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REVIEW ARTICLE

Global Patterns, Toxic Agents, and Prevention of Acute Childhood Poisoning: A Narrative Review

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Abstract: **Introduction:** Studying epidemiological characteristics of acute poisoning in children is essential for identifying risk factors and informing effective prevention strategies. This narrative review aimed to synthesize the available evidence on the epidemiological patterns, common poisoning agents, associated risk factors, and clinical outcomes of acute poisoning in children. **Methods:** A structured literature search was conducted using PubMed, Web of Science, Scopus, Google Scholar, and Persian databases (SID, Magiran, and Irandoc) for relevant studies published between 2015 and 2026. Eligible English- or Persian-language studies were identified using predefined inclusion and exclusion criteria. A total of 61 studies met the eligibility criteria and were included in this descriptive review. Data were synthesized descriptively using frequencies, percentages, and frequency distributions. No meta-analysis or quantitative statistical pooling was performed due to the substantial heterogeneity in study designs, populations, settings, case definitions, and outcome measures across the included studies. **Results:** The included studies were conducted across multiple regions worldwide and varied substantially in sample size and geographic distribution. Acute poisoning was most commonly reported among children aged 1-5 years and was more frequently documented in urban settings and during warmer seasons. Non-pharmaceutical agents accounted for the majority of cases, with household cleaning products and pesticides being the most frequently reported toxic agents. Oral ingestion was the predominant route of exposure. **Conclusion:** This review highlights the substantial burden of acute childhood poisoning and underscores the importance of preventive interventions. However, the findings should be interpreted cautiously due to considerable heterogeneity across studies, variations in study designs and reporting, geographic imbalance of the available evidence, and the exclusion of gray literature.

Keywords: Child; Pediatrics; Poisons; Risk Factors; Primary Prevention

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1. Introduction

Poisoning is a major public health concern resulting from exposure to toxic substances that can cause significant morbidity and mortality across all age groups (1). It remains one of the leading causes of emergency department visits and hospital admissions worldwide, imposing a substantial clinical and economic burden on patients and healthcare systems (2). Monitoring the epidemiological trends and changing patterns of poisoning is essential for improving prevention strategies, optimizing clinical management, and reducing poisoning-related morbidity and mortality (3).

Acute poisoning, characterized by exposure to a toxic substance over a short period, is among the most common poisoning-related emergencies worldwide (4). Children are particularly vulnerable because of their developmental characteristics, natural curiosity, and frequent exposure to potentially hazardous substances in home and community environments (5, 6). Consequently, unintentional poisoning predominates in young children, whereas intentional poisoning is more common among adolescents and is often associated with self-harm or suicide attempts (7, 8).

The severity of poisoning depends on several factors, including the type of toxic agent, the dose, and the duration of exposure (1). If not recognized and managed promptly, acute poisoning may lead to serious complications or death (4). The epidemiology of childhood poisoning varies considerably across countries and regions, reflecting differences in socioeconomic development, environmental exposures, accessibility of toxic substances, healthcare systems, and poisoning prevention policies (9). Consequently, the distribution of poisoning agents, demographic characteristics, routes of exposure, seasonal trends, and clinical outcomes differ substantially among populations (10). Understanding these epidemiological variations is fundamental for developing targeted prevention programs, improving public health interventions, and supporting evidence-based clinical decision-making.

Despite the growing body of epidemiological research on acute poisoning in children, considerable heterogeneity exists in study design, population characteristics, healthcare settings,

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and outcome measures, making direct comparisons across studies challenging (11). Furthermore, substantial regional variations in poisoning patterns make it difficult to obtain a comprehensive understanding of the epidemiology of childhood poisoning from individual studies alone. A recent systematic review summarized the epidemiology of pharmaceutical poisonings among children in low- and lower-middle-income countries, but a comprehensive synthesis encompassing all toxic agents and geographic regions remains lacking (11). To address these gaps, the present review synthesizes global evidence on the epidemiology of childhood poisoning, with a particular focus on regional variations, risk factors, and prevention strategies, thereby providing a more comprehensive and practically applicable resource for clinicians, researchers, and policymakers.

2. Methods

This narrative review aimed to provide a broad descriptive synthesis of the available epidemiological evidence on acute childhood poisoning across diverse geographic regions and settings. The search was limited to studies published between January 2015 and July 2026 to provide an up-to-date overview of the epidemiology of acute poisoning in children and to reflect recent changes in poisoning patterns, causative agents, healthcare practices, and preventive strategies.

While we applied structured search strategies and predefined eligibility criteria to ensure transparency and reproducibility, the primary aim was to summarize and describe the existing evidence rather than to perform a quantitative descriptive synthesis or formal quality-based synthesis. Accordingly, formal risk-of-bias assessment and meta-analytic pooling were not performed. This narrative approach was considered most appropriate given the substantial heterogeneity in study designs, populations, case definitions, and reporting practices observed across the included studies. Although we adopted several systematic review procedures including duplicate removal, independent screening, and structured data extraction to enhance rigor and reduce bias, the overall synthesis remained descriptive and exploratory in nature, which aligns with the objectives of a narrative review rather than a formal systematic review or meta-analysis.

To fulfill these objectives, this review was structured to answer specific research questions guided by the PICOS (Population, Intervention/Exposure, Comparison, Outcomes, Study Design) framework. The target population was children and adolescents under eighteen years of age. The exposure of interest was acute poisoning attributed to any pharmaceutical or non-pharmaceutical toxic agent. A formal comparator was not applicable for this descriptive synthesis; however, descriptive comparisons across geographical regions were considered where data permitted. The outcomes of interest included demographic distribution, types and frequency of toxic agents, routes of exposure, seasonal and geographic patterns, risk factors, and clinical outcomes including morbidity and mortality. The study designs considered were observational studies with cross-sectional, retrospective, or prospective designs published in peer-reviewed journals. In addition to epidemiological characterization, this review also aimed to identify and summarize evidence on preventive measures including caregiver education, safe storage, child-resistant packaging, and regulatory interventions were reported in the included studies. Accordingly, prevention was predefined as an integral component of the review objectives and was included in the data extraction process.

2.1. *Literature search strategy*

A comprehensive literature search was conducted to identify studies reporting the epidemiological characteristics of acute poisoning in children. International scientific databases, including PubMed, Web of Science, and Scopus, as well as Iranian scientific databases, including the Scientific Information Database (SID), Magiran, and Irandoc, were searched to identify relevant publications. The search was limited to studies published between January 2015 and July 2026 to provide an up-to-date overview of the epidemiology of acute poisoning in children and to reflect recent changes in poisoning patterns, causative agents, healthcare practices, and preventive strategies. Google Scholar was also used as a supplementary search engine to identify potentially relevant publications that were not retrieved through the primary database searches.

The search strategy consisted of database-specific indexing terms, where available (e.g., MeSH terms for PubMed), and free-text keywords. For PubMed, the search strategy was enhanced using a combination of MeSH terms and free-text keywords, including: "Poisoning"[Mesh], "Drug-Related Side Effects and Adverse Reactions"[Mesh], "Household Products"[Mesh], "Pesticides"[Mesh], "Hydrocarbons"[Mesh], "Carbon Monoxide Poisoning"[Mesh], along with free-text terms such as "Accidental Poisoning", "Intentional Poisoning", "Ingestion", "Overdose", "Intoxication", "Toxic Exposure", and "Drug Overdose". For pediatric populations, MeSH terms including "Child"[Mesh], "Adolescent"[Mesh], "Infant"[Mesh], and "Child, Preschool"[Mesh] were combined with free-text terms such as "Children", "Pediatric", and "Teen". For epidemiological outcomes, "Epidemiology"[Subheading], "Risk Factors"[Mesh], "Incidence"[Mesh], "Prevalence"[Mesh], and "Mortality"[Mesh] were used in combination with free-text terms including "Clinical Outcomes", "Morbidity", and "Patterns".

Boolean operators (AND and OR) were used to combine search terms, thereby improving the sensitivity and specificity of the search. The principal search terms included acute poisoning, poisoning, toxicity, child, children, pediatric, epidemiology, risk factors, and clinical outcomes, together with their Persian equivalents for searches conducted in the Iranian scientific databases. The following filters were consistently applied across all databases: publication date range (January 2015 to July 2026), language (English and Persian), article type (original research articles only), and full-text availability.

To enhance the comprehensiveness of the literature search, the reference lists of the included articles were manually screened to identify additional relevant studies. The complete search strategies for each database, including all search terms, Boolean operators, and applied filters, are presented in Table 1. Additionally, Supplementary File 1 provides the full detailed search strategies with exact search dates for each database to ensure full reproducibility.

2.2. *Eligibility criteria*

The eligibility criteria were established to identify studies reporting the epidemiological characteristics of acute poisoning in children. Studies were included if they met the following inclusion criteria:

Study design: Original research articles published in peer-reviewed journals (including retrospective, prospective, cross-

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sectional, case-control, and cohort studies)

Population: Studies investigating acute poisoning in children and adolescents (aged <18 years)

Outcomes: Studies reporting at least one of the following epidemiological data: incidence or prevalence, demographic characteristics, poisoning agents, routes of exposure, risk factors, or clinical outcomes

2.3. *Language: Studies published in English or Persian*

2.4. *Availability: Studies available as full-text articles*

Publication period: Studies published between January 2015 and July 2026

Studies were excluded based on the following exclusion criteria:

Study type: Review articles, systematic reviews, meta-analyses, editorials, letters to the editor, conference abstracts, dissertations, case reports, or other forms of gray literature

Population: Studies focusing exclusively on chronic poisoning, animal or experimental research, or studies involving adult populations only (≥18 years)

Outcomes: Toxicological laboratory investigations without clinical or epidemiological data, or studies that did not provide sufficient epidemiological information relevant to the objectives of this review

Data: Studies without extractable data on poisoning patterns, demographic characteristics, or clinical outcomes

2.5. *Study selection*

A total of 116 records were initially identified through the primary database searches and supplementary search (94 English-language and 22 Persian-language publications). After removing 26 duplicate records using EndNote X9's duplicate detection function (verified manually), 90 articles remained for screening. Title and abstract screening was independently performed by two reviewers, resulting in the exclusion of 13 articles because their full texts were unavailable. The remaining 77 articles underwent full-text assessment against the predefined eligibility criteria, leading to the exclusion of 16 articles that did not meet the inclusion criteria. Ultimately, 61 studies met the eligibility criteria and were included in the final epidemiological review (Figure 1). The detailed screening process, including reasons for exclusions at each stage, is presented in Figure 1 (PRISMA flow diagram).

