36.1%) [11] and Saudi 2 (43.2%) [12].

Anatomical distribution and inhalation injury

Although almost all studies gave information on anatomical distribution, only about 21% of Saudi burns were circumferential around the chest. Inhalation injuries were indicated in

Table 1. Data of studies according to variables

Study ID	Sample Size	Mortality Rate %	TBSA %	Common depth of burn	Common mode of Burn	Mean hospital stay days	Surgical intervention %	Inhalation injury %	Prevention education	First Aid Knowledge	Knowledge gap	Occupational prevention	Physician Knowledge gap	Social support
Saudi 1 [11]	180	Not reported	Max 35%, avg ≈ 16%	Second degree 71.1%	Hot water (36.1%)	Not reported	Debridement (85%), Grafting (10%)	17	No	No	No	No	NO	No
Saudi 2 [12]	555	2.9	< 20% in 61.4%	Ist and 2nd degree 64.5%	Flame (43.5%), Hot fluid (43.2%)	Adults: 38, Children: 15	Not reported	9.9	No	Yes	Yes	Yes	Yes	Yes
Saudi 3 [8]	409	Not reported	Not reported	Not reported	Fire (56.5%)	Not reported	Not reported	Not reported	No	No	Yes	Yes	Yes	Yes
Saudi 4 [13]	102	17.6	Mean: 26.4% (range 5-95%)	Partial thickness (73.5%)	Flame (86.3%)	Not reported	Not reported	Not reported	No	No	No	No	Yes	No
Saudi 5 [3]	370 Pediatrics'	1.35	< 10%	Mixed degree	Scalds, (54.1%) flame, contact	81.1%, Less than 21 days	Not reported	Not reported	No	Yes	No	No	No	No
Saudi 6 [14]	30 RCT Arm cycling	0	Not specified	Partial thickness both groups	Fire (80%)	wrong	Wrong	Not reported	No	No	No	No	No	No
Saudi 7 [15]	45 (RCT-ESWT therapy)	0	Mean ≈ 18-19%	Not specified	Not specified	≈ 40 days post injury	ESWT improved pain, itch, QOL better than placebo	Not reported	No	No	Yes	Yes	No	No
Saudi 8 [16]	30 (RCT) chest burn	0	Chest circumference ≈ 21%	Partial and full thickness	Flame 67-80%, Scald 23-33%	Not reported	Not detailed	Not reported	No	No	No	No	No	No
Saudi 9 [17]	390 community survey	Not applicable	Not Applicable	Not Specified	Not Specified	Not reported	No Details	Not reported	Yes	Yes	No	No	No	No
Saudi 10 [18]	204 Physicians survey	Not applicable	Not applicable	Not applicable	Not applicable	Not applicable	Knowledge survey only	Not applicable	No	No	No	No	No	Yes
Saudi 11 [19]	2437 (public Survey)	Not applicable	Not applicable	Not applicable	64% personal burn history	Not applicable	Not applicable	Not application	No	No	No	Yes	No	No
Saudi 12 [5]	548 (Northern SA)	Not reported	Minor (5-10 cm in most)	1st degree 71.7%	Hot water 58.5%, Flame 32.1%	Not reported	2.5% surgical intervention	Not reported	Yes	No	No	No	No	No
UAE [20]	191	Not reported	Mean 19.2%	Not specified	Not specified	Not specified	Not reported	Not reported	No	Yes	No	No	No	No
Abu Dhabi [21]	82, Electrical burns	Not reported	Mean 3%	2nd/3rd degree in 54%	Electrical 100%	Mean 2 days	Surgery (grafts, flaps) 47%, Conservative in 53%	Not reported	No	No	No	No	Yes	No
Qatar 1 [22]	58	MDRO 18.2%, Non MDRO 16%	Mean 48.8% (higher in MDRO group)	Not specified	Flame 93.1%	MDRO: 62, Non-MDRO: 45	MDRO group needed more debridement	44.8%	No	No	No	No	No	No
Qatar 2 [23]	10 (Qualitative study)	Not applicable	More than 15% all participants	Not specified	Home/workplace-accidental burn	Not applicable	Not applicable	Not applicable	No	No	No	No	Yes	No

