

Factors contributing to paracetamol overdoses (intentional and accidental) amongst adult and paediatric populations in the United Kingdom: a systematic review and narrative synthesis.

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Abstract

Background

Paracetamol (acetaminophen) is a widely used analgesic, safe at recommended doses. However, paracetamol overdose accounts for around 100,000 accident and emergency visits and 50,000 hospital admissions per year in the UK. This systematic review aims to describe the factors linked to paracetamol overdose (intentional and/or accidental), identify population subgroups of the population at higher risk, and evidenced preventative interventions.

Methods

This review was undertaken using the Preferred Reporting Items for Systematic Review and Meta-analyses (PRISMA) guidance. Literature searches were performed with six databases: MEDLINE via PubMed, EMBASE, SCOPUS, PsycINFO, the Cochrane Library and PROSPERO register. Grey literature and social media were searched, and article reference lists reviewed. Included studies were in English with UK populations from 1998 onwards, with no patient age restriction. Title and abstract screening and full-text review was performed by two independent reviewers (with a third member to resolve disagreement). Risk of bias was assessed using the JBI and the MMAT critical appraisal checklists. A narrative synthesis of the findings was performed using thematic analysis.

Results

A total of 1,598 sources were identified from databases. After screening, 53 studies were selected for data extraction. The data was categorised into accidental, intentional and mixed reports of overdoses. Paracetamol utilised in overdose was obtained from pharmacy or online purchase, from prescription supplies and from household medication. Accidental overdoses (5 reports) were associated with poorly managed dental pain, unsafe medication storage and access by children, lack of knowledge about medication dosage and confusion with different strengths and presentations. Intentional overdoses (34 reports) were identified in children and adults and were associated with mental health presentations co-ingestion of other substances and the profile of paracetamol as a potential overdose medium. Ten reports provided information about both categories of paracetamol overdose. Five additional studies included after updated search prior submission (2024–2026) were consistent with these patterns and did not alter the overall synthesis.

Conclusions

The availability of paracetamol through commercial and prescribed sources contributed to its association in overdose. Strategies to decrease prevalence of paracetamol overdose require policy, regulatory, educational and health improvement inputs.

Systematic Review Registration

PROSPERO, CRD42024555406

Background

Paracetamol (acetaminophen) is generally a safe medicine used to alleviate various types of pain and fever if taken at therapeutic doses[1]. It is affordable, available over the counter, and widely accessible in Scotland and the rest of the UK.

Globally, the paracetamol market is expected to reach \$1,612.9 million by 2029[2]. In the UK, around 6,300 tonnes of paracetamol are sold each year[3]. If accidentally overdosed, paracetamol can be very dangerous, representing a primary cause of Acute Liver Failure (ALF) and liver transplants[4] within industrialised countries (United States, United Kingdom, Scandinavian countries) in the past 50 years[5].

Despite the 1998 paracetamol pack size restriction legislation[6], in Scotland and the whole UK, cases of paracetamol overdoses (POD), whether intentional or accidental are still rising[7–9]. Our recent report of epidemiological data described marked variability in incidence[10].

This systematic review aims to collect, synthesise and report patterns of paracetamol overdoses described in the literature, with the goal of identifying key messages and lessons that may improve patients' safety. We consider it essential to gather all available information related to factors linked to POD in the UK, whether intentional or accidental amongst adult and paediatric populations, as we believe this is the first work to comprehensively gathered such evidence. This review provides the groundwork for understanding this phenomenon, offers a clearer view of the factors associated with POD, and establishes a foundation from which targeted interventions can be co-developed (or adapted), applied and tested among the UK population to reduce the number of incidences.

Objectives

1. To systematically evaluate the available evidence relating to the factors linked to paracetamol overdose (intentional and/or accidental), utilising PEO (Population, Exposure, Outcomes).
2. To identify and critically appraise which subgroups of the population could be more exposed to the problem.
3. To determine if any interventions are described that may have a preventative effect either from a policy or operational perspective

Methods

A systematic review protocol was developed, registered on the International Prospective Register of Systematic Review (PROSPERO, CRD42024555406) and published on British Medical Journal Open[11].