2.6. *Data extraction*

Data were independently extracted by two members of the research team using a structured data extraction form developed specifically for this review to ensure consistency and completeness of data collection. The extraction process was guided by the PICOS framework, which provided a systematic structure for identifying and classifying relevant information from each included study. Inter-rater agreement was assessed using Cohen's Kappa coefficient, which was 0.87 for title/abstract screening and 0.82 for full-text assessment, indicating substantial agreement.

2.7. *Variables sought for extraction*

The following variables were systematically extracted from each included study, with operational definitions as detailed in Table 2:

Population characteristics: Age, sex, geographic location, and healthcare setting

Exposure characteristics: Poisoning agent(s), route(s) of exposure, and intent of poisoning

Comparison variables: Any comparison groups used in the studies

Outcomes: Incidence/prevalence, demographic characteristics, clinical outcomes, risk factors, and mortality

Study characteristics: Study design, sample size, study period, and data source

Additional information: Funding sources (where reported) and principal findings

2.8. *Data extraction process*

The extraction was performed using a standardized data extraction form developed in Microsoft Excel. The form included predefined fields for each variable listed in Table 2. Two reviewers (Reviewer A and Reviewer B) independently extracted data from each included study. Any discrepancies in data extraction were resolved through discussion and consensus; if consensus could not be reached, a third reviewer (Reviewer C) was consulted for the final decision. The extracted data were subsequently reviewed for completeness and consistency before being summarized and presented descriptively.

2.9. *Assumptions and simplifications in data extraction*

The following assumptions and simplifications were applied during data extraction to ensure consistency across studies:

Age grouping: Ages were grouped into predefined categories (<1 year, 1-5 years, 6-9 years, ≥10 years). If a study reported age ranges that did not precisely match these categories, the data were reclassified into the nearest applicable category where possible; if reclassification was not possible, the original age groups were preserved in Table 3.

Poisoning agent classification: Agents were grouped into standardized categories (household products, pesticides, gases, substance abuse, raticides, cosmetics/perfumes, and others). When a study reported a poisoning agent not falling into these categories, it was recorded in the "others" category and described in the narrative synthesis.

Route of exposure: When multiple routes of exposure were reported for a single case, only the primary route was recorded. When the route of exposure was not specified, it was recorded as "unknown" and not included in the proportional calculations.

Sex classification: Sex was recorded as a binary variable (male/female) as reported in all included studies. No studies reported non-binary or intersex categories; therefore, this was not included as a separate category.

Intent of poisoning: Intent classification (unintentional vs. intentional) was based on the original study's definition. If intent was not clearly stated or could not be determined, it was recorded as "unknown."

Percentages and denominators: Percentages were recalculated based on the total number of cases reported in each study. When denominators were unclear or not reported, original percentages were preserved, and the denominator limitation was noted. The sample sizes reported across studies were not summed into a single pooled population because of the

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substantial heterogeneity among the included studies, and the term “cases analyzed” is used cautiously.

Missing data: When data for a specific variable were not reported in a study, it was recorded as "not reported" (NR). No imputation was performed for missing data.

Funding sources: Funding sources were extracted only when explicitly reported. Due to inconsistent reporting across studies, this variable was recorded as "not reported" in most cases and acknowledged as a limitation.

2.10. *Data synthesis*

The extracted data were organized using a descriptive epidemiological approach. Information from the included studies was categorized into the main epidemiological domains: study characteristics, demographic characteristics, poisoning agents, routes of exposure, geographic distribution, seasonal patterns, associated risk factors, and clinical outcomes. The findings were compared across studies to identify similarities and differences in the epidemiological characteristics of acute poisoning in children across different populations and settings. The evidence was subsequently organized and presented descriptively to provide a comprehensive overview of the epidemiology of childhood acute poisoning and to highlight common epidemiological patterns, regional variations, and gaps in the available literature.

As this review was designed as a structured comprehensive review and no meta-analysis was performed, the principal summary measures used in this review are descriptive epidemiological measures, defined as follows: frequency, defined as the absolute number of cases reported for a specific variable or category, which was used to report the total number of cases and the number of cases in each subgroup; percentage, defined as the proportion of cases in a specific category relative to the total number of cases, which was used to express the distribution of cases across different categories; and frequency distribution, defined as the pattern of distribution of cases across different categories of a variable, which was used to describe the distribution of cases by age, sex, geographic region, season, route of exposure, and toxic agent type. No quantitative summary measures such as risk ratios, odds ratios, mean differences, or pooled effect sizes were calculated or reported, as the study designs, populations, settings, case definitions, and outcome measures across the 61 included studies were too heterogeneous to permit meaningful quantitative pooling.

Since no quantitative meta-analysis was performed, the methods of handling data and combining results consisted of four steps. The first step was data extraction, in which data were extracted from each included study independently by two reviewers using a standardized extraction form, including study characteristics, demographic characteristics, poisoning agents, routes of exposure, geographic distribution, seasonal patterns, risk factors, and clinical outcomes. The second step was data categorization, in which extracted data were categorized into predefined domains and subcategories; for example, poisoning agents were classified into drug-related and non-drug-related categories, and non-drug agents were further classified into household products, pesticides, gases, substance abuse, raticides, and cosmetics or perfumes. The third step was data aggregation, in which for each variable, data from all 61 studies were aggregated, the total number of cases for each category was summed across studies, and percentages were calculated using the total number of cases as the denominator. The fourth step was descriptive synthesis, in which aggregated data were presented in summary tables (Tables 3-6) and described narratively in the Results section, and findings were compared across studies and regions to identify patterns, similarities, and differences.

No measures of consistency, such as I^2, Q-test, or Tau^2, were calculated or reported, as these are measures used specifically for assessing heterogeneity in meta-analyses. However, we acknowledge the substantial heterogeneity across studies in the Limitations section and have provided Table 7 to summarize methodological strengths and weaknesses by study design. Quantitative meta-analytic pooling was not performed for several reasons. First, the 61 included studies comprised diverse designs including retrospective, prospective, cross-sectional, case-control, and cohort studies, making quantitative pooling methodologically inappropriate. Second, studies were conducted in different countries, healthcare settings, and time periods, with different demographic profiles and healthcare systems. Third, studies used varying definitions of acute poisoning, with some using clinical criteria, others relying on laboratory confirmation, and still others employing International Classification of Diseases (ICD) coding systems. Fourth, studies reported different outcomes such as incidence, prevalence, mortality, and clinical severity using different measurement approaches. Fifth, studies varied considerably in how they reported data, including different age categories and different agent classifications, making direct quantitative comparison challenging. Given these limitations, a descriptive narrative synthesis was considered the most appropriate approach to summarize the available evidence while acknowledging the heterogeneity and limitations of the included studies.

2.11. *Assessment of risk of bias affecting the cumulative evidence*

As this review was designed as a structured comprehensive review and no meta-analysis was performed, formal assessment of publication bias using statistical methods (such as funnel plots, Egger's test, or Begg's test) was not conducted. Similarly, formal assessment of selective reporting within individual studies was not performed, as this would require access to study protocols for comparison with reported outcomes, and most of the included studies were retrospective without preregistered protocols.

Despite these efforts, the potential for publication bias cannot be excluded. Studies with positive findings, larger sample sizes, or statistically significant results are more likely to be published in indexed journals, particularly in English-language publications. Additionally, the exclusion of gray literature (such as government reports, dissertations, theses, and conference proceedings) may have further contributed to publication bias, as poisoning surveillance data are often published in these formats, particularly in low- and middle-income countries. The potential for selective reporting within studies also exists, as many included studies did not report all variables of interest, and some may have selectively reported outcomes that were favorable or statistically significant. These limitations are further discussed in the Limitations section, and readers are advised to interpret the findings with appropriate caution.

3. Results

3.1. *Study selection*

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A total of 116 records were identified through the initial database search, including 94 English-language and 22 Persian-language publications. After removing 26 duplicate records, 90 articles remained for title and abstract screening. Of these, 13 articles were excluded because their full texts were unavailable. The remaining 77 full-text articles were assessed for eligibility. Based on the predefined inclusion and exclusion criteria, 16 articles were excluded (reasons: no epidemiological data reported [n=6], adult population only [n=4], not original research [n=3], duplicate publication [n=2], and insufficient data on poisoning patterns [n=1]). Ultimately, 61 studies met the eligibility criteria and were included in the final epidemiological review (Figure 1).

3.2. *Risk of bias assessment*

As detailed in the Methods section (Data Synthesis), formal risk of bias assessment was not performed across the included studies. To partially address the limitation and assist readers in interpreting the findings, Table 7 provides a qualitative summary of the methodological strengths and weaknesses of the included studies by study design. This table should be considered when evaluating the overall quality and reliability of the evidence presented in this review.

3.3. *Study characteristics and geographic distribution of included studies*

A total of 61 studies were included in this epidemiological review. The geographical distribution of the included studies revealed a marked predominance of evidence from Asia, which accounted for 27 (44.3%) of all publications. Europe represented the second largest contribution with 18 (29.5%), followed by Africa with 10 (16.4%), the Americas with 5 (8.2%), and multi-country studies with 1 (1.6%). The geographic distribution of the included studies is shown in Figure 2.

Studies from Asia were mainly conducted in Iran (n=8), Saudi Arabia (n=5), India (n=4), and Pakistan (n=2), with single studies from Nepal, China, Singapore, Sri Lanka, Qatar, Jordan, Taiwan, and Israel. European evidence was primarily derived from Italy (n=5), Romania (n=5), Turkey (n=6), Spain (n=1), and the Czech Republic (n=1). In Africa, most studies originated from Egypt (n=5), Ethiopia (n=2), Nigeria (n=2), and Morocco (n=1). The Americas were represented by studies from Brazil (n=3) and the United States (n=2). One multi-country study (Mintegi et al., 2019) collected data from multiple regions worldwide, including Africa, the Americas, Southeast Asia, Europe, the Eastern Mediterranean, and the Western Pacific, and was therefore excluded from regional comparative analyses to avoid duplication and confounding of regional patterns.

Overall, the available evidence was unevenly distributed across regions, with 45 (73.8%) of the included studies originating from Asia and Europe. In contrast, relatively few studies were identified from the Americas and one multi-country study, indicating that current epidemiological evidence on acute pediatric poisoning is concentrated in a limited number of geographical regions.

Regarding study design, retrospective studies constituted the largest proportion of the included evidence (30 [49.2%]), followed by cross-sectional (23 [37.7%]), prospective (5 [8.2%]), and case-control (2 [3.3%]) studies, and a cohort study (1 [1.6%]). This predominance of retrospective designs demonstrates that the existing literature relies primarily on routinely collected clinical information rather than prospectively designed epidemiological investigations. Similarly, (50 [82%]) of the included studies obtained their data from hospital medical records or national poison control center databases, indicating that most available evidence is based on healthcare facility–reported poisoning cases. Consequently, the epidemiological patterns identified in this review primarily reflect poisoning events requiring medical attention, while cases managed outside healthcare settings may be underrepresented. A detailed summary of the characteristics of the included studies is presented in Table 3.

