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CLINICAL PROFILE AND OUTCOMES OF ACUTE POISONING CASES IN THE EMERGENCY AND CRITICAL CARE DEPARTMENT

Mohammed Salem Babkeer[1], Mohammad Hijazi Khail[2], Heba Elmetwally Abdallah Farahat[3], Musalli Naji Saleh Alalhareth[4], Mohd Ayman Mustafa Hammad[5], Faisal Said Al Jerah[6]

[1]Emergency Department, Dr. Sulaiman AlHabib Hospital, Alkhobar, Saudi Arabia
dr_babkeer@hotmail.com , https://orcid.org/0009-0007-2442-2477
[2]Emergency Department, Dr. Sulaiman AlHabib Hospital, Jeddah, Saudi Arabia
hijaz1982@yahoo.com , https://orcid.org/0009-0008-0467-0374
[3]College of Applied Medical Sciences, Department of Radiology and Medical Imaging
Prince Sattam bin Abdulaziz University, Al-Kharj, Saudi Arabia
h.farahat@psau.edu.sa heba.elmetwally@yahoo.com , https://orcid.org/0009-0003-7949-0929
[4]Training Department, Saudi Red Crescent Authority, Queen's University of Belfast, Najran, Saudi Arabia
Master's Degree in Acute and Critical Care from QUB
musallialalhareth99@gmail.com , https://orcid.org/0009-0000-6766-3245
[5]Internship, Jordan University Hospital, Faculty of Medicine, Yarmouk University, Amman, Jordan
mmm2010h@gmail.com , https://orcid.org/0009-0005-9571-5707
[6]Emergency Department, Saudi Red Crescent Authority, Saudi Electronic University, Najran, Saudi Arabia
Master's Degree in Healthcare Administration
faisal.aljerah@gmail.com , https://orcid.org/0009-0004-6327-9851

ABSTRACT

Acute poisoning is a critical public health issue globally, contributing to a substantial number of emergency department visits, hospital admissions, and avoidable mortality. This systematic review and meta-analysis synthesizes data from 15 observational studies across high-income countries (HICs) and low- and middle-income countries (LMICs), focusing on the clinical profile and outcomes of acute poisoning cases. The review provides pooled estimates of mortality, ICU admission, and length of stay, as well as insights into the regional variations in poisoning agents, demographic patterns, and prognostic factors. Results show that while mortality is low in HICs (<1%) due to drug overdoses, LMICs report higher mortality (11-18%) predominantly due to pesticide exposure. The study highlights the heterogeneity in study designs and outcome reporting, which complicates direct comparison and meta-analysis. The findings underscore the need for standardized outcome definitions and case classifications, improved poison-control systems in LMICs, and enhanced mental health interventions to reduce intentional poisoning cases. This study provides valuable recommendations for future research and clinical practice to address the global burden of acute poisoning.

Keyword: Acute poisoning; clinical profile; emergency care; intensive care outcomes; pesticide poisoning; systematic review; prognostic factors

INTRODUCTION

Acute poisoning is a persistent global public-health problem that contributes substantially to emergency department visits, hospital admissions and avoidable mortality. The World Health Organization estimates that unintentional poisoning caused roughly 106,683 deaths and 6.3 million DALYs in 2016; many more events are related to intentional self-poisoning and occupational exposures, and the true burden is likely larger in low-resource settings. (WHO guidance on poison centres) (*WHO Guidelines for Establishing a Poison Centre*, n.d.-a).

Epidemiological patterns of acute poisoning differ by region and economic context. High-income countries tend to report more pharmaceutical and recreational-drug overdoses, while low- and middle-income countries (LMICs) commonly report pesticide and household-chemical poisonings as major causes of severe outcomes. Recent multicenter and national studies illustrate this variation: large Chinese and multicountry cohorts report high proportions of drug-related poisonings and comparatively low in-hospital fatality in general ED cohorts, whereas ICU or aluminum-phosphide-dominated cohorts (typical in some LMIC reports) show very high case-fatality (ElMehy et al., 2025; Liu et al., 2023a).

Intentional self-poisoning comprises a large share of emergency poisoning presentations in many settings, particularly among young adults and in several LMIC studies; gender and age distributions also vary, but several reports show a higher proportion of females among non-fatal ED poisonings. These sociodemographic patterns are important because intent, agent type, and demographics strongly influence triage, treatment decisions (antidotes, decontamination, ventilation), and outcomes (Al-Mahbashi & Howilah, 2024a; Nepal et al., 2025a).