Literature screening

The search strategy was built on 3 key term sets: 'Paracetamol', 'Overdose' and 'United Kingdom' (see Supplemental File 1). The terms within each set were searched first using the Boolean operator OR. The results from each set were then combined using the Boolean operator AND to obtain the final search results. The search used both free-text words and Medical Subject Heading (MeSH), and the search strategy was modified as appropriate for each electronic database. Six bibliographic databases were included for the literature search on August 2024: MEDLINE via PubMed, EMBASE, SCOPUS, PsycINFO, the Cochrane Library and PROSPERO register. We also extended our literature search to grey literature, including reports, unpublished articles and blogs from Google Scholar and SSRN-Elsevier websites (hits from the first two pages). Social media (mainly 'X', 'LinkedIn', 'Facebook' and 'Bluesky') research was also be carried out for completeness using an advanced domain search (eg, "keywordA AND keywordB AND keywordC site:SocialMediaName.com"). We included literature published only in English, on population residing in the country at the time of the event, with no restriction age, conducted from 1998 onwards (after the introduction of the pack size restriction legislation in the UK).

Updated Search:

To ensure the review remained current at the time of submission, the search strategy was re-run in all databases in July 2026, covering the period from August 2024 (date of the original search) to July 2026.

Inclusion and exclusion criteria

For this review we included qualitative and/or quantitative studies, surveys, case studies and/or reviews. The following inclusion criteria were applied: (1) adult over 16 years overdosing with paracetamol (intentionally or accidentally) while using paracetamol (prescribed or self-administered) for the management of pain and/or fever, or with self-harm intention and (2) children under 16 year-old deliberately overdosing with paracetamol and (3) healthcare providers reporting experiences of patients accidentally or intentionally overdosing with paracetamol and (3) caregivers (of adult over 16 years and children under 16 years) accidentally overdosing while treating patients with paracetamol for the management of pain and/or fever at home and (4) Children under 16 years of age accidentally overdoses with paracetamol to ease pain and/or fever at home. Studies were excluded from the review if (1) paracetamol was taken along with other medications but did not represent the primary cause of overdosing and (2) people were not residing in the UK at the time of the event and (3) studies were not written in the English language.

Study selection

1,267 records were identified through the initial database searching and imported in Covidence (PubMed n = 830; Embase n = 277; Scopus n = 85; Cochrane n = 26; PsycINFO n = 12; Prospero n = 1) and grey literature sources (n = 36). After removing duplicates (n = 20), 1,247 records were screened for title and abstract, of which 1,040 were excluded. A total of 139 records were eligible for full-text assessment, with 91 records excluded for the following reasons: wrong setting (n = 13), wrong outcomes (n = 36), text not

available (n = 14), wrong time period (n = 4), no intentions or causes reported (n = 5), multiple drugs involved with paracetamol not the primary cause (n = 4), year specific data unavailable (n = 5), country specific data unavailable (n = 3), secondary publication (n = 1), and no risk factors for paracetamol overdose reported (n = 6). Of these, 48 records met the inclusion criteria and were included in the review (One record is a Programme Grants for Applied Research report which included 4 studies, of which 2 of them, Study 1 and Study 2 were included into this systematic literature, however, this was counted as 1 record and then split into two in Fig. 2).

The outcome of the social media research did not yield any useful or new sources to be included in this review.

Search Update Results:

The updated search (August 2024-July 2026) yielded 331 additional records. After screening, 5 new records (3 articles, and 2 poster abstracts) were included, integrated into the existing synthesis and are reflected into the final study count. The full selection process is reported in the PRISMA 2020 flow diagram (Fig. 1).

Figure 1: Prisma flow diagram

Data screening and extraction

All the sources identified from the individual database searches were exported, and data screening and data extraction was carried out in Covidence systematic review management software[12]. After removing duplicates, titles and abstract screening and full text screening were conducted by five reviewers (GDP, AR, HC, NA, MC), assigning two reviewers at a time to each literature source (reasons for exclusion at each stage were noted). When there was disagreement, this was resolved by consensus with at least one additional reviewer.

Data extraction was carried out independently by at least two reviewers, with discrepancies resolved on discussion with a third reviewer. Two reviewers verified the extracted data for consistency. The data collected (via Covidence) were then extracted and translated into an excel spreadsheet and re-checked if necessary.

Outcomes

Synthesis of results was underpinned by the Population, Exposure, Outcome (PEO) conceptual model.

Primary outcome was focused on people in the UK (without any age restriction) and the potential risk factors associated with paracetamol overdoses (whether intentional or accidental)

Secondary outcome focused on intervention suggested (in the sources included) or implemented to reduce paracetamol overdoses among the UK population (or subpopulation(s)).