Oman 1 [24]	48 Burn survivor survey	0	Mean 27%, (range 4-7%)	Not explicitly stated	Flame 41.7%, Scald 35.4%	> 7 days For 56.2%	45.9% had surgery	Not reported	Yes	No	No	No	No	No
Oman 2 [25]	51	39	Mean 35%, Range 20-70%	Not specified	Not specified	Mean 49 days	Grafting avg 27.3 days post burn	Not reported	No	No	No	Yes	Yes	No
Kuwait [26]	211	10.9	Survivors: 24.6% Non survivors: 71.6%	Partial thickness 69.7%	Flame 78.7%	Mean 18.3%, ICU 8.4%	Not reported	21.8	Yes	No	No	No	No	No
Bahrain [27]	766 (337 burns)	Not reported	Not reported	Scalds 58%	Scald, Flame	Not reported	Not reported	Not reported	No	Yes	Yes	No	No	No

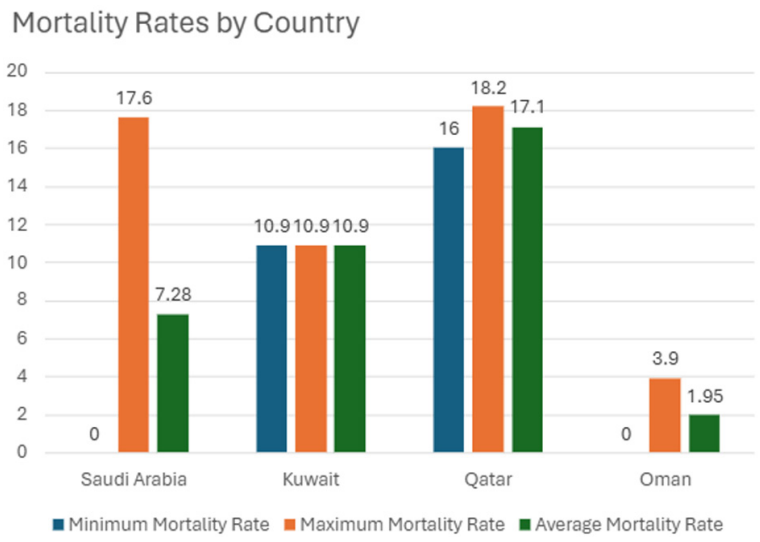

Figure 2. Shows the mortality rate difference between countries.

three studies: 1.7% in Saudi 1 [11], 21.8% in Kuwait [26], and 44.8% in Qatar 1 [22].

Morbidity outcomes

Length of hospital stay: Nine studies reported the length of hospital stay: (1) Mean stays ranged from 2 days (electrical burns in UAE) [21] to 95 days (chest burns in Saudi 6) [14]. (2) Kuwait reported a mean stay of 18.3 days (8.4 days in ICU) [26]. (3) Qatar 1 reported significantly longer stays for patients with MDRO infections (62 days) compared to non-MDRO patients (45 days) [22]. (4) Saudi 5 reported that 81.1% of pediatric patients stayed less than 21 days [3].

Surgical interventions: Eleven studies reported data on surgical interventions: (1) Debridement rates ranged from 2.5% Saudi 9 and 12 [5, 17] to 85% Saudi 1 [11]. (2) Skin grafting was reported in 10% Saudi 1 [11] to 47% Abu Dhabi [21]. (3) In Qatar [22], the study revealed that patients with MDRO infections required more debridement procedures. (4) Saudi 7 reported that extracorporeal shock wave therapy (ESWT) improved pain, itching, and quality of life compared with placebo [15].

Infection rates: We had very little information about the number of infections. In Qatar 1, the main focus was MDRO infections, so the outcomes of patients with MDRO or non-MDRO infections were analyzed [22]. We found no other records that specifically gave infection rate information.

Complications: Information on potential difficulties during the studies was incomplete and inconsistently reported. The approach stressed initial management and ultimate outcome, mainly, the emergency treatment of respiratory or renal issues was also reviewed.