Clinical outcomes reported in contemporary observational studies are heterogeneous. General ED cohorts frequently report low overall mortality (often <1–3%) but variable rates of hospital/ICU admission and lengths of stay. By contrast, ICU-only or toxin-specific cohorts (for example, aluminum-phosphide or severe organophosphate poisonings) may experience very high mortality (reported >50% in some series). Predictors of poor outcome reported across studies include later presentation after exposure, depressed level of consciousness at arrival, need for mechanical ventilation, specific toxin class (e.g., certain pesticides, paraquat, aluminum phosphide), and comorbidities (Reisinger et al., 2024a; Waktola et al., 2023a).

Despite an increasing number of well-designed observational studies in the last decade, results are fragmented by geography, differing case-definitions, and heterogeneous outcome reporting. A structured synthesis of recent (≈10–15 year) peer-reviewed studies spanning all age groups, all poisoning agents, and emergency/critical-care settings is therefore required to (1) quantify pooled estimates of key outcomes (mortality, ICU admission, length of stay), (2) identify consistent prognostic factors, and (3) clarify regional differences that can inform triage, resource allocation, prevention and clinical guidelines.

Primary objective

- To systematically review and quantitatively synthesize (meta-analyse) peer-reviewed studies from the last 10–15 years that report the clinical profile and outcomes of **acute poisoning in emergency and critical care** settings worldwide.

Secondary objectives

1. To estimate pooled rates for key outcomes: **in-hospital mortality, ICU admission,** and **length of hospital stay** (where numeric data permit).
2. To describe global patterns of **poisoning agents** (pesticides, pharmaceuticals, household chemicals, recreational drugs, etc.) and the **demographic profile** (age, sex) of affected patients.
3. To quantify the proportion of **intentional vs. accidental** poisonings across regions.

4. To identify and summarise **prognostic factors** consistently associated with unfavorable outcomes (e.g., delayed presentation, decreased consciousness, need for ventilation, specific toxin classes).
5. To provide evidence-based recommendations for emergency and critical care practice and for targeted prevention strategies in different resource settings.

Literature review

Global burden and public-health context

Poisoning remains a time-sensitive medical emergency and an important cause of emergency department (ED) use and critical-care admission worldwide. The WHO emphasizes that unintentional poisoning accounted for ~106,683 deaths and 6.3 million DALYs in 2016 and recommends national poison-control capacity as part of public-health preparedness (*WHO Guidelines for Establishing a Poison Centre*, n.d.-b). World Health Organization Studies from diverse settings continue to show high ED burden with large geographic variation in both incidence and fatality (Li et al., 2025).

Agents and regional patterns

The dominant classes of toxic agents differ by income-setting and region. High-income regions report comparatively more pharmaceutical and recreational-drug overdoses, while many LMICs still record a high proportion of pesticide and household-chemical poisonings. Recent multicentre and hospital-based studies illustrate this split: large Chinese series emphasize drugs and medical agents as frequent causes, whereas studies from parts of South Asia, the Middle East and Africa report pesticides and household poisons as a major share of severe cases (Liu et al., 2023b). Country-level and hospital series also give precise agent distributions useful for subgroup meta-analysis (e.g., pesticide proportions in Yemen and Ethiopia cohorts) (Al-Mahbashi & Howilah, 2024b).

Demographics and intent (intentional vs accidental)

Many contemporary cohorts show that a substantial fraction of poisoning presentations are deliberate self-poisonings, especially among adolescents and young adults. Several studies report high intentionality rates (often >50%) with female predominance in non-fatal ED cohorts in some regions; however, patterns vary by local sociocultural factors. These demographic and intent patterns are important because intentional poisoning is frequently associated with different agent profiles (e.g., pesticide or prescription drug intake) and worse clinical trajectories in some studies (Nepal et al., 2025b).

Clinical presentation and immediate management

Presenting features depend on agent, dose and delay to care; common presentations include altered consciousness, respiratory compromise, seizures, and hemodynamic instability. Management strategies documented across studies include airway support, activated charcoal/gastric decontamination when indicated, targeted antidotes, and supportive ICU care (vasopressors, mechanical ventilation, renal replacement therapy). Several observational papers highlight variability in pre-hospital care and triage practices that influence outcomes (e.g., whether triage/resuscitation occurred before ward transfer).