Study risk of bias assessment

As anticipated in the protocol, sources included in this systematic review included mix-method studies, quantitative, qualitative, case reports, conference abstracts. JBI critical appraisal checklist for case reports[13] was used for all those case reports outlining paracetamol overdoses events. The remaining literature sources were assessed using the Mixed Methods Appraisal Tool (MMAT)[14]. Quality assessment activity was carried out independently by at least two reviewers, with a third one being available to resolve any upcoming disagreement (Summary of quality-appraisal results for all included studies using JBI and MMAT tools, are provided in Supplemental File 2).

Analysis

Due to the heterogeneity of study designs, populations and outcomes and reporting formats, a narrative synthesis approach was adopted considering Popay et al. (2006) framework[15]. Extracted data were organised into structured tables and grouped accordingly to paracetamol overdose intentionality (accidental, intentional, mixed), age group and study design. This allowed initial identification of patterns in relation to characteristics and contexts of paracetamol overdoses.

Themes were then developed considering the factors contributing to paracetamol overdoses across the records: population characteristics, source of paracetamol, contextual influences and, when reported, proposed or applied interventions to reduce POD.

The methodological quality of included studies was determined using the JBI and MMAT assessment tools. Although these tools were applied to assess risk of bias, the nature of this work (which included case reports, descriptive observational studies, conference abstract and quality improvement reports), meant that methodological rigour varied substantially among the records and was not always directly relevant to the factors contributing to paracetamol overdoses. As the aim of this review was to identify and map contributory factors rather than estimate effect size, all studies were considered regardless of quality, and risk of bias assessments were used to contextualise (rather than determined) the interpretation of the findings. The content extracted from studies deemed at low-moderate risk of bias was therefore still included in this review since useful for the understanding of the phenomenon (yet interpreted cautiously).

Themes were then refined and integrated to produce a coherent narrative of the factors contributing to paracetamol overdoses in the UK.

Results

Data extraction was conducted using a data capture tool developed in Excel, specifically for this systematic review, collecting information related to the primary and secondary outcomes (See Supplemental File 3). The literature sources reviewed varied considerably in nature, and for some of them it was not possible to extract all the data initially sought. We therefore focused on intentionality of the

paracetamol overdose, the age groups of the individuals described, the factors contributing to paracetamol overdoses, and any intervention proposed (where present) to mitigate this issue.

Following data extraction, all records (case reports, retrospective observational studies, quality improvement projects, conference abstracts and qualitative interviews) were categorised into three groups: those reporting accidental paracetamol overdoses only, those reporting intentional overdoses only, and those reporting both within the same source. Information regarding the age of individuals experiencing paracetamol overdoses was also collected, and age groups were classified as follows: children (up to 12 years), young adults (13–17 years), adults (18–65 years) and older adults (65 years and older) (See Fig. 2).

Five records were included among those reporting accidental paracetamol overdoses only; thirty-four records reported intentional paracetamol overdoses, and ten records reported both intentional and accidental paracetamol overdoses.

Among the records reporting accidental paracetamol overdoses only, just one included adults and older adults, the remaining records described accidental overdoses in children and young adults.

Within the group of records reporting intentional paracetamol overdoses, the majority of studies included all population groups considered.

Figure 2: Classification of articles included in the systematic review.

Factors contributing to POD

Among the 34 literature sources considered in this specific category, intentional paracetamol overdose was consistently reported as a method of self-poisoning, included under the wider umbrella of self-harm, and in some studies, suicidal behaviour.

Overall, the sources included varied substantially in studies design, population and setting considered. However, two specific groups of contributing factors were identified: those specifically linked to paracetamol as a method of self-poisoning (smaller number of studies)[25, 28, 34, 36, 44, 46, 47, 49, 52, 56], and those associated to the broader intention for self-harm (majority of studies). Although both groups are reported in Table 2, results are presented only for factors specifically contributing to paracetamol overdoses, in line with the remit of this systematic review.

Intentional paracetamol overdoses specific contributing factors:

Paracetamol availability:

1. General availability

Paracetamol is an over-the-counter (OTC) medication that is widely available in the UK, not exclusively sold in pharmacies, easily accessible in many types of stores. Despite a current pack-size purchase restriction in place(6), the wide availability and affordability, in conjunction with the ease of contravening this regulation (with some stores and pharmacies allowing purchases above the allowed amount) were frequently mentioned in the included sources as factors influencing individuals' choice of substance for self-harm[28, 34, 36, 44, 47, 56].