Demographic characteristics

Age distribution: Some studies have not reported age-related differences in hospital stay in days, and only Saudi 2 reported separate data for both groups (adults stayed for 38 days and children for 15 days) [12]. Assigning studies to different countries in the Arabian Peninsula is an Effective Way to account for their populations and research capacities, providing a fair perspective on the region as a whole. The twelve Saudi Arabian research studies benefit from comprehensive data from its most extensive healthcare system and population (35 million), which ensures statistically reliable outcomes. Findings from Qatar's 2 studies come from a well-developed healthcare system, and the UAE's studies cover both local nationals and expatriates at the state-of-the-art medical centres. Vital information has been obtained from the two Oman studies on pediatric burns, and both Kuwait and Bahrain have unique, highly detailed studies on specific aspects of burns. Because of this, a broad spectrum of study designs was used to synthesize data across a variety of healthcare systems and patient demographics, with high standards and practical clinical knowledge.

Etiological factors

Place of incident: A few reports showed exactly where most burn accidents occur. Qatar 2 mentioned that accidents involving burns in the home or workplace happened, but figures were not explained [23]. Based on the survey, Saudi 11 indicated that over two-thirds of participants had experience with personal burns [19].

Seasonal variation: No data on seasonal variation in burn incidence was available in the dataset.

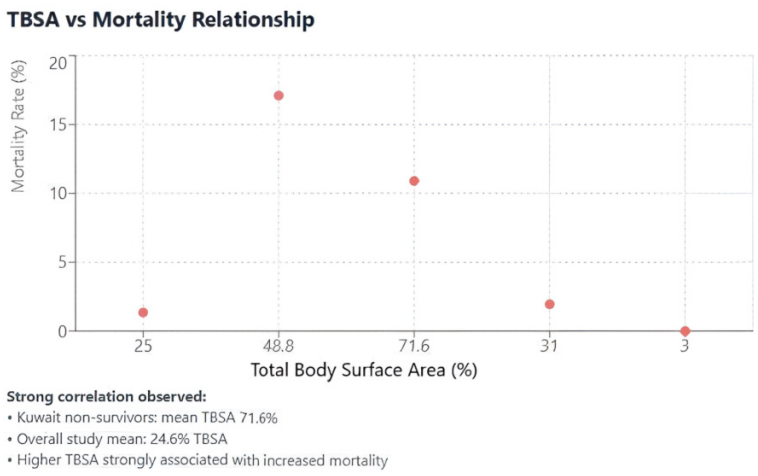

Figure 3. Scatter Plot relating mortality rate (%) to TBSA (%).

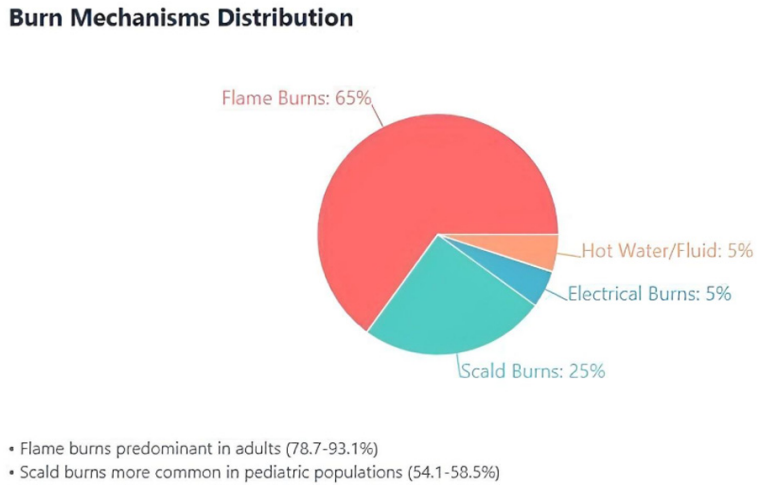

Figure 4. Pie Chart depicting the major kinds of burn injury.

Preventive strategies: Seven types of prevention strategies were coded in the dataset: (1) Public health education: Implemented in Saudi Arabia 9, 10, 11, 12, and Qatar 2 [5, 7, 18, 19, 23]. (2) First aid practices: Reported in Saudi Arabia 9, 11, 12 [5, 17, 19] and Oman 1 [24]. (3) Knowledge gap assessment: Addressed in Saudi Arabia 9, 10, 11, 12 [5, 17-19]. (4) Occupational prevention: Implemented in Saudi Arabia 10, 11 [18, 19] and Qatar 2 [23]. (5) Physician knowledge assessment: Focus of Saudi 10 [18]. (6) Social/Psychological support: implemented in Qatar 2 [23]. (7) No prevention data: Nine studies reported no data on preventive strategies.