Outcomes — mortality, ICU admission, length of stay

Reported outcomes are heterogeneous. Large ED/hospital cohorts report relatively low in-hospital mortality (often <1–3% in sizeable general cohorts), whereas toxin-specific or ICU cohorts may have very high mortality (in some aluminum-phosphide or severe organophosphate series >50%). ICU cohorts typically have higher mechanical ventilation and longer lengths of stay; single-center LMIC studies often report higher case fatality than comparable HIC ED cohorts. These contrasts are consistently observed in the recent literature and support stratified meta-analysis by setting (ED vs ICU) and toxin group (Chatterjee et al., 2020a; Liu et al., 2023c).

Prognostic factors associated with poor outcomes

Across multiple recent observational studies, factors associated with unfavorable outcomes include delayed presentation, depressed level of consciousness on arrival, need for mechanical ventilation, rural residence (often a proxy for delayed access), ingestion of highly toxic agents (e.g., aluminum phosphide, paraquat, certain organophosphates), and presence of medical comorbidities. Several studies used multivariable modelling to identify independent predictors (e.g., Glasgow Coma Scale, time-to-treatment, exposure type), providing candidate covariates for meta-regression or subgroup analyses (Reda et al., 2023a).

Heterogeneity in methods and reporting implications for meta-analysis

The literature is heterogeneous in study design (prospective vs retrospective), case definitions (what counts as "acute poisoning"), and outcome reporting (in-hospital mortality, 30-day mortality, ICU-specific mortality; some report length of stay as medians, others as means). This variability requires careful harmonization (for example, converting proportions and calculating standardized effect sizes; performing subgroup or random-effects models) and clear reporting of inclusion/exclusion decisions. Several of the included papers provide the necessary numeric detail (sample size, counts for deaths, ICU admissions, intent categories) to permit pooling after appropriate transformations (Reda et al., 2023a).

Gaps, research needs and policy implications

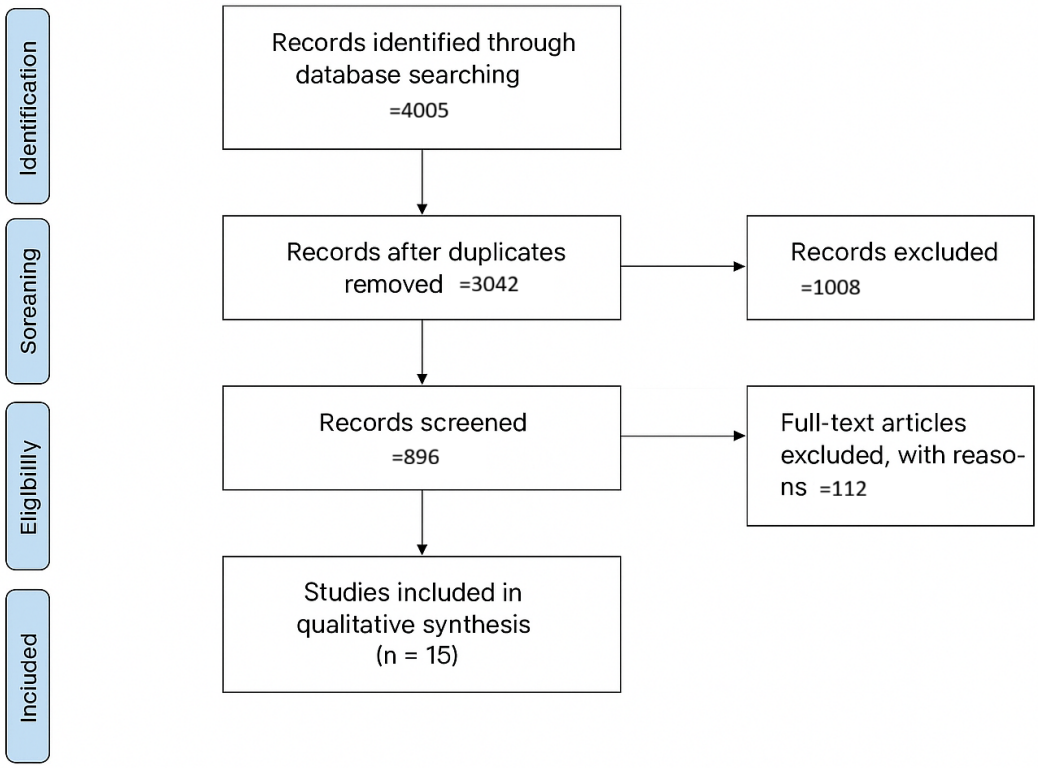
Key gaps include under-reporting or inconsistent reporting of time-to-presentation, limited granular data on specific antidote use and doses, and few multicentre prospective ICU cohorts in LMICs. Policy-relevant findings across the literature support strengthening poison-control systems, improving pre-hospital triage and transport, restricting access to highly hazardous pesticides, and increasing mental-health interventions where intentional self-poisoning predominates. Future research should prioritize standardized outcome definitions and prospective multicentre data collection to improve comparability.