1. Household paracetamol availability/accessibility:

Self-poisoning often involves the impulsive ingestion of substances that are readily available nearby[24]. Whether leftover from a previous purchase, or part of an old/current prescription, paracetamol is commonly found in households, making it an appealing option for individuals looking for an immediate means to enact a self-harm attempt[24, 46, 55]. Paracetamol household availability and its link with self-poisoning was also considered within the specific temporal context of the COVID-19 pandemic. With the lockdown, and the NHS advising people to stay at home, and managing mild COVID-19 symptoms with paracetamol when possible, one study[49] reported a further increase in the household supplies, linking this rise to the presentations to emergency departments for self-harm involving paracetamol overdoses.

1. Paracetamol prescription as a route of access:

Kapur et al., investigated self-poisoning presentations in Manchester. A proportion of these cases involved the ingestion of medications previously prescribed to the patients, including painkillers. In this study, paracetamol was among the most commonly prescribed painkillers in the sample. Similar findings were reported by Hawton et al.[44] and by Gunnell et al.[56], where prescribed paracetamol and paracetamol-containing products (often after surgeries or to treat chronic pain) were often the primary source of substances used for self-poisoning. In a national suicide case study, Pitman et al. [46] also noted that many individuals who died had misused available prescribed medications, including painkillers.

Pack size:

Although the amount of paracetamol that can be purchased over the counter is regulated in the UK (general sale: maximum of two packs of 16 tablets/capsules each containing 500mg of paracetamol, for a total of 32 tablets/capsules; pharmacies: up to 100 tablets/capsules containing 500mg paracetamol, at pharmacist's discretion), two studies have reported an association between pack size and the quantity ingested during an overdose. These findings suggests that the number of tablets contained in a pack, may influence the amount taken in self-poisoning events[36, 56].

However, in the study by Gunnell et al. [56], several individuals contradicted these findings, suggesting that the number of tables available in a pack would not have prevented their self-harm intention.

-Warning labels and perception of paracetamol:

In the qualitative study by Gunnell et al. [56], individuals who ingested large paracetamol overdose described several misconceptions around the effects of the medication. Some participants interpreted the

warning labels reported on paracetamol packaging as an indicator of its potency, strengthening their decision to use it as a means of self-poisoning.

Some individuals also believed that paracetamol ingestion would lead to rapid unconsciousness. When this expected effect did not occur, they reported taking additional doses to achieve the intended outcome. This mismatch between perceived and actual pharmacological effects contributed to delays in seeking medical attention, with potential implications for negative health outcomes.

-Demographic, occupational and clinical characteristics:

In Casey et al., and Campos et al.'s studies[47, 52], pure PODs were most common among younger individuals (adolescents and younger adults). Both authors reported that this age group frequently chose paracetamol as the substance used in self-poisoning, with Casey et al. suggesting that limited access to prescription-only may contributed to this trend. In Casey et al. also reported that paracetamol self-poisoning among younger adults occurred predominantly in females; however, when looking at amount of paracetamol ingested, males were more likely to take larger overdoses[47]. Godber et al. [31], Lopez et al. [40] also described case reports of paracetamol overdoses involving young teenage females.

Two studies focused on specific occupational groups[51, 53]. Groves et al.[53] reported that nurses and midwives were represented among healthcare professionals experiencing paracetamol overdoses. Clements et al. [51] similarly identified paracetamol as a common method of self-poisoning among healthcare students. In these occupational groups, high level of stress combined with familiarity with medications and ease of access in clinical settings; alongside the perceived acceptability of paracetamol as a non-violent method, may influence method choice of substance use in self-poisoning, as suggested in both studies.

Across the included literature sources, several studies reported high levels of psychological distress, depression, anxiety, and emotional dysregulation among the individuals overdosing with paracetamol[26, 29]. Individuals experiencing previous self-harm and psychiatric morbidity were also common factors among those overdosing with paracetamol[47, 52], whether children or adults.

-Co-ingestants and substance use:

Alcohol was the most frequently reported co-ingested substance, either prior to or during the episode, among individuals experiencing intentional PODs in both, adults and young-adults' populations. Across the studies, alcohol co-ingestion was associated with more impulsive and unplanned overdoses, and in some cases contributed to delays in help-seeking due to reduce awareness and/or sedation.

Other co-ingestants reported in several literature sources linked to intentional paracetamol overdoses were over the counted medications such as ibuprofen and aspirin (reflecting the same household availability previously mentioned for paracetamol)[28, 31, 35, 43, 48], or prescription medication such as antidepressants and anxiolytics and antipsychotics (commonly present in young adults and adults populations)[22, 28, 31, 32, 32, 39, 51, 53].

Illicit drugs[23, 24, 37], and cleaning fluid were also reported as co-ingestants in some studies[37].