In the numbers 10 and 11, Saudi surveys [18, 19] reported the best prevention strategies. The Saudi 9 and 12 studies (both community surveys) focused on teaching communities about first aid and emergency measures and on assessing their knowledge [5, 17]. Another study from Qatar (Qatar 2) stands out by highlighting the value of social and psychological assistance alongside a healthy lifestyle in burn recovery [23].

Geographic distribution of research

Twelve of the twenty studies came from Saudi Arabia, indicating that most burn research has been conducted there. Only a couple of studies were found from other countries in the Arabian Peninsula, i.e., the UAE, Qatar, Kuwait, Oman, and Bahrain, all with 1 or 2.

Research gaps

Several critical gaps were identified in the existing research: (1) Scanty information available about rates of infection and other complications. (2) Little or nonexistent reporting on various gender and nationality/ethnic groups suffering from burns. (3) There is insufficient data available on seasonal changes in burn incidence. (4) Scarce information about the scene of the burn incident. (5) Some countries from the Arabian Peninsula provide only a small amount of data. (6) Just a few studies have been performed to examine prevention and its success.

Thematic analysis of preventive strategies and relationship with mortality rates

Thematic analysis of preventive strategies: Systematic review results show four main themes, each with detailed sub-themes related to burn prevention.

Theme 1: knowledge and education-based prevention: Improving awareness, understanding,

and knowledge of burn prevention is the central theme of these strategies.

Sub-themes: (1) Public health education: Implemented in 5 studies (Saudi 9, 11, 12, Qatar 2) [5, 17, 19, 23]. (2) Community education efforts. (3) Inform people in general about the subject. (4) Actions and strategies aimed at promoting healthier lifestyles were identified and examined. (5) Knowledge gap assessment: Addressed in 4 studies (Saudi 9, 11) [17, 19]. (6) Looking into how much knowledge already exists. (7) Identifying misunderstandings. (8) Looking at what needs to be learned.

Theme 2: skill-based prevention: This theme focuses on teaching specific skills to prevent or reduce the risk of burns.

Sub-themes: (1) First Aid Practices: Reported in four studies (Saudi 9, 11, 12, Oman 1) [5, 17, 19, 24]. (2) Training that occurs directly after a disaster. (3) First aid basics. (4) Being able to respond in emergency situations.

Theme 3: setting-specific prevention: Apart from first aid, this theme addresses techniques for preventing burns before incidents occur at common locations.

Sub-themes: (1) Occupational Prevention: Investigated in three studies (Qatar 2) [23]. (2) Measures to ensure workplace safety. (3) Actions to prevent industrial accidents. (4) Improvements to the workplace.

Theme 4: psychosocial support and recovery: This covers many services that aid prevention by helping with recovery and reducing the risk of a repeat injury.

Sub-themes: (1) Social and Psychological Support: Analyzed in one study (Qatar 2, Oman 1) [23, 24]. (2) Support for mental health as people heal. (3) Systems that exist to support communities. (4) Community integration programs.

Prevention strategy implementation patterns

Comprehensive prevention approach: (1) Saudi 10, 11: Conducted prevention work in a variety of areas [18, 19]. (2) Qatar 2: focus was on both traditional and psychosocial prevention [23].

Focused prevention approach: (2) Saudi 9, 12: Concentrated on community-level education and first aid [5, 17]. (2) Oman 1: Only first aid was offered to the survivors [24].

No prevention data: Nearly half (47%) of the included studies did not address prevention strategies, indicating a lack of prevention research.