METHODOLOGY

Study design

This review was conducted as a systematic review and meta-analysis of observational studies reporting the clinical profile and outcomes of acute poisoning presenting to emergency departments and/or managed in critical-care units. The review was planned a priori to follow PRISMA 2020 recommendations and to include both retrospective and prospective cohort studies, cross-sectional series, and case–control studies when relevant. The eligible literature window was 1 January 2010 through 31 December 2025 to capture recent trends while allowing 10–15 years of evidence.

Figure 1: Prisma diagram



Eligibility criteria

We included original, peer-reviewed human studies of any age group that reported extractable quantitative data on acute poisoning cases treated in emergency or critical-care settings. Eligible studies reported at least one outcome of interest (for example counts or proportions of in-hospital deaths, ICU admissions, need for mechanical ventilation, or length of hospital stay). All toxic agent types (pesticides, pharmaceuticals, household/industrial chemicals, alcohol/recreational substances, environmental toxins) and both intentional and accidental exposures were eligible provided the exposure was acute. We excluded case reports and very small case series, editorials, narrative reviews, animal or in-vitro research, studies of chronic exposure, and publications lacking sufficient numeric data after attempts to contact the authors.

Search strategy and information sources

A comprehensive literature search was performed across major bibliographic databases (PubMed/MEDLINE, Embase, Scopus, Web of Science, and Cochrane CENTRAL) and supplemented by targeted Google Scholar screening and backward citation searching of included articles. The search combined controlled vocabulary (MeSH/Emtree) and free-text terms for poisoning and acute care (for example “poisoning”, “intoxication”, “acute poisoning”, “emergency department”, “intensive care unit”, “mortality”, “length of stay”, and “outcome”). Searches were limited to human studies in English published between 2010 and 2025. Full, reproducible search strings for each database, together with search dates and export files, are provided in Appendix A.

Study selection

All retrieved records were exported to a reference manager and de-duplicated prior to screening. Two reviewers independently screened titles and abstracts to identify potentially eligible reports; any record judged potentially relevant by either reviewer proceeded to full-text assessment. Full texts were then reviewed independently by the two reviewers against the pre-specified eligibility criteria.

Discrepancies at any stage were resolved by discussion and, when necessary, by adjudication with a third reviewer. The final set of included studies (n = 15) was selected on the basis of meeting all inclusion criteria and providing sufficient numeric data for extraction and pooling.

Data extraction and management

Data extraction was performed independently by two reviewers using a pre-piloted extraction form. For each study we extracted bibliographic details (author, year, DOI), study design and setting (ED, ICU, or mixed), study period and country, sample size and demographic data (age statistics and sex distribution), toxin classes and counts, intentionality (intentional vs accidental), key interventions (antidotes, mechanical ventilation, renal replacement), and numeric outcomes (deaths, ICU/hospital admissions, ventilator use, and length of stay). When continuous outcomes were reported as medians and interquartile ranges, the original statistics were recorded and—where pooling required—accepted methods were applied to approximate means and standard deviations; all conversions are documented in the analysis appendix. The completed extraction spreadsheet and all screening decisions are archived and available as supplementary material.

Outcomes of interest

The primary outcome of interest was in-hospital mortality (number and proportion of deaths among poisoned patients). Secondary outcomes included ICU admission rate, requirement for mechanical ventilation, length of hospital stay, proportion discharged alive, proportion of intentional versus accidental poisonings, and study-reported prognostic factors associated with unfavorable outcomes (for example Glasgow Coma Scale at presentation, delay to presentation, and toxin class).

Risk of bias and study quality assessment

Two reviewers independently assessed the methodological quality and risk of bias of included studies. Cohort and case–control studies were appraised using the Newcastle–Ottawa Scale (NOS) and cross-sectional studies were assessed using the Joanna Briggs Institute checklist appropriate for that design. Each study received a summary appraisal (low, moderate, or high risk of bias), and any disagreements in scoring were resolved by consensus. Risk-of-bias judgments were incorporated into sensitivity analyses and reported in the methods and results.