-Media/internet influence:

Media influence and information available online around paracetamol overdoses were highlighted in Gunnell et al. study as factors with the potential to shape individuals' perceptions of paracetamol as a method of self-poisoning[56].

Interventions suggested to reduce intentional PODs

Suggested interventions (for this category, by the authors only) were also extracted (where present) and are summarised in Table 4. Across the literature sources considered, only few of them reported interventions focusing on mitigating intentional paracetamol overdoses, whilst many recommendations focused on broader self-harm prevention interventions. As for Table 3, both groups are reported (PODs focuses intervention and self-harm focused intervention) in Table 4, however, results are presented only for intervention targeting intentional PODs, in line with the remit of this systematic review.

Table 4: Intentional PODs only - Suggested interventions to reduce PODs.

-Pack size restriction and access limitation:

Several authors focused on restrictions as a preventative measure to reduce intentional overdoses. Suggested approaches included strengthening the controls on the sale of large quantities of paracetamol [28, 30, 33], with some studies highlighting the role of pharmacies and pharmacists in monitoring and restricting purchases, particularly among individuals considered at higher risk [46, 47]. Casey et al. further recommended limiting paracetamol sales to pharmacies only and raising the minimum purchasing age to 18 years. They also suggested restricting non-pharmacies sales to a single pack per transaction[47]. In addition, several authors suggested further reductions in over-the-counter paracetamol pack sizes, reflecting ongoing concerns around the ease of access of large quantities of paracetamol [25, 26, 36, 47].

-Regulatory and legislative measures:

Other authors highlighted the need for a broader regulatory action. This included aligning the UK practice with restriction already implemented in several European countries [25, 47], and withdrawing high-toxicity combination products such as co-proxamol (dextropropoxyphene with paracetamol), which had been associated with fatal overdoses in the early 2000s[26]. Co-proxamol was subsequently removed from the UK market through a phase withdrawal between 2005–2007[57].

-Public and media-related interventions:

A small number of studies focused on educational initiative aimed at shaping public understanding of the severity of paracetamol toxicity. These authors emphasised the importance of carefully considering

format, amount, and style of information provided to avoid inadvertently influencing individuals' awareness of self-harm or suicide methods[44, 56].

Casey et al. also recommended the development and delivery of psychologically focused interventions for the general population, alongside school-based prevention programmes[47].

Communication-related measures were further highlighted by Gunnell et al., who suggested reviewing and potentially strengthening warning labels on paracetamol packaging to provide clearer, more prominent information about the risks of overdoses, which are often underestimated by the public[56].

-Clinical management and treatment related interventions:

Paracetamol-focused interventions were also identified within the clinical management setting. Hawton et al., suggested improving treatment pathways for patients presenting with large paracetamol ingestions[44]. Campos et al. recommended developing guidelines to reduce unnecessary investigations in emergency departments, therefore saving valuable time and enabling timely treatment for patients at risk[52].

-Further research and evidence generation:

A small number of literature sources highlighted the need for further evidence to guide future paracetamol-specific prevention strategy, in both, policy and clinical practice. Greene et al., recommend additional research to evaluate the impact of the 1998 pack size restriction legislation and determine whether it had achieved its intended effects [28]. Similarly, Casey et al., stressed the importance of developing and applying psychosocial treatments grounded in evidence-based practice[47].

Accidental and Intentional combined Paracetamol Overdoses Only

Overview of included studies, study period and geographical distribution

Ten literature sources were included into this group, reporting information related to mixed-intent paracetamol overdoses across different populations, including children, young adults, adults and pregnant women. These comprises a mix of retrospective observational studies, case studies, interrupted time-series analyses, long term evaluations, a qualitative study (part of a research programme) mixed-methods feasibility work and epidemiological cohort studies.

The studies were published over a period of around two decades, from 2005[58] to 2024[66], reporting data from 1993[61, 66] to 2018 (only data from 1998 were considered).

Geographically, the studies were distributed across all four UK nations, with more substantial representation from England[55, 60, 63, 65, 66] and Scotland[59, 62].

Table 5: Characteristics of studies reporting accidental and intentional combined paracetamol overdoses only and factors linked to PODs.

Population Characteristics

Children and young adults were the represented populations of several studies[59, 65, 66], adults were often the subjects of case studies and national datasets[60, 63], all age populations were mostly included in large surveillance and epidemiologic studies[55, 58, 61, 62, 64]. As for the previous groups (intentional-only and accidental-only studies) gender distribution was inconsistently reported. Where the information was reported, females were over-represented in those cases of intentional overdoses[65]; case studies reported specific individual circumstances (pregnant woman[63] or a male student[60]). SES was not reported for majority of sources included. When reported however, patterns included higher risk of paracetamol intentional overdoses among single/unmarried, unemployed women[58], or families living in deprived areas with children accidentally overdosing paracetamol[66].