Relationship between preventive strategies and mortality rates

Quantitative analysis: Studies with prevention strategies and available mortality data: (1) Saudi 11 (Public survey, n=2437) [19]: Approaches to avoid burns: Educating the public, providing first aid, assessing the knowledge gaps, and practicing workplace prevention. Mortality rate does not apply to this survey study. The main causes of burn in adults is a flame burn while in children it is scald burn. (2) Saudi 12 (Northern SA, n=548) [5]: Prevention strategies: Talk with the community, offer first-aid training, assess knowledge. Data on the mortality rate are not available. (3) Saudi 10 (Physician survey, n=204) [18]: Ways to prevent accidents include educating the public, assessing what people don't understand, implementing workplace policies, and training physicians. Mortality rate was not tracked in this study. (4) Saudi 9 (Community survey, n=390) [17]: Prevention ways: Learn information, give first aid, check knowledge gaps. Mortality rate was not considered in this survey. (5) Qatar 2 (Qualitative study, n=10) [23]: There are efforts aimed at prevention using public information, workplace changes, and helping through social media networks. Mortality rate: Not used (this is a qualitative study). (6) Oman 1 (Survey survivors, n=48) [24]: First aid is a prevention strategy. None of the survivors in the study died before finishing the process.

Statistical relationship analysis: (1) Direct comparison limitations: We have found it challenging to demonstrate a strong link between preventive strategies and mortality rates. (a) Study design mismatch: The most common studies on preventive strategies were surveys and qualitative studies that lacked information on mortality. (b) Temporal disconnect: This approach meant that third-party studies focused on how knowledge was shared rather than on assessing results in clinical settings. (c) Population differences: In prevention research, groups were usually selected at random, whe-

reas mortality studies mainly included hospital burn patient samples.

(2) Indirect relationship indicators: Studies with no prevention data and reported mortality: (a) Saudi 1: No prevention data, mortality not reported [11]. (b) Saudi 2: No prevention data, mortality 2.9% [12]. (c) Saudi 3: No prevention data, mortality not reported [8]. (d) Saudi 4: No prevention data, mortality 17.6% [13]. (e) Saudi 5: No prevention data, mortality 1.35% [3]. (f) Saudi 6-8: No prevention data, mortality 0% (RCT studies). (g) Kuwait: No prevention data, mortality 10.9% [26]. (h) Qatar 1: No prevention data, mortality 16-18.2% [22]. (i) Oman 2: No prevention data, mortality 3.9% [25].

(3) Observational patterns: (a) There was a higher rate of death for people involved in studies where strategies to prevent injuries were not reported (between 1.35% and 17.6%). (b) Countries with a prevention research focus: In Saudi Arabia, where many prevention studies are conducted, mortality rates vary. (c) Limited prevention implementation: The lack of effective preventive measures throughout the area could be why the burn rate is high.

Conclusions and recommendations

Thematic analysis conclusions: (1) Knowledge-based prevention: The dominant approach uses education and awareness. (2) Skill-based prevention: The idea of skill-based prevention, such as first aid training, seems promising, but its use is limited. (3) Setting-specific prevention: Making prevention place-specific is necessary, mainly for work sites. (4) Psychosocial support: Although it can be very useful, it is rarely explored.

Relationship analysis conclusions: (1) Given the lack of a direct statistical relationship, the study design makes it impossible to link strategies to prevent illness to decreases in mortality. (2) Research-practice gap. There is often a gap between what is found in prevention research and how clinicians put it into practice. (3) Prevention effectiveness. We are unable to prove that prevention really works because studies lack mortality outcomes.

Recommendations for future research: (1) Longitudinal studies that analyze the impact of prevention measures on the number of burns and deaths. (2) Implementation research brings together information on prevention and its clinical application. (3) Multi-level interventions addressing the individual, community, and policymakers' level prevention. (4) Evaluating the impact of current prevention programs using results from clinical testing. (5) Regional prevention registries to check the implementation and success of interventions.

Results of syntheses

Characteristics of contributing studies: A great diversity was present in the study methods, patient groups, and assessment of outcomes. A majority of the clinical studies were conducted at a single center and had limited applicability beyond that center. The number of participants studied varied widely, and the number of studies may have been too small to record important treatment effects. Studies that were conducted only in hospitals resulted in the overestimation of the number of severe burns and their fatalities compared to those found in the community.