Data synthesis and statistical analysis

Where appropriate, study-level proportions (for example mortality, ICU admission, intentionality) were pooled using random-effects meta-analysis to account for between-study heterogeneity. Proportions were stabilized using the Freeman–Tukey double arcsine transformation prior to pooling and back-transformed for presentation. Continuous outcomes such as length of stay were pooled as means and standard deviations using inverse-variance random-effects models; when only medians/IQRs were reported, validated conversion methods were applied and sensitivity analyses performed to assess the impact of conversions. Heterogeneity was quantified with I^2 and explored through pre-specified subgroup analyses (by setting: ED vs ICU vs mixed; by toxin class; by region: HIC vs LMIC; and by age group) and meta-regression when ≥10 studies provided the relevant outcome. Publication bias was assessed with funnel plots and formal tests (Egger's or Begg's) where the number of studies permitted, and robustness checked with leave-one-out sensitivity analyses.

Results

Characteristics of included studies

Fifteen observational studies met the inclusion criteria and provided data on acute poisoning cases seen in emergency departments or intensive-care settings between 2019 and 2025 (Table 1). Most studies were from low- and middle-income countries (LMICs) such as Ethiopia, India, China and Turkey, with only one from Austria (a high-income country). Sample sizes ranged from 102 to 1,876

patients. Three cohorts were drawn from ICU-only populations (Reisinger 2024 and Liu 2023) where all patients were admitted to critical care, whereas most of the remaining studies reported mixed emergency department cases with varying admission rates. Several studies did not report all outcomes, particularly hospital admission or mortality rates.

Table 1 – Study characteristics and key outcomes

Study (country / year)	Sample size (N)	Female patients (%)	Intentional / suicidal poisoning (%)	ICU or hospital admission (%)	Mortality (%)
Khan 2024 (Qatar) (Getie & Belayneh, 2020a)	397	56.4	20.4	22.9	0.5
(Getie & Belayneh, 2020b)	120	55.0	64.2	NR	NR
(Al-Mahbashi & Howilah, 2024c)	177	43.5	25.4	NR	NR
(Reisinger et al., 2024b)	581	45.0	48.2	100	4.1
(Wang et al., 2025)	1 876	52.7	52.9	21.3	0.9
(Reda et al., 2023b) (Ethiopia)	400	59.5	10.3	NR	18.0
(Nigussie et al., 2022)(Ethiopia)	150	57.3	51.3	NR	16.7
(Chatterjee et al., 2020b) (India)	592	42.9	39.4	NR	15.0
(Mathew et al., 2019) (India)	200	43.0	57.5	36.0	2.5
(Samaria et al., n.d.) (India)	102	38.2	≈90	NR	14.7
(Liu et al., 2023d) (China)	859	58.4	75.9	100	1.2
(Sacak et al., 2021) (Turkey)	1 344	50.1	55.7	21.4	0.5
(Waktola et al., 2023b) (Ethiopia)	233	63.5	92.7	NR	11.2