Table 4 presents a comparative summary of the epidemiological patterns of acute pediatric poisoning across five geographical regions.

Across all regions, children aged 1–5 years consistently represented the most affected age group, reflecting the universal vulnerability of early childhood to poisoning exposures. However, notable regional variations were observed in the predominant classes of toxic agents. In Asian countries, pesticides and insecticides were the most frequently reported agents, likely reflecting the widespread agricultural use of these compounds in the region. In contrast, household cleaning products constituted the leading cause of poisoning in European and multi-country studies. African studies reported a more heterogeneous pattern, with household products and animal venoms both contributing substantially to the poisoning burden. Studies from the Americas showed a mixed pattern, with medications and household products reported as the primary agents (Table 4).

Sex-specific patterns also varied across regions. While male predominance was consistently observed in younger age groups across most regions, the shift toward female predominance in adolescence was more pronounced in Asian and European studies. The proportion of urban cases exceeded rural cases in all regions except Africa, where several studies reported a higher burden in rural populations, possibly reflecting differences in healthcare access and reporting systems. Seasonal peaks were most consistently reported during summer months in Asian and European studies, although this pattern was less consistent in other regions. Mortality rates were generally very low in European and American studies, while African and some Asian studies reported moderate mortality rates, highlighting disparities in healthcare access and poisoning management.

3.4. *Demographic and epidemiological characteristics of poisoning cases*

Childhood poisoning cases were analyzed across the included studies. Overall, males accounted for 50.93% of all childhood poisoning cases (Table 5), indicating a slight male predominance. Age-specific distribution showed a pronounced clustering of cases in early childhood. The 1–5-year age group accounted for 53% of all reported cases, representing the highest burden across all age strata. In contrast, children under one year of age constituted 12.08% of cases, representing the lowest reported proportion in the dataset. Sex-specific patterns demonstrated variability across age groups. A higher proportion of male cases was observed in younger age categories, whereas female cases predominated in children older than 10 years (Table 5), indicating heterogeneity in sex distribution across developmental stages.

3.5. *Routes of exposure, place of residence, and seasonal*

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distribution

Oral ingestion was the most frequently reported route of poisoning, accounting for 12.89% of cases (Table 5). Route of exposure was not explicitly reported or categorized in all included studies; these percentages therefore do not sum to 100%. Inhalation of toxic gases, particularly carbon monoxide, represented 6.84%, while dermal exposure and insect stings together accounted for approximately 4%. A higher proportion of cases occurred in urban areas (64.58%) compared with rural settings (Table 5). Seasonal distribution showed that poisoning cases were reported most frequently in summer (27.89%), followed by spring (25.34%), autumn (23.45%), and winter (23.32%). When grouped, 53.23% of cases occurred during warmer seasons (spring and summer), compared with 46.77% during colder seasons (Table 5).

3.6. *Types and distribution of poisoning agents*

Non-pharmaceutical agents were responsible for the majority of poisoning cases, accounting for 41,281 (61.58%) of all cases, compared with 25,771 (38.42%) for pharmaceutical agents (Table 6). Within non-pharmaceutical exposures, household cleaning products constituted the largest proportion of cases (13,282 (32.17%) of non-pharmaceutical cases; 19.81% of all cases), followed by pesticides (9,753 (23.62%) of non-pharmaceutical cases; 14.55% of all cases), together representing more than half of all non-pharmaceutical poisonings. Other non-pharmaceutical agents showed lower but distinct contributions, with chemical gases (mainly carbon monoxide) accounting for 3,648 (8.84%) of non-pharmaceutical cases and substance abuse–related exposures (alcohol, marijuana, hashish, amphetamines) accounting for 2,139 (5.18%) of non-pharmaceutical cases. A further 11,516 non-pharmaceutical cases (27.90% of non-pharmaceutical cases; 17.17% of all cases) were not allocated to any of the listed agent categories (Table 6). Misuse of perfumes and cosmetic products represented the smallest category, with 389 reported cases (Table 6), indicating a markedly lower frequency compared with other exposure types. Overall, the distribution of agents demonstrates a strongly skewed pattern, with poisoning cases concentrated in a limited number of dominant categories, particularly household cleaning products and pesticides. Figure 3 provides an overview of the demographic characteristics and distribution of childhood poisoning cases, including the proportions of drug- and non-drug-related poisonings and the major categories of non-drug poisoning.

4. Discussion

This review synthesized evidence from 61 studies across multiple regions worldwide. The findings suggest a relatively consistent but context-sensitive pattern in acute pediatric poisoning. A clear concentration of cases was observed in early childhood, particularly among children aged 1–5 years, across most included datasets. Non-pharmaceutical agents, especially household cleaning products and pesticides, were the most frequently reported toxic agents, and oral ingestion was the most frequently reported route of exposure. However, these patterns should be interpreted in light of the substantial heterogeneity, geographical imbalance, and methodological limitations of the available evidence. In particular, the absence of formal quality appraisal and the predominance of retrospective, hospital-based studies indicate that the observed proportions primarily reflect poisoning events requiring medical attention, while cases managed outside healthcare settings may be underrepresented.

The findings of this review are broadly consistent with reports from national poison control centers. For instance, the annual reports of the American Association of Poison Control Centers have consistently identified household cleaning products and medications as leading causes of pediatric exposures, corroborating the pattern observed in our synthesis (3). Similarly, a large study using NPDS data during the COVID-19 pandemic by Lelak et al. demonstrated that while overall ingestions decreased, there was a significant increase in intentional ingestions and clinically significant outcomes, highlighting the dynamic nature of poisoning patterns and the importance of continuous surveillance (12). European poison center data have shown comparable age and sex distributions, with the highest incidence in children aged 1-4 years and a shift toward female predominance in adolescence (13) . These concordant findings across different surveillance systems are consistent with our observations and support the global nature of childhood poisoning as a public health challenge.

The concentration of poisoning cases in children aged 1–5 years was observed across nearly all included studies and has been similarly reported in previous literature (14-16) . This pattern is likely explained by developmental characteristics of early childhood, including exploratory oral behavior, increasing mobility, and limited awareness of danger (17). However, the magnitude of this pattern varied across settings, and the heterogeneity and geographical imbalance of the available evidence should be considered when interpreting this observation. The consistency of this observation may reflect a genuine developmental vulnerability, but it may also be partly attributable to similarities in study design and healthcare-seeking behavior across settings.

Sex-related findings were not stable across studies. Although a higher proportion of male cases was observed in younger age categories, female cases predominated in children older than 10 years in several studies (7, 15, 16). A shift from male predominance in early childhood to female predominance in adolescence was reported in several studies included in this review; however, this pattern was not uniform across all settings. This shift may reflect different motivational contexts: unintentional exploratory behavior in young children (more common in boys) versus intentional self-poisoning in adolescents (more common in girls) (18, 19). This distinction may have implications for prevention strategies, suggesting that age- and sex-specific interventions could be considered (7). However, because this review did not perform individual-level pooled or multivariable analyses, this interpretation should be regarded as hypothesis-generating rather than definitive. The available evidence did not demonstrate a consistent sex-specific pattern across settings, and the observed variability suggests that sex is more likely to be mediated by behavioral and contextual factors rather than acting as a consistent independent determinant.

The recurrent dominance of a limited number of household substances suggests that the poisoning burden may be largely attributable to highly accessible domestic agents rather than to a broad toxic exposure spectrum. Nevertheless, differences in classification systems and reporting practices across studies may have contributed to variability in estimated proportions, which should be considered when interpreting cross-study comparisons. Poisoning by medicinal and poisonous plants has been reported as an important cause of childhood poisoning in

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some regions; however, this category was not consistently reported across the included studies and therefore could not be evaluated as a separate exposure group in the present review. This inconsistency highlights the need for more standardized reporting of plant-related poisoning in future epidemiological studies.

Oral ingestion was consistently identified as the primary route of exposure, aligning with established pediatric behavioral patterns (17) . However, route-of-exposure information was unavailable for a substantial proportion of cases (Table 5). Therefore, the term "predominant route" should be interpreted with caution, and the interpretation of exposure pathways should remain cautious due to variability in reporting granularity across included studies. Minor or mixed exposure routes may be underrepresented in retrospective datasets, which could slightly distort proportional estimates.

The regional comparisons presented in this review should be interpreted cautiously, as the number of studies contributed by each geographical region was unequal, and the included studies differed substantially in design, sample size, setting, and time period. Therefore, the observed regional differences primarily reflect differences in the available evidence rather than confirmed differences in the underlying epidemiology of childhood poisoning. With this caveat in mind, studies from Asian countries more frequently reported pesticides and insecticides as the predominant agents, which may reflect the widespread agricultural use of these compounds and their accessibility in rural households (10, 20, 21). In contrast, studies from European countries more commonly reported household cleaning products as the leading cause of poisoning, which may be attributable to different household consumption patterns, regulatory frameworks, and surveillance systems that capture a broader range of exposures (14, 17, 22). Studies from African countries reported a more heterogeneous pattern, with household products and animal venoms both contributing substantially. Studies from the Americas showed a mixed pattern, with medications and household products reported as the primary agents. These observations suggest that prevention strategies should be tailored to the local context rather than adopting a uniform global approach; however, they should not be interpreted as definitive evidence of true continental differences in poisoning epidemiology.

The higher proportion of cases reported from urban areas (Table 5) should also be interpreted cautiously, as this may reflect better healthcare access and more complete reporting in urban settings rather than a true higher incidence. Several studies from rural populations, particularly in Ethiopia and India, reported substantial poisoning burdens, suggesting that rural areas may be underserved in terms of both prevention and healthcare services (16, 23, 24). This disparity suggests that improved poisoning surveillance and prevention programs in rural communities may be needed, where access to poison control centers and emergency care may be limited (25).

Seasonal variation appeared limited and inconsistent, with only a modest increase during warmer months (Table 5). The relatively small amplitude of seasonal differences suggests that poisoning risk is primarily driven by persistent household-level exposures rather than climate-dependent factors. This is further supported by the stability of household chemical exposure across seasons in most datasets. Although less frequent, carbon monoxide exposure remains clinically relevant in certain settings, particularly where domestic heating systems are widely used (22). Its potential for severe outcomes, especially in younger age groups, indicates that frequency alone may underestimate its public health importance.

Although the current review was not designed to systematically evaluate temporal trends, several included studies reported changes in poisoning patterns over the study period. Notably, some studies documented an increase in pharmaceutical poisonings during the COVID-19 pandemic, possibly related to increased medication availability at home and psychological stress (12, 26, 27). This observation supports the importance of ongoing surveillance to detect emerging poisoning patterns and to adapt prevention strategies accordingly (3).