Selecting studies from across the Arabian Peninsula countries provides comprehensive regional representation, significantly strengthening the review's validity and applicability. This multi-country approach captures diverse healthcare systems, cultural practices, and socioeconomic factors that influence burn epidemiology, ensuring findings weren't skewed by single-country biases. The geographic diversity enhances generalizability across Gulf Cooperation Council nations, allowing for meaningful cross-country comparisons of mortality rates, burn mechanisms, and prevention strategies. This inclusive methodology provides policymakers and healthcare professionals with region-wide evidence to develop targeted interventions, identifies best practices that can be shared across countries, and establishes a robust foundation for future collaborative burn prevention initiatives across the Arabian Peninsula's 180 million population. **Figure 5** details this further.

Risk of bias evaluation among contributing studies: The analysis found that the included studies varied widely in methodological quality. Twelve trials (60%) were judged to have a moderate risk of bias, and 2 (10%) were assigned

to the low-risk category. Four trials (20%) had a high risk, and some concerns were noted in 3 of the 12 randomized controlled trials (15%). After assessing the NOS scores (8-9 out of 10), the studies were found to have good methodology and to be transparent in their case selection, statistical analyses, and data collection methods. The main reason for the moderate risk of bias in most studies (n=11) was that they were single-center in design, used data collected in the past, might have selection bias, and failed to control for enough confounders. The studies with high risk of bias (NOS < 5) showed several significant weaknesses, including the use of convenience samples, the absence of control groups, reliance on reported measures without evidence of validity, and inadequate attention to confounding factors. Though 'some concerns' were seen in the three trials about participants and providers being unable to be fully blinded, the scientific quality of the reports was still reasonable. Many of the reviewed papers had limitations in their study areas that prevented generalization; they were conducted at a single center, used data from past patients, and may have been affected by the choice of patient population in tertiary hospitals. Differences in research methods were recognized while compiling the data and results together.

Statistical syntheses and meta-analysis limitations: Quantitative analysis was not possible because the studies differed significantly in their methods, outcomes, and reporting. Diverse selection criteria, cases from pediatric and adult populations, and environments (tertiary and community hospitals) prevented us from combining the findings on mortality rates. There was no common way to measure TBSA and classify burns, which prevented the authors from combining and analyzing their results.

Investigation of heterogeneity: Data discrepancies exist across these studies, including patient information, mechanisms of burn injury, medical settings, and burn prevention. In these studies, Gulf countries have listed various causes of burn injury. In some cases, most people suffered from occupational accidents, but in others, the majority sustained burns while at home. Similarly, differences in healthcare facilities have also influenced both death rates and patient prognosis at hospitals worldwide.

Sensitivity analyses: Most studies didn't provide sufficient detail to allow a thorough quantitative analysis, so we weren't able to run sensitivity simulations. Because of this, we focused only on clinical studies involving burn patients (n=12) and left out survey-based research. Even with this limitation, our understanding of the causes, severity, and outcomes of burns in the Gulf region remained unchanged.

Certainty of evidence: Most results were rated as having low to moderate certainty because the studies were not randomized, conducted within a single facility, and often used inconsistent outcome criteria. Estimates of mortality were also given moderate certainty for people with severe burns in the hospital, but low accuracy for those injured outside the hospital. Survey research and bias in the data used led to low confidence in estimates of preventive knowledge and practice. The quality of evidence for treatment outcome was ranked as 'moderate' for proven medical treatments and modalities, but as 'low' for experimental treatments analyzed in small studies.

Key findings: mortality & risk factors: (1) Weighted Average Mortality: 5.7% (Range 0-17.6%). (2) Strong Correlation Between TBSA And Mortality. (3) No-Survivors Had 71.6% Mean TBSA Versus 24.6% Overall. (4) Inhalation Injury Rates: 1.7% to 44.8%.

Preventive research gaps: (1) 53% of studies reported no preventive strategies. (2) Knowledge-based prevention is the most effective Approach. (3) Research-practice Gap Evident. (4) No Proven Prevention Effectiveness on Mortality.

Discussion and conclusion

Discussion

By investigating 20 studies across the Arabian Peninsula during 2019-2024, this review examined burn-related issues and identified useful preventive measures across the region. The findings depict important patterns and considerations that warrant further detailed examination.