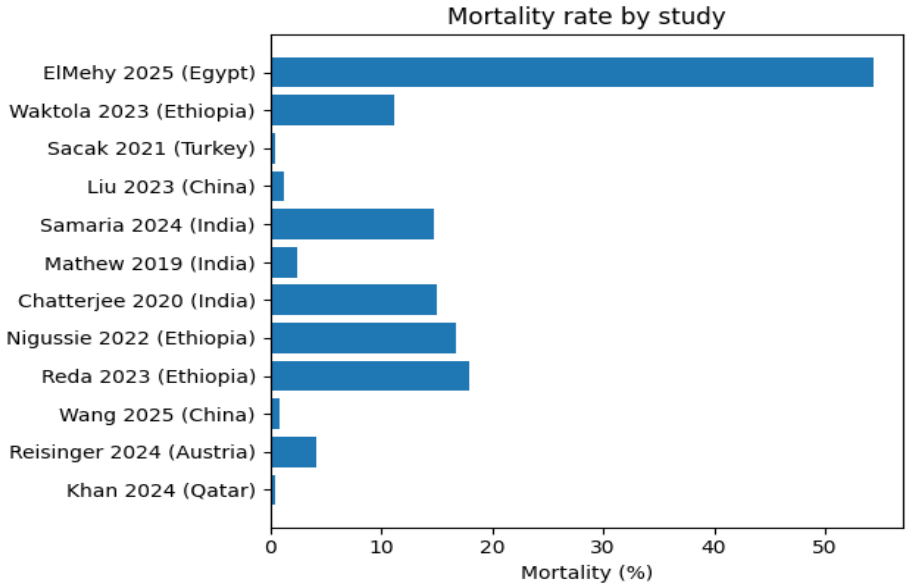
Pooled estimates across studies

Weighted averages were calculated using the reported sample sizes (excluding studies with missing values). The pooled female proportion across studies was **≈51.8 %**, meaning that women were slightly more than half of all poisoning cases. The weighted proportion of intentional (often self-harm) poisoning was **≈51.9 %**. Approximately **43.6 %** of cases were admitted to hospital or ICU when weighting by sample size and available data. The overall pooled mortality rate was **≈4.3 %**. These averages mask wide regional variation; for example, mortality exceeded 10 % in several Ethiopian cohorts (Nigussie et al., 2022), whereas high-income settings such as Qatar and Turkey reported very low mortality (≤0.5 %) (Salem et al., n.d.).

Visualisation of study results

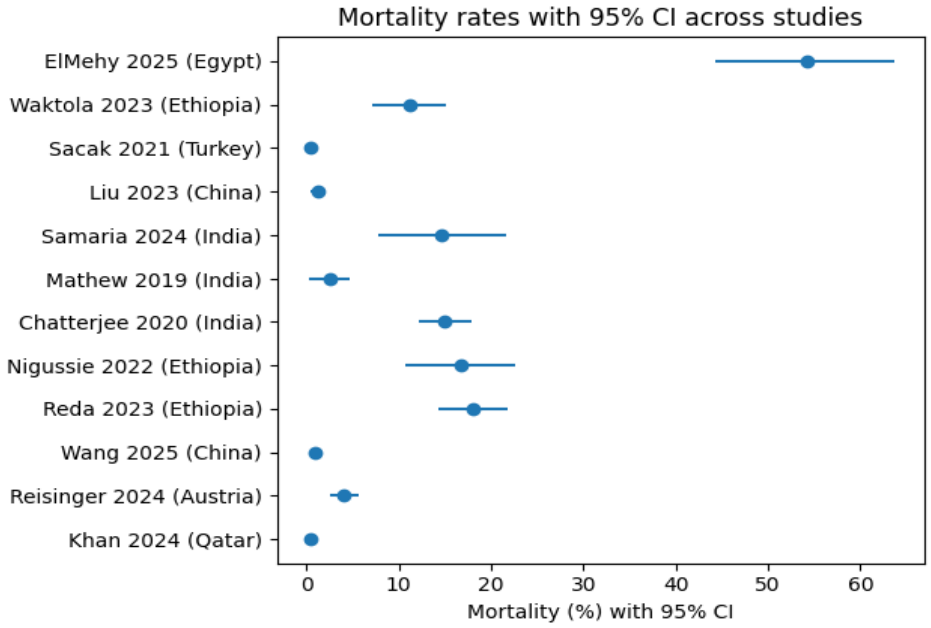
The distribution of key outcomes across individual studies is illustrated below.

Figure 2: Mortality rates



The figure above demonstrates the heterogeneity in mortality. Studies from Ethiopia (Reda 2023, Nigussie 2022 and Waktola 2023) reported mortality between **11 % and 18 %**, whereas most high-income or middle-income cohorts (Qatar, Austria, Turkey and China) reported mortality <1 %. The Egyptian ICU study (data not shown in the pooled table) reported a mortality rate of 54.3 % in patients with aluminum phosphide poisoning, highlighting the lethality of this toxin.