Although the present review was not designed to systematically synthesize prevention-related outcomes, the epidemiological findings provide a reasonable basis for discussing potential preventive strategies. Pediatric poisoning is influenced by multiple interacting factors, with household accessibility to toxic substances remaining a key challenge (17, 25, 28). Medications, cleaning agents, pesticides, and other hazardous materials are frequently stored in unsafe conditions, which may increase the risk of accidental exposure in children (23, 27, 28). Limited awareness among caregivers regarding safe storage practices may further contribute to this burden and may also delay recognition and timely management due to the non-specific nature of early symptoms (29, 30). In addition, limitations in surveillance and reporting systems in several settings may hinder accurate identification of risk patterns and reduce the effectiveness of preventive strategies (3, 31). Inadequate enforcement of safety regulations related to the packaging and labelling of hazardous substances, along with limited access to specialized healthcare services in some regions, may further exacerbate outcomes (3, 32). Preventive efforts are also constrained by gaps in policy implementation and public education, including insufficient caregiver-focused awareness programs and weak regulation of hazardous product distribution (22, 25, 33). Cultural practices such as self-medication and delayed healthcare-seeking behavior may further contribute to the persistence of the problem (3, 25, 28).

Addressing these challenges may require coordinated strategies, including improved caregiver education, stronger regulatory frameworks for hazardous substances, enhanced reporting systems, and improved access to pediatric toxicology services (3, 13, 32). Such measures may contribute to reducing the burden of preventable childhood poisoning (17, 25, 33). However, these recommendations should be regarded as informed by the epidemiological patterns observed in this review rather than as conclusions derived from a systematic evaluation of prevention interventions.

4.1. *Strengths and limitations*

This review has several strengths. It synthesizes a large body of evidence from 61 studies across multiple geographical regions, with sample sizes ranging from small single-center studies to large national surveillance datasets. The findings provide a comprehensive overview of the epidemiological patterns of childhood poisoning and highlight important regional variations and knowledge gaps.

At the study level, the included studies were predominantly retrospective and based on hospital records or poison control center databases, which may introduce selection bias toward more clinically significant cases and underrepresent mild exposures managed outside healthcare settings. There was also

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substantial heterogeneity across studies in study design, population characteristics, case definitions, and classification of poisoning agents, limiting standardized comparisons. Several potentially important determinants of childhood poisoning, including socioeconomic status, parental education, family characteristics, and pre-existing medical conditions, were inconsistently reported. Poisoning caused by medicinal and poisonous plants could not be analyzed separately because this category was inconsistently reported or combined with other non-pharmaceutical agents. Most studies also lacked detailed contextual information regarding exposure circumstances, such as supervision status, storage conditions, or intentionality. In addition, substantial heterogeneity existed in the definitions of poisoning across studies, with some using clinical criteria, others relying on laboratory confirmation, and still others employing ICD coding systems. Differences in healthcare systems—including access to emergency care, availability of poison control centers, and treatment protocols—may also have influenced reported clinical outcomes and severity distributions.

At the review level, several limitations should be acknowledged. First, and most importantly, no formal quality appraisal or risk-of-bias assessment was performed. This is a major limitation because, without evaluating the methodological quality of the included studies, it is difficult to determine whether the reported patterns were disproportionately driven by studies with substantial methodological limitations. Consequently, the findings of this review should be interpreted as descriptive rather than definitive, and the overall certainty of the conclusions is limited. The observed patterns represent a synthesis of heterogeneous observational studies rather than pooled estimates derived from comparable populations, and they should not be regarded as definitive epidemiological estimates.

Second, the included studies varied substantially in geographic location, study period, healthcare setting, case definition, and sampling frame. Because of this heterogeneity, the sample sizes reported across studies were not summed into a single pooled population. Potential overlap between study populations—particularly when several studies originated from the same hospital, poison control center, surveillance database, or country and covered overlapping time periods, could not be fully assessed. Therefore, the term "cases analyzed" should be interpreted cautiously, and the findings should be regarded as a descriptive synthesis rather than a pooled estimate.

Third, the possibility of publication bias should be considered, as studies with positive findings or larger sample sizes are more likely to be published, particularly in English-language journals. This may have led to overrepresentation of certain types of poisoning or specific geographic regions, further limiting the generalizability of the findings.

Fourth, the exclusion of gray literature such as government reports, theses, and conference proceedings may have contributed to the underrepresentation of evidence from regions with limited academic publishing infrastructure. Because poisoning surveillance and poison-control-center data are often published in national health reports rather than indexed journals, the exclusion of these sources may have introduced publication and geographical bias and may have limited the comprehensiveness of the global patterns described in this review. Future research should consider incorporating relevant gray literature, including national health reports and poison-control-center data, to provide a more comprehensive and globally representative picture of childhood poisoning epidemiology.

Fifth, the restriction to English- and Persian-language publications may have excluded relevant evidence published in other languages, potentially limiting the global representativeness of the findings.

Sixth, differences in reporting methods including voluntary versus mandatory reporting systems and variations in data collection instruments likely affected the completeness and consistency of the extracted information, which may have influenced the observed distribution patterns.

Seventh, although the review included studies from multiple regions, the representation of countries and healthcare systems was uneven, which may limit the generalizability of the findings to some low-resource settings where reporting infrastructure is less developed.

Taken together, these limitations substantially affect the certainty of the conclusions of this review. The absence of formal quality appraisal, the heterogeneity of the included studies, the potential for publication and geographical bias, and the aggregate (rather than pooled) nature of the overall case count collectively indicate that the findings should be interpreted as descriptive and hypothesis-generating rather than definitive. The observed patterns may not be representative of all settings, particularly low-resource regions with limited surveillance infrastructure. Therefore, the conclusions of this review represent a synthesis of heterogeneous observational studies rather than pooled estimates derived from comparable populations, and they should be used to inform not replace context-specific epidemiological assessments and prevention strategies. Nevertheless, despite these limitations, this review provides a comprehensive synthesis of the available evidence and highlights consistent epidemiological patterns that can inform prevention strategies and future research. The findings should be viewed as a foundation for further investigation rather than as definitive conclusions.

4.2. *Research gaps*

Several important research gaps were identified. First, the geographical imbalance of the available evidence with most studies originating from Asia and Europe limits the generalizability of findings to under-represented regions, particularly low-income countries where poisoning surveillance infrastructure is less developed. Second, there is a lack of prospective, multicenter studies with standardized case definitions and uniform reporting of poisoning agents, exposure routes, and outcomes. Third, socioeconomic and contextual determinants of poisoning risk, including parental education, household storage practices, and supervision status, remain inconsistently reported. Fourth, plant-related poisonings are poorly characterized in the current literature and require dedicated epidemiological investigation. Fifth, the effectiveness of prevention interventions including caregiver education, child-resistant packaging, and regulatory measures has not been rigorously evaluated in most settings. Finally, the impact of emerging public health crises, such as the COVID-19 pandemic, on pediatric poisoning patterns requires ongoing surveillance. Establishing and strengthening poison control centers in low-resource settings, along with mandatory reporting systems, would substantially improve the quality and comparability of future epidemiological evidence.

4.3. *Conclusions*

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This review showed that acute poisoning remains an important public health concern in children, with cases concentrated among those aged 1–5 years. Non-pharmaceutical agents, particularly household cleaning products and pesticides, were the most frequently reported toxic agents, and oral ingestion was the most frequently reported route of exposure. These descriptive findings should be interpreted cautiously because of the heterogeneity, geographical imbalance, and hospital-based retrospective nature of the available evidence. Prevention should focus on caregiver education, safe storage, child-resistant packaging, and regulatory measures, and future prospective multicenter studies with standardized case definitions are needed.

5. Declarations

5.1. *Acknowledgments*

None.

5.2. *Conflict of interests*

None.

5.3. *Funding and supports*

None.

5.4. *Authors' contributions*

All authors contributed to study design, data collection, and writing the draft of the study. All authors read and approved the final version of manuscript.

5.5. *Ethical statement*

Not applicable.

5.6. *Informed consent*

Not applicable.

5.7. *Availability of supporting data*

Not applicable.

5.8. *Using artificial intelligence chatbots statement*

We utilized AI-powered tools to check grammar and enhance the academic quality of the text, which was primarily written by the authors.

5.9. *Other declarations*

Abbreviations The following abbreviations are used in this manuscript: CO: Carbon Monoxide HIS: Hospital Information System MeSH: Medical Subject Headings NPDS: National Poison Data System PRISMA: Preferred Reporting Items for Systematic Reviews and Meta-Analyses PSS: Poison Severity Score SID: Scientific Information Database

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HOSPITAL BASED PROSPECTIVE STUDY TO ASSESS THE CORRELATION OF CLINICO-EPIDEMIOLOGICAL PROFILE OF CHILDREN WITH IMMEDIATE OUTCOME OF ACUTE POISONING IN CHILDREN AT A TERTIARY CARE CENTER. Int J Acad Med Pharm. 2023;5(2):354-7.

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Table 1: Database-specific search strategies used for literature retrieval