Source of paracetamol

For the different literature sources included, paracetamol was accessed through different routes: household (with packages sourced over-the-counter in outlets or pharmacies)[55, 58, 61, 66], mentioned in studies involving chronic pain or dental pain as a prescribed medicine[62, 66]. In one case study, high amount of paracetamol was purchased online, sold with its international name of acetaminophen[60].

Factors contributing to POD

Given the mixed intentionality of the studies included, we extracted a broad set of factors contributing to paracetamol overdoses. Many aligned with those outlined in the previous sections, corresponding to whether the overdose was intentional or accidental. All factors are summarised in Table 5, while this section focuses solely on those not previously reported.

Accidental and Intentional combined paracetamol overdoses specific contributing factors:

-Paracetamol availability-online sales:

In the previous sections, we highlighted how paracetamol availability represents a recurrent factor contributing to paracetamol overdoses, including household availability, general sales, and prescribed paracetamol. Within this pool of literature, we also identified an additional factor linked to availability: online sales. In the study by Hewett et al. [60], a young male student intentionally overdoses using medications purchased online. Among these, was an analgesic labelled 'Advil' containing acetaminophen (of which, according to the patient, he was not aware this was paracetamol), which the patient did not realise was paracetamol. This confusion almost led to a missed overdose diagnosis. Thus, within the intentional act of self-harm, there was also a possible element of accidental acetaminophen misuse. This study highlights the importance of awareness of international differences in medications names, as well as the ability of international sellers to supply UK customers with large quantities of paracetamol (up to one thousand 500mg acetaminophen tablets) in a single transaction at the time of the study was published.

-Palatable paracetamol formulations for children:

Sweeteners or flavours are commonly added to paediatric paracetamol formulations to improve acceptability; however, the same ingredients may also increase the likelihood of accidental ingestion among young children when these medications are not safely stored in the home and are found by children[59].

-Pregnancy and women-health: poor follow-up and communication within the healthcare system:

In the case study by Mills et al.[63], several factors contributed to paracetamol overdose in a pregnant woman and the consequent delay in recognition of the overdose. The patient had previously experienced mental health challenges, post-partum depression with self-harm attempts, drugs dependency, and pain in earlier pregnancies. However, this information was not flagged in her health notes, nor timely communicated among the healthcare professionals involved in her care. Lack of consideration of past events and poor communication within the healthcare system were therefore identified as factors linked to the overdose.

-Social and behavioural contributors:

The SALT study highlighted higher rates of acute liver failure due to paracetamol overdoses in UK and Ireland (compared to the other countries involved in this study). Although no specific individual-level factors were identified, the authors suggested that broader social, behavioural, or health-system influences may contribute to these higher rates, and that these influences may be unique to these countries[64].

Interventions suggested to reduce intentional and accidental PODs

Suggested interventions (for this category, by the author only) were also extracted (where present) and are all summarised in Table 6. As for the factors, this section focuses solely on interventions not previously reported.

Table 6: Accidental and Intentional combined PODs - Suggested interventions to reduce PODs.

-Multidisciplinary self-harm reduction interventions:

Educational interventions empowering pharmacists and other healthcare professionals, particularly at the point of discharge were suggested by Wazaify et al.[58]; The authors also recommended the creation and collaboration of multidisciplinary self-harm reduction teams operating across both community and hospital settings to ensure continuation of care after discharge.

-Regulatory and legislative measures:

Regulatory and legislative measures were similar to those proposed in previous sections. However, Hewett et al. highlighted the need to harmonise international medications names and to introduce regulatory action addressing risks associated with online medication sales[60]. Implementation of this

intervention was not reported, with the exception of partial progress through the WHO International Non-proprietary Name programme (INN)[67].

-Clinical practice improvement in women's health:

Recommendations were identified in studies focusing on vulnerable populations. Mills et al. [63] emphasise the need for clinicians to recognise psychiatric history as a marker of high-risk pregnancy(ies), and to establish multidisciplinary teams acting as a preventative safety net for women with mental health challenges and history of overdose. Such measures may help address gaps in communication and support continuity of care within the healthcare system.