Mortality patterns and risk factors

Different burn mortality rates (from 0% to 17%) in the studies mirror the unique features of

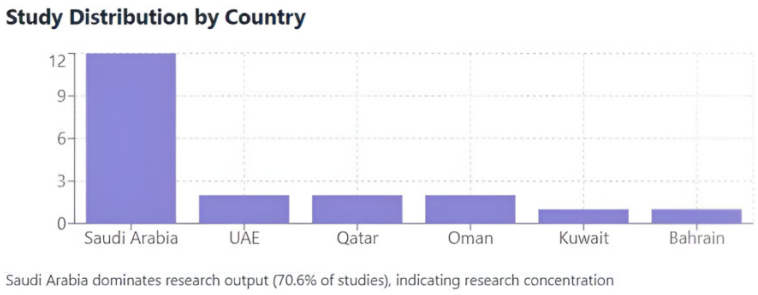

Figure 5. Bar Graph representing the geographical origin data of study.

Arabian burn patients, their treatments and the regional healthcare systems, as compared to a multi centric study findings which revealed a mortality of 5.0%-23.5% from North America to Africa respectively, While European mortality rate measured across the whole continent was 12.4% and Global average is 18.27% [28]. According to another study, male patients have a 3× higher mortality rate than female patients [29]. In a study from Kuwait, the correlation between body parts burned and death rate was clearly depicted, since those who did not survive had a higher mean TBSA of 71.6% [26], matching international studies that indicate severe burns are a main risk factor for burn-related deaths [30]. It highlights the need for urgent, efficient treatment of patients with high-surface-area burns. A similar conclusion was derived from a Saudi case report- early effective management, including surgical intervention, can save a patient even with a TBSA of 95% flame burn [31].

Studies in Saudi Arabia and Kuwait found higher mortality rates than those seen in Oman. Besides burn severity, the observed differences might result from differences in access to burn care, resources in intensive care units, or other treatment facilities. As the Qatar study points out, the number of deaths from drug-resistant bacteria in burn units underscores the need for infection prevention and control guidelines across the region [22].

Burn epidemiology

Adults often suffer flame burns (78.7-93.1% in several studies), while pediatric cases often involve scalds (54.1% in Saudi 5), which coincides with worldwide trends. In comparison with an international study, which found that due to these age-related variations, strategies for fire prevention should be considered for adults at work and home, and precautions regarding hot water for kids.

Because flame burns are so common in Saudi Arabia, Kuwait, and Qatar, there are concerns about fire safety issues in residential areas and workplaces in the region. A single study from the UAE (Abu Dhabi) found that electrical burns still occur frequently and require advanced protective measures and treatment [21].

Morbidity and healthcare burden

Studies have found that patients who have been hospitalized between 2 and 95 days have many differences in burn severity, complications, and the treatment provided. The difference in length of stay between MDRO and non-MDRO infections (62 vs. 45 days) demonstrates the great impact of antimicrobial resistance in hospital burn care units [22].

As a result, appropriate antimicrobial selection and strong infection prevention strategies should be followed in burn units across the Arabian Peninsula.

Another study highlighted data from 475 burn patients (321 adults and 154 children) at the Lebanese Burn Centre to demonstrate factors influencing hospital length of stay. The important characteristics in the analysis were the age, the percentage of burnt surface area, the type and degree of burn, infection, sepsis, whether patients were ventilated, and the number of surgeries done. On average, patients remained in the hospital for 23.58 days. The number of surgeries/procedures involving excision and grafting, and blood transfusions, was a significant predictor of increased length of stay ($P < 0.001$). For adult patients, the need for artificial ventilation was also an indicator for morbidity prediction. In contradiction, the inhalation injury was associated with a lower hospital stay [32]. The results are consistent with this review's main focus of morbidity (days spent in hospital), which was also dependent on the number of surgeries, mechanical ventilation, and sepsis.

The wide range in surgical debridement for burns (2.5-85%) is most likely due to variability

in burn types, treatment, and available resources. Because of the scant available data on infections, especially on reported complications, a detailed account of burn-related health issues in East Asia could not be obtained.