Database	Search field(s)	Search strategy
PubMed	Title/Abstract & MeSH	("Poisoning"[Mesh] OR "Drug-Related Side Effects and Adverse Reactions"[Mesh] OR "Household Products"[Mesh] OR "Pesticides"[Mesh] OR "Hydrocarbons"[Mesh] OR "Carbon Monoxide Poisoning"[Mesh] OR "Accidental Poisoning"[Title/Abstract] OR "Intentional Poisoning"[Title/Abstract] OR "Ingestion"[Title/Abstract] OR "Overdose"[Title/Abstract] OR "Intoxication"[Title/Abstract] OR "Toxic Exposure"[Title/Abstract] OR "Drug Overdose"[Title/Abstract] OR "Chemical Poisoning"[Title/Abstract] OR "Substance Abuse"[Title/Abstract]) AND ("Child"[Mesh] OR "Adolescent"[Mesh] OR "Infant"[Mesh] OR "Child, Preschool"[Mesh] OR "Pediatrics"[Mesh] OR Child[Title/Abstract] OR Children[Title/Abstract] OR Pediatric[Title/Abstract] OR Adolescent[Title/Abstract] OR Teen[Title/Abstract] OR Infant[Title/Abstract]) AND ("Epidemiology"[Subheading] OR "Risk Factors"[Mesh] OR "Incidence"[Mesh] OR "Prevalence"[Mesh] OR "Mortality"[Mesh] OR Epidemiology[Title/Abstract] OR "Risk Factors"[Title/Abstract] OR "Clinical Outcomes"[Title/Abstract] OR "Morbidity"[Title/Abstract] OR "Incidence"[Title/Abstract] OR "Prevalence"[Title/Abstract])
Web of Science	Topic Search	TS= (("Acute Poisoning" OR Poisoning OR Toxicity) AND (Child OR Children OR Pediatric) AND (Epidemiology OR "Risk Factors" OR "Clinical Outcomes"))
Scopus	TITLE-ABS-KEY	TITLE-ABS-KEY (("Acute Poisoning" OR Poisoning OR Toxicity) AND (Child OR Children OR Pediatric) AND (Epidemiology OR "Risk Factors" OR "Clinical Outcomes"))
Google Scholar*	Full text	("Acute Poisoning" OR "Child Poisoning" OR "Pediatric Poisoning") AND ("Epidemiology" OR "Patterns" OR "Risk Factors" OR "Outcomes")
Scientific Information Database (SID)	Title, Abstract, Keywords	Persian equivalents of: "Acute Poisoning", "Poisoning", "Intoxication", "Ingestion", "Child", "Children", "Pediatric", "Adolescent", "Epidemiology", "Risk Factors", "Clinical Outcomes", "Incidence", "Prevalence", "Patterns", combined using Boolean operators (AND, OR).
Magiran	Title, Abstract, Keywords	Persian equivalents of: "Acute Poisoning", "Poisoning", "Intoxication", "Ingestion", "Child", "Children", "Pediatric", "Adolescent", "Epidemiology", "Risk Factors", "Clinical Outcomes", "Incidence", "Prevalence", "Patterns", combined using Boolean operators (AND, OR).
Irandoc	Title, Abstract, Keywords	Persian equivalents of: "Acute Poisoning", "Poisoning", "Intoxication", "Ingestion", "Child", "Children", "Pediatric", "Adolescent", "Epidemiology", "Risk Factors", "Clinical Outcomes", "Incidence", "Prevalence", "Patterns", combined using Boolean operators (AND, OR).

Note: Search limits applied to all databases: Publication period: January 2015 to July 2026; Languages: English and Persian; Full-text articles; Original research studies. Abbreviations: TS = Topic Search; TITLE-ABS-KEY = Search within the title, abstract, and keywords. Note*: Google Scholar was used solely as a supplementary search engine to identify additional eligible studies and to manually screen the reference lists of included articles for potentially relevant publications not retrieved through the primary database searches.

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Table 2: Variables extracted from included studies with operational definitions, extraction methods, and assumptions

Category	Variable	Operational Definition	Extraction Method	Assumptions/Simplifications
P - Population	Age	Age of the child at the time of poisoning episode (in years or months, as reported)	Extracted as reported; grouped into predefined categories: <1 year, 1-5 years, 6-9 years, ≥10 years	**Assumption:** Age categories were standardized across studies; studies reporting different age ranges were reclassified into these standard categories where data permitted
	Sex	Biological sex of the child (male or female)	Extracted as reported (male/female)	**Assumption:** Sex was recorded as binary (male/female) in all included studies; no studies reported non-binary or intersex categories
	Geographic location	Country and region where the study was conducted	Extracted as reported; classified into continents/regions (Asia, Europe, Africa, Americas)	**Simplification:** Multi-country studies were classified separately to avoid duplication and confounding of regional patterns
	Setting	Healthcare setting where cases were identified (e.g., emergency department, hospital ward, poison control center)	Extracted as reported	**Assumption:** All cases were healthcare-seeking; cases managed outside healthcare settings are not captured
I- Intervention/Exposure	Poisoning agent	Toxic substance responsible for the poisoning episode	Extracted as reported; classified into drug-related and non-drug-related categories	**Simplification:** Agents were grouped into standardized categories (household products, pesticides, gases, etc.) using the classification system described in the original studies
	Route of exposure	Pathway by which the toxic agent entered the body (oral, inhalation, dermal, other)	Extracted as reported	**Assumption:** When multiple routes were reported, the primary route was recorded; if not specified, the route was recorded as "unknown" and not included in the proportional calculations
	Intent of poisoning	Whether the poisoning was accidental/unintentional or intentional	Extracted as reported (unintentional/intentional/unknown)	**Assumption:** Intent classification was based on the original study's definition; if intent was not clearly stated, it was recorded as "unknown"
C - Comparison	Comparison groups	Any comparison groups used in the study (e.g., age groups, sex groups, regions)	Extracted where applicable	**Simplification:** Not all studies included comparison groups; descriptive studies without comparisons were recorded as such
O - Outcomes	Incidence/Prevalence	Number of poisoning cases per population at risk (where reported)	Extracted as reported	**Assumption:** Incidence and prevalence calculations were based on the denominators provided in each study; when denominators were not reported, only absolute numbers were recorded
	Demographic characteristics	Age distribution, sex distribution, urban/rural residence	Extracted as reported; percentages recalculated where necessary	**Assumption:** Percentages were recalculated based on the total number of cases reported in each study; when denominators were unclear, original percentages were preserved
	Clinical outcomes	Clinical manifestations, treatment received, complications, mortality	Extracted as reported	**Simplification:** Clinical outcomes were categorized into broad groups (e.g., mild, moderate, severe) based on the severity classification used in each study
	Risk factors	Identified risk factors for poisoning (e.g., storage practices, parental education, socioeconomic status)	Extracted as reported	**Assumption:** Risk factors were recorded as reported in each study; no re-analysis or re-interpretation of risk factor associations was performed
S - Study Design	Study design	Methodological design of the study (retrospective, prospective, cross-sectional, case-control, cohort)	Extracted as reported; verified against methodology description	**Assumption:** Classification was based on the authors' stated design; if not explicitly stated, design was inferred from the methodology description
	Sample size	Total number of poisoning cases included in the study	Extracted as reported	**Assumption:** Sample size was taken as the total number of cases analyzed in the study; if multiple analyses were performed, the largest sample was recorded

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Category	Variable	Operational Definition	Extraction Method	Assumptions/Simplifications
Additional	Study period	Dates during which data were collected (from-to)	Extracted as reported	**Assumption:** Study period was recorded exactly as reported; if not specified, the publication year minus typical data collection lag was estimated
	Data source	Source of data (hospital records, poison control center database, surveillance system, etc.)	Extracted as reported	**Assumption:** Data sources were classified into standard categories (hospital-based, registry-based, survey-based, etc.)
	Funding sources	Sources of funding for the study (if reported)	Extracted where reported	**Assumption:** Funding sources were often not reported; this was recorded as "not reported" when unavailable and acknowledged as a limitation
	Principal findings	Main epidemiological findings of each study	Extracted as reported	**Simplification:** Findings were summarized narratively; no quantitative synthesis or meta-analysis was performed
	Missing data handling	How missing data were addressed in each study	Extracted where reported	

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Table 3: Included acute pediatric poisoning studies

No	Article Title	Author/Year	Data Source	Study Type	Location	Results
1	A cross-sectional study of children with acute poisoning: A three-year retrospective analysis (34)	Bacha and Tilahun 2015	medical records	Cross-sectional	Ethiopia	All children survived
2	A Hospital-Based Prospective Study to Assess the Correlation of Clinico-epidemiological Profile of Children with Immediate Outcome of Acute Poisoning in Children at a Tertiary Care Center (20)	Charan et al., 2023	Microsoft Excel, Semi-structured proforma	Cross-sectional	India	All the children survived. Early intervention did not significantly impact outcomes.
3	A Hospital-Based Epidemiologic Study on Acute Pediatric Poisonings in Chennai, India (35)	Raman et al., 2015	hospital records, patient history, and clinical examination, Microsoft Excel	Cross-sectional	India	No Mortality, Importance of childproof containers and proper storage of dangerous substances, educating parents about the risks of poisoning and appropriate first-aid measures.
4	A Study on the Variation of Season on Acute Poisoning Among Children (36)	Akram et al., 2019	Hospital records, PSS Version10	Cross-sectional	Pakistan	Parents should store kerosene and other hazardous substances in childproof containers, away from children, especially in summer.
5	Accidental Poisoning in Children and Adolescents Admitted to a Referral Toxicology Department of a Brazilian Emergency Hospital (37)	Vilaça et al., 2019	Patient treatment forms at the Toxicology Department, electronic medical records	Cross-sectional	Brazil	Implement preventive measures like safer storage of medicines and cleaning products at home, with a special focus on younger children and male children.
6	Acute exogenous intoxications in childhood: factors related to hospitalization (38)	Werner and Platt 2024	Medical records	Cross-sectional	Brazil	Importance of implementing preventive measures: child-resistant packaging, proper storage of toxic substances, and increased caregiver awareness
7	Acute Medication Poisoning Causing Hospital Admissions in Childhood: A 3-Year Prospective Observational Single-Center Study (39)	Matalová et al., 2019	Medical records, Patient's history	Prospective observational	Czech Republic	-Acute medication poisoning in children, particularly from NSAIDs, is most common among toddlers and girls. -Improved prevention through parent education and child-resistant packaging.
8	Acute Poisoning among Children Admitted in a Tertiary Care Hospital: A Descriptive Cross-sectional Study (40)	Aryal et al., 2024	Hospital records, checklist, convenience sampling	Cross-sectional	Nepal	Implement targeted prevention strategies, raise awareness about poisoning risks, and enhance safety measures in home environments, particularly for adolescents.
9	Acute poisoning in children admitted to pediatric emergency department: a five-year retrospective analysis (17)	Soave et al., 2022	Hospital computerized clinical record (GIPSE®)	Cross-sectional	Italy	Acute poisoning in children is common in emergency departments, with household products being the leading cause, highlighting the need for preventive measures.
10	Acute poisoning in children in Ethiopia: a cross-sectional study (23)	Molla et al., 2022	Hospital records, Structured checklist, Multiple logistic regression	Cross-sectional	Ethiopia	-Acute poisoning in children is prevalent in Ethiopia, with venom and insecticides being the most common agents, and rural populations being at higher risk for fatal outcomes. - Importance of emergency care, preventive measures, and public awareness campaigns to reduce poisoning incidents.
11	Acute Poisoning in Children Referred to Qazvin Children Hospital (2009 to 2012) (41)	Pirzadeh et al., 2016	Medical records,	Cross-sectional	Iran	Benzodiazepines are the most common cause of poisoning, highlighting the need for better parental education and safe medication storage.