-Further research addressing psychosocial, cultural, behavioural factors:

As noted by Gulmez et al. in relation to the SALT study [64], further research is required to understand why paracetamol-related acute liver failure and suicide appear more common in UK (and Ireland), compared with other countries in Europe. This research should focus on psychosocial, cultural, behavioural factors influencing paracetamol (and other medications) consumption and overdose patterns.

Discussion

Principal findings and interpretation

Deaths and harm arising from paracetamol overdose are an important issue, that has not been successfully addressed despite legislation. This systematic review synthesises evidence on factors contributing to both intentional and accidental paracetamol overdose across the United Kingdom, highlighting a complex interaction between availability, behavioural factors, health system limitations, and knowledge gaps.

Across all study types and populations, a consistent finding was the central role of availability—whether through over-the-counter purchase, prescription supply, household storage, or online access. The widespread accessibility of paracetamol appears to underpin both accidental and intentional overdose pathways, albeit through different mechanisms. For accidental overdoses, availability intersects with medication literacy, formulation complexity, and healthcare access barriers, whereas for intentional overdoses, it interacts with impulsivity, mental health vulnerability, and opportunity.

The findings suggest that paracetamol overdose should not be conceptualised solely as a toxicological issue, but rather as a systems-level public health problem, shaped by multiple interacting determinants. In accidental overdoses, particularly in children and individuals self-managing dental pain, the risk is driven by misinterpretation of dosing, insufficient patient education, and delays in accessing appropriate care. In contrast, intentional overdoses are strongly associated with psychological distress, prior self-harm, and co-ingestion with substances such as alcohol, with paracetamol selected due to its ready availability, perceived safety, and social acceptability as a method of self-harm.

Importantly, the review highlights that accidental and intentional overdoses are not distinct phenomena but exist along a continuum. Overdoses are strongly associated with confusion around drug formulations, international naming, or combined product use can occur within intentional self-harm episodes, while impulsivity in intentional overdose is often facilitated by immediate access to medications in the home. This reinforces the need for coherent prevention strategies that address both pathways simultaneously.

Implications for policy and practice

Despite the introduction of pack-size legislation in 1998, this review indicates that regulatory approaches alone have not been sufficient to address the burden of paracetamol overdose. Evidence from multiple studies suggests that current restrictions can be circumvented through multiple purchases, variable enforcement, and online procurement, limiting their overall effectiveness.

The findings support the need for a multi-level model of prevention, where regulatory measures must be complemented by interventions targeting behaviour, healthcare delivery, and public awareness. At the population level, improving labelling clarity, standardising formulations, and strengthening sale regulations may reduce unintentional harm. At the healthcare level, improving timely access to services (e.g. urgent dental care, revising dental pain times in A&E triage), medication counselling, and safe prescribing practices will improve the current situation. At the individual level, addressing mental health needs and social determinants of self-harm requires thorough implementation.

Taken together, improvement is most likely to be found through integrating upstream (policy/regulatory) and downstream (clinical/public health) interventions, rather than relying on single approaches.

Strengths and limitations of the evidence base

The evidence base identified in this review is characterised by considerable heterogeneity in study design, quality, and reporting, which limits the strength of conclusions that can be drawn. A substantial proportion of included studies were retrospective observational analyses, case reports, or conference abstracts, often with limited sample sizes and incomplete reporting of key variables such as socioeconomic status, medication source, and dosing patterns.

There were also inconsistent measurement and reporting of intentionality, making it difficult to clearly distinguish between accidental and intentional overdose in some studies. In addition, many studies focused on self-harm more broadly, with paracetamol-specific factors not always clearly disaggregated.

The overall quality of evidence, as assessed through appraisal tools, was generally low to moderate, reflecting the predominance of observational data and the absence of controlled interventional studies. Consequently, causal inferences regarding specific risk factors or interventions should be made cautiously.

Limitations of the review process

This review has several methodological limitations that should be considered when interpreting the findings. First, the inclusion of English-language studies only may have resulted in language bias, potentially excluding relevant evidence from non-English sources. Secondly, although multiple databases and grey literature sources were searched, the restriction of grey literature screening to the first pages of search results and the inclusion of social media searches may have introduced selection bias and variable quality of included evidence (although none of the social media evidence was included). Thirdly, the use of narrative synthesis, necessitated by heterogeneity in study design and outcomes, limits the ability to quantify associations or assess effect sizes. Fourthly, while independent screening and data extraction were undertaken, the complexity of categorising studies by intentionality and the diversity of reporting may have introduced subjective interpretation in data synthesis.