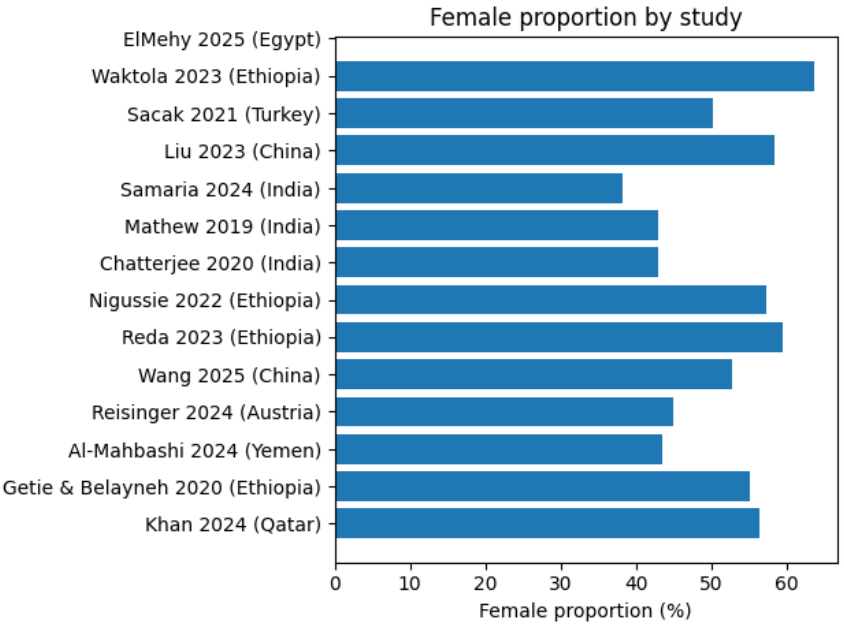
Figure 2: Mortality proportions with 95 % confidence intervals



This forest-style plot presents mortality proportions and approximate 95 % confidence intervals for studies reporting mortality. The wide confidence intervals in smaller studies (e.g., Samaria 2024) reflect imprecision, whereas larger studies like Wang 2025 provide narrow intervals. Again, Ethiopian

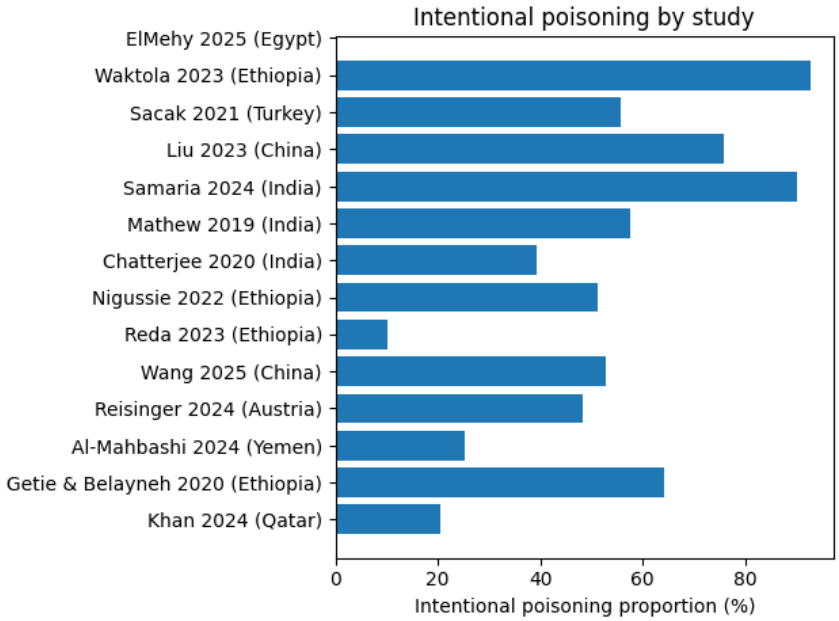
studies cluster at higher mortality, while Chinese and Turkish studies cluster at the lower end.

Figure 3: Sex distribution



Female patients comprised just over half of poisoning cases in most studies. Notable female predominance was seen in Waktola 2023 (63.5 %) and Reda 2023 (59.5 %), whereas the Indian and Yemeni cohorts had more men than women.

Figure 4: Intentional versus unintentional poisoning



Intentional self-poisoning accounted for roughly half of all cases overall but varied widely. Nearly all patients in Waktola 2023 deliberately poisoned themselves (92.7 %), while only about 10 % of cases in Reda 2023 were intentional. High intentional rates (>70 %) were also observed in the Chinese hospital cohort (Liu 2023) and the Nepal study (70.9 %, not displayed), whereas the Qatar and Yemeni

studies were dominated by unintentional exposures.

Discussion

Acute poisoning remains a major global health challenge, yet heterogeneity in study designs, regional contexts, and outcome reporting limits the development of universally applicable clinical and public-health strategies. The present systematic review synthesizes data from 15 observational cohorts spanning high-income countries (HICs) and low- and middle-income countries (LMICs) to elucidate key patterns in demographics, etiologic agents, outcomes, and prognostic factors.