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No	Article Title	Author/Year	Data Source	Study Type	Location	Results
12	Acute toxic exposures in children: analysis of a three-year registry managed by a Pediatric poison control Center in Italy (42)	Marano et al., 2021	Medical records, Pediatric Poison Control Center (PPCc) registry, Stata 15.0, Logistic regression	Prospective observational	Italy	-Most poisoning cases were accidental, with a high incidence of exposure to industrial and pharmaceutical agents - Enhancing preventive measures and public awareness, especially for children at home.
13	Assessment of acute poisoning in children using poisoning severity scores: A cross-sectional study at Damietta General Hospital Egypt (43)	Sayed et al., 2024	Medical records, Poison Severity Score (PSS)	Cross-sectional	Egypt	- Accidental poisoning, particularly from household cleaning products and petroleum products, was most common among preschool-aged children - Importance of parental education and preventive measures, especially in rural areas, to reduce pediatric poisoning risks. The study also supports the use of the Poison Severity Score (PSS) in clinical care.
14	Childhood acute poisoning in the Italian North-West area: a six-year retrospective study (14)	Berta et al., 2020	Data registry, hospital discharge cards, interviews with patients and caregivers	Retrospective registry-based	Italy	- Most poisonings were accidental - No deaths or ICU admissions were recorded. - Improving preventive measures, particularly for non-pharmaceutical toxins, and enhancing public awareness to reduce the incidence of childhood poisonings
15	Childhood Drug and Non-Drug Poisoning in Nigeria: An Economic Appraisal (44)	Ikhile et al., 2019	Medical records, Microsoft Excel	Retrospective	Nigeria	-It is a costly public health concern in Nigeria, emphasizing the need for preventive strategies. - Education on child safety, use of child-resistant containers, establishment of poison control centers.
16	Clinical Assessment of Acute Organophosphorus Pesticide Poisoning in Pediatric Patients Admitted to the Toxicology Emergency Department (45)	Caba et al., 2022	Medical records, Hematology Analyzers (hospital laboratory equipment), Statistica 10, Microsoft Excel	Retrospective	Romania	Urgent need for increased awareness and preventive measures to reduce pediatric exposure to organophosphorus pesticides, particularly in rural areas.
17	Clinical characteristics and toxicological spectrum analysis of 493 cases of acute poisoning in children (10)	Xue et al., 2024	Electronic health record system (HIS)	Retrospective	China	Pesticide poisoning was the most common, primarily due to rodenticides, with accidental ingestion being the main route; prevention should focus on child safety education and adolescent psychological support.
18	Epidemiological and Clinical Features of Acute Poisoning in Children in a Referral Teaching Hospital in Iran, 2015 – 2018 (21)	Mohammadi et al., 2020	Electronic database of Qods Children's Hospital	Retrospective	Iran	Enhanced control over medication storage and increased public education
19	Epidemiological Trends of Acute Chemical Poisoning among Children over a Recent Three-Year Period in Saudi Arabia (46)	Alshahrani et al., 2023	Data from MOH epidemiological surveillance system; Microsoft Excel	Retrospective	Saudi Arabia	-Home-based chemical poisoning is a major concern, highlighting the need for stronger preventive measures. -Public awareness campaigns, childproof chemical storage, and stricter regulatory control of hazardous substances are essential to reduce poisoning cases.

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No	Article Title	Author/Year	Data Source	Study Type	Location	Results
20	Epidemiology of Acute Pediatric Poisonings Complicated by Cardiogenic Shock – A 6-Year Study in a Clinical Toxicology Unit (47)	Enache et al., 2021	IBM SPSS, Clinical records	Retrospective	Romania	-Public health services should implement specific educational and preventive measures to reduce pediatric poisoning and its severe outcomes. - Intentional poisonings leading to cardiogenic shock were nearly twice as frequent as accidental poisonings, with adolescent girls being the most affected group.
21	Frequency and Management of Acute Poisoning Among Children Attending an Emergency Department in Saudi Arabia(48)	Tobaiqy et al., 2020	Patients' electronic medical records (EMR)	Retrospective	Saudi Arabia	Inform parents about the safe storage of medicines and cleaning products
22	Epidemiological and Clinical Characteristics of Pediatric Acute Drug Intoxications: A Retrospective Analysis(18)	Singer et al., 2024	Patient medical records, the Poisoning Severity Score (PSS)	Retrospective	Romania	Focus on Parental learning, support for adolescent mental health, and Enhanced access to healthcare services in rural areas.
23	Evaluation of poisoning cases admitted to the pediatric emergency clinic retrospectively(15)	Ozkan et al., 2022	Hospital records	Retrospective	Turkey	Focus on preventive measures, such as educating families, designing child-proof boxes and lids, and providing training for health professionals on managing poisonings.
24	Acute intoxication and poisoning in children: the experience of a tertiary-care hospital from 2001-2012(49)	Napodano et al., 2015	Data collected and placed in a singular electronic database	Retrospective	Italy	Informative campaigns in schools, educate parents by experts on, the necessity of establishing a standardized therapeutic protocol for managing toxic substance ingestions.
25	The pattern of acute poisoning in hospitalized children under 18 years old in Yazd, Iran(50)	Nafei et al., 2021	Medical records	Cross-sectional	Iran	Raising parents' awareness about the importance of storing medications in a secure location, out of reach of children
26	International Epidemiological Differences in Acute Poisonings in Pediatric Emergency Departments(13)	Mintegi et al., 2019	EDs reported data, electronic questionnaires completed via Google Drive,	Cross-sectional	1	Consider epidemiological differences in acute poisoning in children evaluated in EDs across different countries and regions of the world to design effective local prevention interventions.
27	Clinical spectrum of acute poisoning in children admitted to the pediatric emergency department(7)	Lee et al., 2019	Hospital's electronic medical records	Retrospective	Taiwan	The majority of poisonings happen in young children, as a result of accidentally ingesting a single substance. Female adolescents were frequently seen as intentionally poisoning patients.
28	Poisonings in childhood: A 5-year experience of a tertiary city hospital in İstanbul(51)	Köle et al., 2023	Medical records of patients	Retrospective	Turkey	Provide Effective clinical management to prevent unnecessary hospitalizations.
29	Epidemiology of pediatric poisoning presenting to a children's emergency department in Singapore over five years(31)	Koh et al., 2018	Patients' electronic records in the Online Paediatric Emergency Care system	Retrospective	Singapore	educating caregivers of young children and at-risk adolescents, Justification for Establishing a Specialized Drug and Poison Information Center
30	Phosphide Poisoning in Children in Tertiary Care Hospital of South India: A Retrospective Study(52)	Kariyappa et al., 2015	Medicolegal registry, inpatient records, daily duty reports, specially designed data collection performa	Retrospective	India	Implementing a comprehensive strategy to reduce mortality rates associated with phosphide poisoning.
31	The Pattern of Acute Poisoning in Children in Chud-	Iftikhar et al.,	Hospital records	Retrospective	Pakistan	Acute poisoning is particularly prevalent in Pakistan, leading to a

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No	Article Title	Author/Year	Data Source	Study Type	Location	Results
	ary Mohammad Akram Teaching and Research Hospital Lahore(53)	2022				notable number of fatalities. Bleach is currently the most frequently reported toxic agent. Raising awareness is recommended.
32	Pattern of acute pediatric poisoning at banha poisoning control center, Egypt: One-year prospective study(54)	Farag et al., 2020	Collection of patients' data by using designated sheets by the treating physicians,	Cross-sectional	Egypt	Acute children poisoning is more common at a young age; highlights the importance of prevention as the best solution to reduce morbidity and mortality.
33	Risk factors contributing to the incidence and mortality of acute childhood poisoning in emergency department patients in Iran: a hospital-based case-control study(25)	Disfani et al., 2019	Collected data of daily admissions to the emergency departments of the included hospitals	Cross-sectional	Iran	Educational programs to reduce the incidence and mortality of childhood poisoning
34	Patterns and outcome of acute poisoning among children in rural Sri Lanka(16)	Dayasiri et al., 2018	Interviewing caregivers (using a pretested multi-structured questionnaire)	Retrospective	Sri Lanka	Promoting awareness of the importance of seeking timely medical attention and avoiding potentially harmful first aid practices. Well-trained pediatric professionals are crucial.
35	Pediatric Emergency Department Management in Acute Poisoning—A 2-Year Retrospective Study(55)	Corlade-Andrei et al., 2023	Intoxication Registers and observation sheets, the data from the existing InfoWord system	Retrospective	Romania	To prevent deliberate intoxication, especially in high-risk groups, use better supervision or cognitive therapy.
36	Unintentional Acute Poisoning Related Emergency Department Visits in Children in a Single-Center: A Nine-Year Prospective Survey(26)	Wiener Amram et al., 2022	A computerized questionnaire	Prospective	Israel	Boosting public awareness, enacting relevant laws, and increasing collaboration among government agencies, health organizations, educational institutions, and businesses.
37	Exposures and Suspected Intoxications to Pharmacological and Non-Pharmacological Agents in Children Aged 0–14 Years: Real-World Data from an Italian Reference Poison Control Centre(56)	Brilli et al., 2023	Medical records (phone calls) of the Toxicology Unit and PCC of Careggi University Hospital, Florence	Retrospective	Italy	Establish preventive interventions, Educating parents and caregivers/ providers.
38	Evaluation of accidental and intentional pediatric poisoning: Retrospective analysis in an emergency Department of Turkey(57)	Bulut et al., 2022	Patient files, epicrisis reports, the Patient Information Management System (PIMS) software program	Retrospective	Turkey	Educating parents about the prevention of acute poisoning, storage all medications securely, seeking medical help for any suspected ingestion, accidental or intentional.
39	Epidemiology of acute pediatric poisonings in Spain: A prospective multicenter study from the Spanish Society of Pediatric Emergency Medicine(58)	Santiago et al., 2020	Electronic questionnaires completed via Google Drive	Cohort	Spain	Educational programs and healthy lifestyle promotion
40	An epidemiological snapshot of toxicological exposure in children 12 years of age and younger in Riyadh(19)	Alruwaili et al., 2019	A preformatted data collection sheet filled with Emergency physicians	Prospective	Saudi Arabia	Focus on prevention and early intervention