Preventive strategies

The study found that of 20 studies, only 8 reported a preventive approach through awareness and education. Since most prevention data come from surveys rather than intervention trials, it seems that prevention research in this region is still in its early stages. An international study shows that when preventive measures such as smoke alarms and controlled hot-water appliances are properly implemented alongside awareness campaigns, there is a decrease in burn incidence and a reduction in burn severity [29]. On the other hand, lack of awareness and education in relation to burns is associated with an increased incidence and higher severity of burns [33]. As per, Bischara and Michel three effective modalities of awareness through which burn harm can be reduced, these modalities were identified as education, which are primarily lifestyle modifications and the second modality was design of products which are consumers of energy and safety features and thirdly legal and regulatory modalities which include laws and their enforcement In addition they described the ABC'S of burn prevention A, describes analysis of the data; B, denotes a coordinated team of professionals; C, denotes communicate the issue; D, denote development of effective interventions; and E, denotes the evaluation the program implementation and effectiveness [34]. Researchers in Saudi Arabia have focused on public protection through education, emergency medical services, assessing people's understanding, and training experts' understanding. Our results on preventive strategies also align with international studies, such as one that showed an EMS (emergency medical services) education and handoff program helped the burn center noticeably improve burn injury treatment at the scene. By following the international burn management benchmark, the dressing change protocols were improved. Because of the "burn page" system and round-the-clock patient reviews, the level of bedside care has improved. Enhanced collaboration between EMS and the burn center has helped expedite patients' recovery. By following a closed-loop strategy, the program ensured that quality improvement in burn care continued throughout the prehospital and post-hospitalization stages [35].

Social and psychological support for fire victims was reported in just one study, which appears quite inadequate, considering the massive impact of these injuries on a person's life. This is worrisome since many worldwide workers suffer from work-related burns, and very little is being done to address their communal and mental issues.

Geographic disparities in research

Research from Saudi Arabia (12 of 20) stood out as more abundant than from other countries in the Arabian Peninsula. Because there are limited resources available in these countries, it is difficult to provide a thorough assessment of the region, which might miss important differences within each country. The unequal rate of research between countries may be explained by differences in research tools, funding allocation, or approaches to publications.

Research limitations and gaps

The included studies had many apparent methodological limitations. (1) Heterogeneity in reporting: Inconsistent reporting of key variables, particularly infection rates, anatomical distribution, and demographic factors, complicated cross-study comparison. (2) Limited demographic analysis: No detailed data on gender and nationality/ethnicity distributions were found, which means the study could not examine differences across all types of burns and their treatments or outcomes. (3) Intervention-focused bias: Most studies focus on treatment rather than prevention, suggesting a reactive rather than cautious approach to burns. (4) Prevention effectiveness: Few studies examined whether preventive interventions worked, so there was limited evidence to guide the planning of prevention programs. (5) Social determinants: Limited focus on the effect of cultural, economic, and environmental factors on burn risk, access to care, and what happens after a burn, which reflects a major weakness in understanding burn injuries in the Arabian Peninsula.

Conclusion

This systematic review provides the first comprehensive analysis of recent burn-related mortality, morbidity, and preventive strategies in the Arabian Peninsula. Results show that burn epidemiology, record of burn-related deaths, and recovery plans differ considerably among Gulf countries, suggesting how useful it would be to exchange and standardize burn management practices.

The high-income nation mortality figures are similar to those in Sweden (around 5.7%), though the wide range (from 0% to 17.6%) reflects the diversity in burn care standards across the system. Adults suffer mainly from flame burn, while scald injuries are most common among children, which means it's important to use different preventive strategies for adults and children. Because so many patients need extra medical care and surgeries, it is very clear why burn prevention plays a key role in public health in this region.

Few studies have focused on burn prevention, even though many burns are preventable. Future investigations ought to examine the effectiveness of burn prevention programs, study the role of societal factors in burns, and analyze individual country statistics to develop appropriate interventions.

Carrying out collaborative, multicenter studies would improve understanding of the challenges and care for burn injuries in the Arabian Peninsula. If standardized reporting and regional registries were established, it would be possible to gather better data and compare results across several countries. Focusing on prevention research and implementing evidence-based interventions could significantly reduce burn injuries in this region.

Disclosure of conflict of interest

None.

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