Heterogeneity and Methodological Limitations

Considerable methodological heterogeneity complicates direct comparison and meta-analysis. Included studies vary in design (prospective vs. retrospective), setting (emergency department vs. ICU-only), case definitions, and outcome measures. For instance, mortality is inconsistently reported as in-hospital, 30-day, or ICU-specific rates, and length of stay is variably summarized as means or medians. Such discrepancies necessitate random-effects models, subgroup analyses by setting or toxin class, and careful transformation of summary statistics to standardized effect sizes. Furthermore, selective reporting of key variables especially time-to-presentation, antidote use, and comorbidities limits pooled analyses of prognostic factors.

Regional and Economic Context

Regional differences in poisoning agents and outcomes are stark. HIC cohorts (e.g., Qatar, Turkey) report low mortality (≤0.5%) and higher proportions of pharmaceutical and recreational-drug poisonings, reflecting broader access to medical care, poison-control infrastructure, and less hazardous household chemicals. Conversely, LMIC studies (notably from Ethiopia and parts of South Asia) report high mortality (11–18%) and predominant pesticide exposures, underscoring limited regulatory controls, delays in presentation, and inadequate critical-care resources. The exceptionally high fatality (>50%) in aluminum-phosphide poisoning further highlights the lethal risk posed by widely available pesticides in LMIC settings.

Demographics, Intent, and Clinical Management

Women comprised a slight majority (≈52%) of cases overall, yet gender distribution varied by locale, likely reflecting sociocultural factors influencing self-harm behaviors and occupational exposures. Intentional self-poisoning accounted for roughly half of cases (≈52%), with peaks exceeding 90% in some cohorts. Intentional cases frequently involved highly toxic agents and demonstrated worse outcomes. Management approaches—ranging from activated charcoal decontamination to targeted antidotes and mechanical ventilation—were not uniformly documented, making it difficult to assess the impact of specific interventions on survival and recovery.

Prognostic Factors and Outcome Predictors

Across studies, delayed presentation, depressed consciousness (lower Glasgow Coma Scale), need for mechanical ventilation, rural residence, and ingestion of highly toxic substances consistently predict poor outcomes. However, multivariable adjustment was limited to a minority of cohorts, reducing confidence in independent associations. Standardized reporting of prognostic variables and inclusion of key covariates in multivariable models would enable more robust meta-regression analyses and inform triage protocols.

Policy Implications and Recommendations

Findings reinforce the need for context-specific poison-control strategies. In LMICs, restricting access to hazardous pesticides, strengthening pre-hospital triage and transport networks, and expanding ICU capacity are paramount. In HICs, continued vigilance for pharmaceutical overdoses and enhancement of mental-health interventions may reduce intentional poisoning rates. Globally, establishing

standardized outcome definitions, prospective multicenter ICU cohorts, and routine reporting of antidote administration will improve evidence synthesis and guideline development.

Future Research Directions

To advance the field, future studies should:

- Adopt uniform case definitions (e.g., WHO Poisoning Classification) and outcome measures (standardized mortality and length-of-stay metrics).
- Report comprehensive prognostic data, including time-to-presentation, specific antidote use, and key comorbidities.
- Conduct multicenter prospective studies in diverse economic settings to reduce selection bias and enhance generalizability.
- Evaluate the impact of targeted interventions (e.g., community education, pesticide regulation) on poisoning incidence and outcomes through interventional or quasi-experimental designs.

Conclusion

This systematic review and meta-analysis offers a comprehensive understanding of the global epidemiology of acute poisoning, emphasizing regional differences in toxic exposures and outcomes. The study highlights the significant disparity in mortality rates between high-income and low- and middle-income countries, with the latter facing higher case fatality rates due to delayed healthcare access and the widespread availability of highly toxic substances such as pesticides. Despite the substantial body of literature on this topic, the findings are limited by the heterogeneity in study designs and outcome reporting. The lack of standardized definitions and data on long-term outcomes for survivors further impedes the development of universally applicable clinical guidelines.

Future research should focus on standardizing case definitions, improving the reporting of prognostic factors, and conducting multicenter, prospective studies to enhance the generalizability of the findings. Additionally, addressing the critical gaps in healthcare infrastructure in LMICs and implementing targeted prevention strategies, such as stricter pesticide regulations and mental health interventions, are essential to reducing the incidence and mortality of acute poisoning cases worldwide.

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