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No	Article Title	Author/Year	Data Source	Study Type	Location	Results
41	Epidemiological study on accidental poisonings in children from northeast Romania(22)	Nistor et al., 2018	Patients' files	Retrospective	Romania	Secure storage, Continuous professional development
42	Population attributable risk of unintentional poisoning in Iranian children(33)	Ayubi et al., 2016	A standardized questionnaire completed in a structured interview for cases	Case-control	Iran	Home modifications, safety behaviors, and parental health literacy
43	Determination of pediatric poisoning factors in children(59)	Haratipour et al., 2016	HIS, also interviews and completion of information collection forms in patients who had outpatient visits	Cross-sectional	Iran	Increased drug poisoning: prevention strategies are recommended
44	Study of acute poisoning cases in children admitted to menoufia poison control center (MPCC) during the year (2016)(29)	Kandeel and El-Farouny 2017	Patient clinical sheets, PSS for scoring system	Prospective	Egypt	Supervise children closely, public awareness campaigns, use Child-resistant containers
45	Acute poisoning in children in Bahia, Brazil(30)	Rodrigues et al., 2016	Standardized forms of the Poison Control Center and patient record charts	Retrospective	Brazil	Child-resistant packaging, Animal venom safety
46	An epidemiological study of acute poisoning in children in a tertiary care hospital of western Rajasthan, India(24)	Agarwal et al., 2016	Data collected and recorded in predesigned performa	Cross-sectional	India	Increase poisoning knowledge through Workshops, media, and schools
47	Evaluation of pediatric patients admitted to the emergency department due to drug intoxication(60)	Halhalli and Uslu 2021	Electronic data system records and patient files	Retrospective	Turkey	Significant age/gender differences in exposure
48	Evaluation of poisoning cases admitted to pediatric emergency department(61)	Gokalp 2019	Data collected from the automation system of the hospital	Retrospective	Turkey	Store poisonous products out of reach
49	Acute poisoning in children; Evaluation of cases admitted to Marmara University Hospital in 2015(62)	Tiplamaz et al., 2018	Clinical records	Retrospective	Turkey	Focus on Mandated child-resistant packaging
50	Pattern of acute pediatric poisoning in middle delta poison control centers(63)	Sobeeh et al., 2018	Data collected from poison control centers	Retrospective	Egypt	In Egypt, child poisoning is prevalent, and children under six are most affected.
51	A case-control study on risk factors for unintentional childhood poisoning in Tehran(28)	Mansori et al., 2016	Interviews of all children and their guardians, using a standard questionnaire	Case-control	Iran	Keeping poisonous products out of reach consider family addiction as a significant risk factor.
52	Poisoning emergency visits among children: a 3-year retrospective study in Qatar(64)	Ahmed et al., 2015	Hospital medical records	Cross-sectional	Qatar	Target social inequality for prevention
53	Patterns and Outcomes of Acute Poisoning Among Children Presenting to Emergency Department in AlAhsa, Saudi Arabia(65)	AlGhadeer et al., 2024	Hospital's electronic medical records	Cross-sectional	Saudi Arabia	Update prevention strategies, improve caregiver toxin knowledge
54	General pattern of paediatric poisoning in Jordan during 2018–2019(66)	Alzayadneh et al., 2024	Case records in the poison center database (based on	Retrospective	Jordan	Educate parents/caregivers on safe medication storage. Urgent health facility access for poisoning

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No	Article Title	Author/Year	Data Source	Study Type	Location	Results
			self-reported calls)			
55	Patterns and clinical outcomes of childhood poisoning presenting to a children's emergency department in Yenagoa, Nigeria: a 10-year retrospective study (67)	Areprekumor et al., 2024	Medical records	Retrospective Cross-sectional hospital-based	Nigeria	Increase poisoning awareness. The necessity of safe storage
56	Epidemiology of acute poisoning in children presenting to the poisoning treatment center at Ain Shams University in Cairo, Egypt, 2009-2013 (68)	Azab et al., 2016	Electronic records in the Microsoft Access (Seattle, WA) database maintained by ASU-PTC.	Retrospective	Egypt	Increase pesticide safety education, Expand research on childhood poisoning
57	Pattern of acute pediatric poisonings in Birjand City, East of Iran(69)	Mehrpour et al., 2015	Files of the pediatric poisoned patients	Retrospective	Iran	Increase safety training and prevention skills
58	Children's poisoning profile during the Covid-19 pandemic – Experience of Hassan II University Hospital in Fez, MOROCCO(27)	Sahar et al.,2021	Hospital's electronic medical records	Retrospective	Morocco	An increase in poisoning cases and the emergence of new poisoning circumstances during the COVID-19 pandemic.
59	Epidemiological Statistical Analysis of Emergency Cases of Child Poisoning in the Tabuk Region Over the Period 2015-2020(70)	Albalawi, 2024	Getting information from competent authorities and Ministry of Health	Cross-sectional	Saudi Arabia	The emergency response was considered one of the most effective procedures in handling referred patients.
60	Profile of Childhood Poisoning and Its Outcomes in the United States: A One-Year Nationwide Study of Emergency and Inpatient Admissions(71)	Uwumiro, et al., 2023	Medical records	Cross-sectional	America	Emphasizes the need for continued investment in prevention initiatives.
61	COVID-19 and Pediatric Ingestions(12)	Lelak et al., 2021	NPDS data	Cross-sectional	United States	Overall pediatric ingestions decreased by 6.3% during the pandemic; however, intentional ingestions increased (10.3% to 10.8%), with 70% increase in melatonin and 43% increase in hand sanitizer ingestions; clinically significant outcomes increased from 3.6% to 4.2%

1: Africa, the Americas, Southeast Asia, Europe, Eastern Mediterranean, and Western Pacific regions. ED: Emergency department.

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Table 4: Comparison of Epidemiological Patterns of Acute Pediatric Poisoning Across Geographical Regions

Characteristic	Asia	Europe	Africa	Americas	Multi-country
Number of studies	27	18	10	5	1
Most common agent	Pesticides/Insecticides	Household products	Household products/ Venom	Medications/ Household products	Household products
Predominant age group	1-5 years	1-5 years	1-5 years	1-5 years	1-5 years
Sex predominance	Male (younger), Female (older)	Male (younger), Female (older)	Male (overall)	Female (overall)	Male (younger)
Main route	Oral ingestion	Oral ingestion	Oral ingestion	Oral ingestion	Oral ingestion
Urban predominance	Yes (60-70%)	Yes (70-80%)	Mixed	Yes (65-75%)	Yes
Seasonal peak	Summer	Summer	Variable	Summer	Variable
Mortality rate	Low to moderate	Very low	Moderate	Very low	Very low

The data presented in this table represent descriptive frequencies and percentages aggregated from the 61 included studies. These are not pooled quantitative estimates from a meta-analysis. Percentages were calculated using the total number of cases as the denominator, unless otherwise specified. No measures of statistical heterogeneity, such as I^2 or Q-test, or pooled effect sizes, such as risk ratios, odds ratios, or mean differences, are presented, as quantitative meta-analysis was not performed due to the substantial heterogeneity across studies in designs, populations, settings, case definitions, and outcome measures. These descriptive statistics should be interpreted as aggregated patterns across studies rather than precise quantitative estimates.

Table 5: Distribution of childhood poisoning cases by demographic characteristics, route of exposure, residence, and seasonality

Category	Subcategory	Male (%)	Female (%)	Percentage (%)
Age group	Under 1 year	6.21	5.87	12.08
	1–5 years	28.27	24.71	52.98
	6–9 years	7.11	6.39	13.50
	≥10 years	9.34	12.10	21.44
	Total	50.93	49.07	100
Route of exposure	Oral ingestion	—	—	12.89
	Inhalation (toxic gases, e.g., CO)	—	—	6.84
	Dermal exposure & insect stings	—	—	4.00
Place of residence	Urban	—	—	64.58
	Rural	—	—	35.42
Seasonal distribution	Summer	—	—	27.89
	Spring	—	—	25.34
	Autumn	—	—	23.45
	Winter	—	—	23.32
	Warm seasons (spring + summer)	—	—	53.23
	Cold seasons (autumn + winter)	—	—	46.77

The data presented in this table represent descriptive frequencies and percentages aggregated from the 61 included studies. These are not pooled quantitative estimates from a meta-analysis. Percentages were calculated using the total number of cases as the denominator, unless otherwise specified. No measures of statistical heterogeneity, such as I^2 or Q-test, or pooled effect sizes, such as risk ratios, odds ratios, or mean differences, are presented, as quantitative meta-analysis was not performed due to the substantial heterogeneity across studies in designs, populations, settings, case definitions, and outcome measures. These descriptive statistics should be interpreted as aggregated patterns across studies rather than precise quantitative estimates. * Note: Percentages for routes of exposure do not sum to 100% because this variable was not explicitly categorized or reported in all included studies.

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Table 6: Distribution of childhood poisoning cases by drug-related and non-drug categories and detailed non-drug poisoning agents

Category	Subcategory	Number of Cases	% of Total Cases	% of Non-drug Cases
Drug-related poisoning	—	25,771	38.42	—
Non-drug poisoning	—	41,281	61.58	100
	Household items	13,282	19.81	32.17
	Insecticides	9,753	14.55	23.62
	Gas (e.g., CO)	3,648	5.44	8.84
Non-drug subcategories	Substance abuse	2,139	3.19	5.18
	Raticide	554	0.83	1.34
	Cosmetics/Perfume	389	0.58	0.94
	Other/unclassified non-drug agents	11,516	17.17	27.90

The data presented in this table represent descriptive frequencies and percentages aggregated from the 61 included studies. These are not pooled quantitative estimates from a meta-analysis. Percentages were calculated using the total number of cases as the denominator, unless otherwise specified. No measures of statistical heterogeneity, such as I^2 or Q-test, or pooled effect sizes, such as risk ratios, odds ratios, or mean differences, are presented, as quantitative meta-analysis was not performed due to the substantial heterogeneity across studies in designs, populations, settings, case definitions, and outcome measures. These descriptive statistics should be interpreted as aggregated patterns across studies rather than precise quantitative estimates. * Note: "% of Total Cases" uses all poisoning cases as the denominator, whereas "% of Non-drug Cases" uses the non-drug poisoning cases (n = 41,281) as the denominator. The categories are mutually exclusive. "Other/unclassified non-drug agents" comprises non-drug cases that are not allocated to the listed subcategories.

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Table 7: Summary of methodological strengths and weaknesses of included studies by study design

Study Design	N	Methodological Strengths	Methodological Weaknesses	Implications for Interpretation
Retrospective	30	- Large sample sizes often available - Use of real-world clinical data - Reflects routine clinical practice - Relatively inexpensive to conduct	- Relies on completeness and accuracy of medical records - Inability to control for confounding variables - Potential selection bias (only cases that reached healthcare facilities) - Missing data common - Cannot establish causality	Findings from retrospective studies should be interpreted as associations rather than causal relationships; results may underestimate mild cases not presenting to healthcare facilities
Prospective	5	- Pre-planned data collection - More complete and standardized data - Better control over variables collected - Less missing data	- Smaller sample sizes typically - May not reflect routine practice - Potential for selection bias - Time-consuming and expensive	Prospective studies generally provide more reliable data but may have limited generalizability due to smaller sample sizes; findings are more robust for establishing patterns
Cross-sectional	23	- Provides prevalence estimates - Relatively quick to conduct - Useful for descriptive epidemiology	- Cannot determine temporal relationships - Selection bias possible - Limited to a single point in time - May not capture seasonal variations	Cross-sectional studies provide important prevalence data but cannot determine risk factors or causal relationships; should be interpreted as descriptive estimates
Case-control	2	- Efficient for studying rare outcomes - Can assess multiple risk factors - Useful for hypothesis generation	- Recall bias possible - Selection of appropriate controls challenging - Cannot calculate incidence or prevalence - Potential for confounding	Case-control studies provide insights into risk factors but are subject to recall and selection biases; findings should be interpreted cautiously
Cohort	1	- Establishes temporal sequence - Can calculate incidence rates - Less susceptible to recall bias - Can assess multiple outcomes	- Expensive and time-consuming - Loss to follow-up possible - Large sample sizes needed - May not be representative	Cohort studies provide the strongest evidence for risk factors and temporal relationships among observational designs; however, few such studies exist in pediatric poisoning literature
All Studies	61	- Broad geographic coverage (multiple regions) - Large total sample size - Reflects real-world clinical practice - Includes diverse healthcare settings	- Heterogeneous case definitions and reporting - Variable quality of data sources - Limited to healthcare-seeking cases - Missing data on key variables	Overall evidence provides a comprehensive descriptive overview but is limited by heterogeneity and lack of standardized quality assessment; findings should be considered as descriptive patterns rather than definitive epidemiological estimates

N: Number of Studies.

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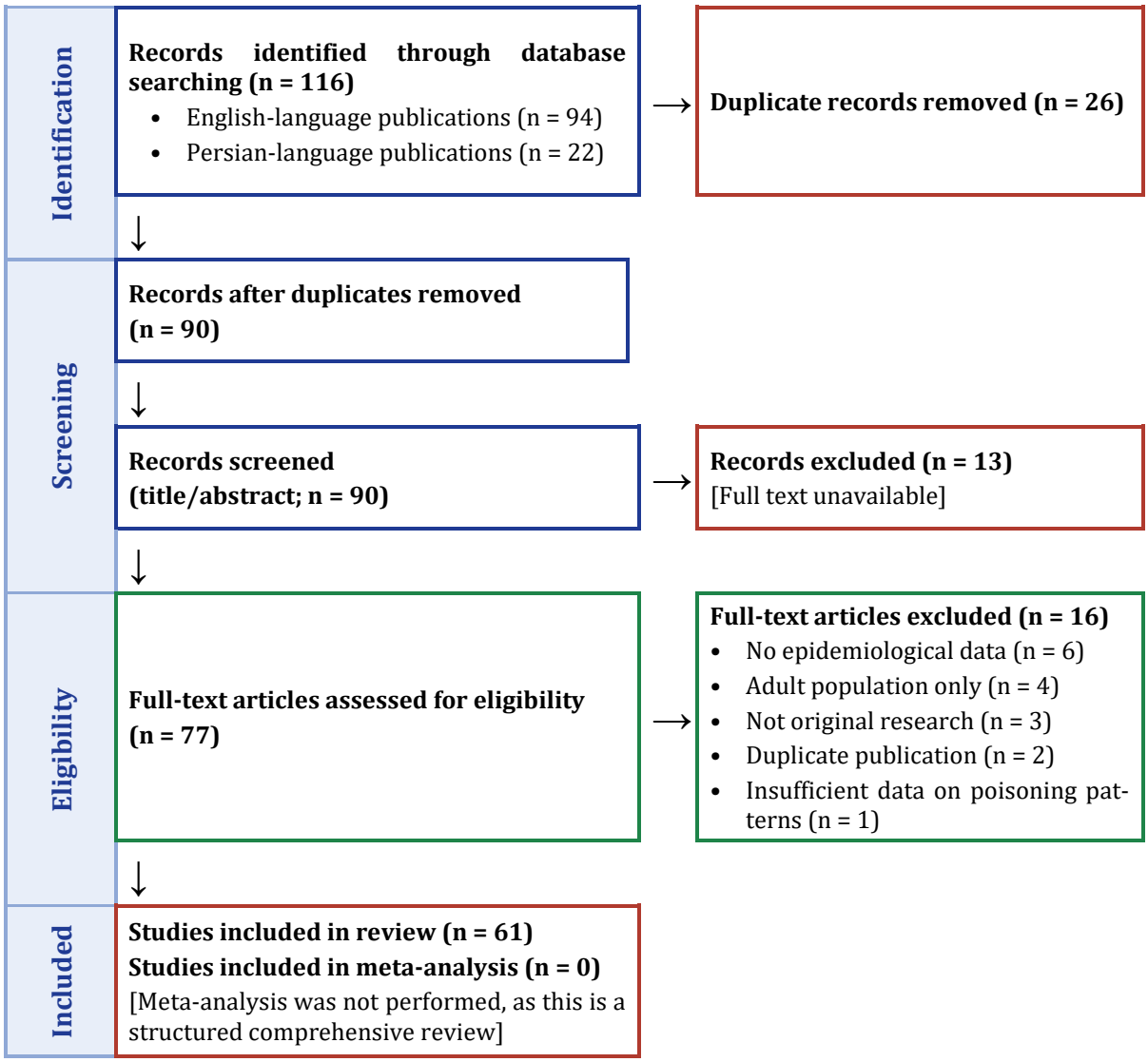


Figure 1: PRISMA Flow diagram of study selection.

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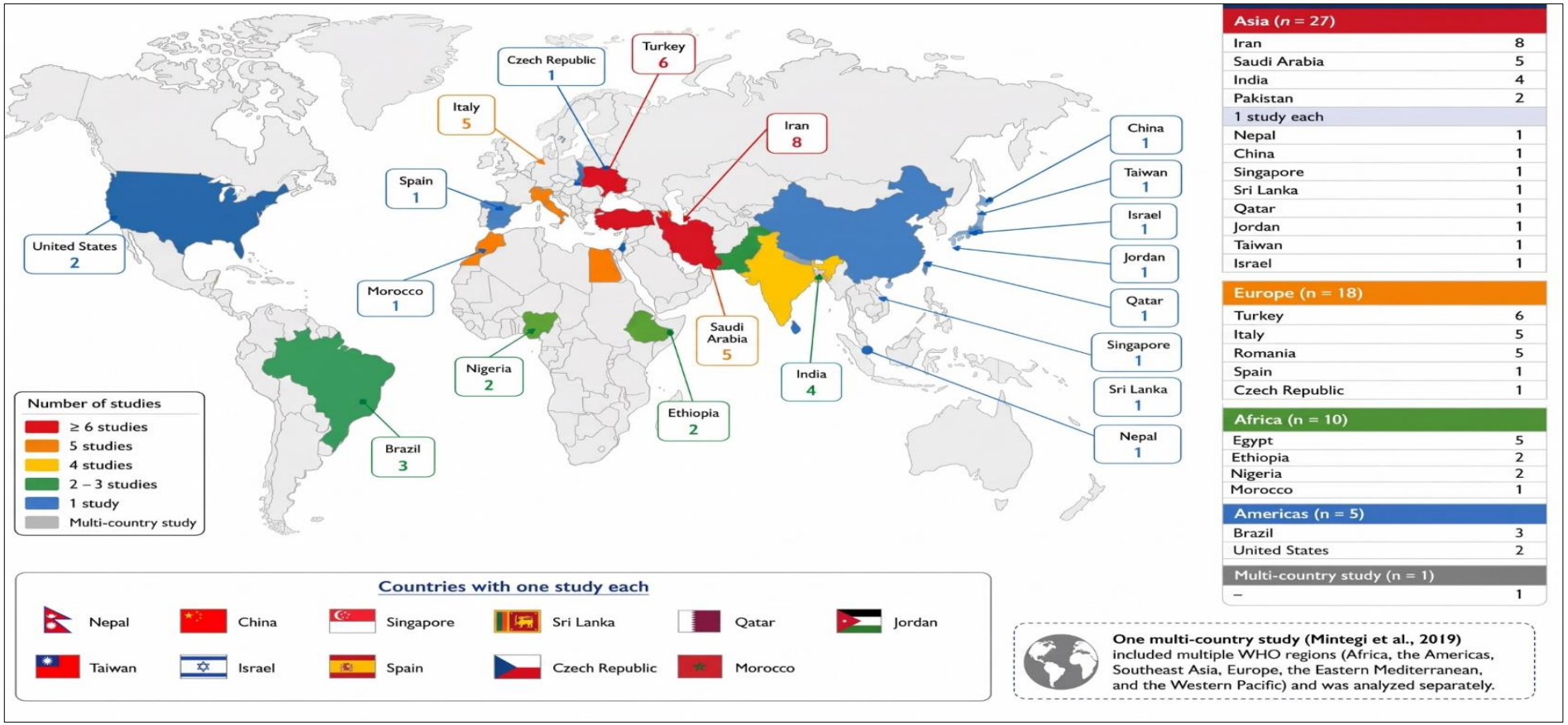


Figure 2: Geographic distribution of the included studies by country (n = 61).

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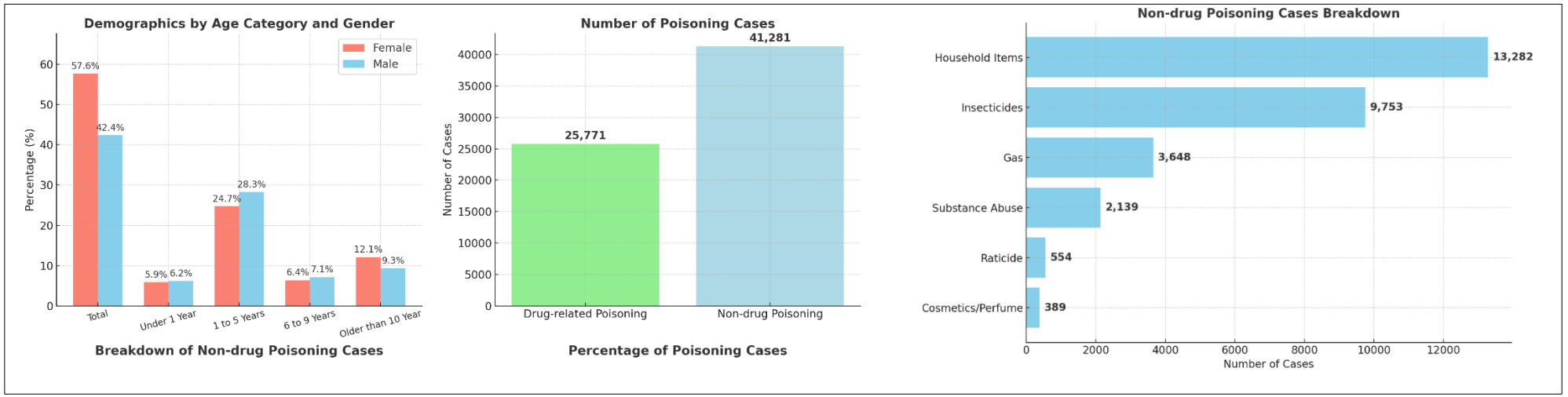


Figure 3: Demographics and poisoning cases overview.

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