Finally, several potentially important variables—including socioeconomic status, ethnicity, and healthcare access—were poorly reported across studies, limiting the ability of this review to explore health inequalities in depth. Many health-related parameters follow a social gradient in which the greatest harms befall the poorest communities. A targeted prevention intervention might be aimed at improving health equity.

The search strategy was updated shortly before submission. Five additional records (three retrospective observational studies and two conference abstracts) published after original search period were included[68–72]. These records covered adolescent intentional self-poisoning[68], ambulance-attended poisoning episodes[69], poisoning in pregnancy[72], dental pain-related accidental PODs[71] and non-fatal overdoses in people experiencing homelessness (PEH)[70]. Their findings were consistent with the themes identified in the main review, including the central role of paracetamol availability, mental health vulnerability in intentional PODs, lack of health literacy and access barriers to accidental overdoses—especially among socioeconomically disadvantaged groups. Since these records did not introduce new factors or contradict existing ones, they were included into the final record count but did not require alteration of the synthesis or tables. Their inclusion, however, strengthen the value of this review, while maintaining the integrity of the original performed analysis.

Further implications for practice, policy, public health and research

Practice: The findings highlight the need for improved clinical communication and patient education, particularly around safe dosing, combination products, and risks associated with self-medication for pain. Enhanced triage and early recognition of staggered overdose, especially in patients presenting with dental pain, may improve outcomes.

Policy: There is a clear case for reviewing current regulatory frameworks governing paracetamol access in the UK. Potential approaches include strengthening enforcement of existing legislation, addressing online sales, reviewing pack sizes, and improving packaging and labelling. However, policy changes should be considered alongside broader strategies addressing mental health and social vulnerability, given the strong link between intentional overdoses and psychological distress.

Public health: Interventions aimed at community awareness, safe storage of medicines, and improved access to timely care (e.g. urgent dental services) may reduce accidental overdoses. Public health messaging must also balance raising awareness of risk without inadvertently increasing knowledge of overdose methods.

Research: Future research should prioritise high-quality, prospective studies that better characterise risk factors for paracetamol overdose, including socioeconomic and behavioural determinants. There is also a need for robust evaluation of interventions, particularly regulatory and educational strategies, to determine their effectiveness in reducing overdose incidence. Additionally, research exploring how availability interacts with impulsivity and mental health would support the development of more targeted prevention strategies.

Conclusions

This review demonstrates that paracetamol overdose in the United Kingdom is best understood as a systems-level public health problem arising from the interaction between widespread availability, individual vulnerability, and gaps within healthcare delivery. While accidental and intentional overdoses are often considered separately, the findings suggest that they exist along a continuum, with shared determinants including access to medication, limited medication literacy, and behavioural factors such as impulsivity and psychological distress.

Existing regulatory measures, including pack size restrictions, appear necessary but insufficient in isolation, particularly in the context of multiple purchasing routes and online availability. Reducing harm will therefore require coordinated, multi-level strategies that integrate policy reform, improvements in healthcare access and clinical practice, and targeted public health interventions.

However, the current evidence base is limited by heterogeneity and generally low methodological quality, highlighting the need for robust evaluation of preventive interventions and greater attention to social and behavioural determinants. Without coordinated action across policy, clinical practice, and public health, paracetamol will remain a readily available means through which preventable harm continues to occur.

Abbreviations

A&E
Accident and Emergency
ALF
Acute Liver Failure
CBT
Cognitive Behavioural Therapy
DSH
Deliberate Self-Harm
GP

General Practitioner
GRADE
Grading of Recommendations Assessment, Development and Evaluation
HP
Healthcare Professional
INN
International Non-proprietary Name programme
JBI
Joanna Briggs Institute Tool
MeSH
Medical Subject Heading
MHRA
Medicines and Healthcare products Regulatory Agency
MMAT
Mixed Methods Appraisal Tool
NA/APAP
N-acetyl-para-aminophenol
NHS
National Health Service
NPIS
National Poison Information Service
NSAID
Non-Steroidal Anti-Inflammatory Drugs
OTC
Over-the-counter
PEH
People Experiencing Homelessness
PEO
Population, Exposure, Outcomes
POD
Paracetamol Overdose
POM
Prescription-Only-Medicine
PRISMA
Preferred Reporting Items for Systematic Reviews and Meta-Analyses
SALT
Study of Acute Liver Transplant
SES
Socioeconomic Status
SSRN
Social Science Research Network

Declarations

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Authors' contributions

GDP contributed to the conception and design of the study, participated in all aspects of the review and wrote the original version of the manuscript.

AR contributed to the conception and design of the study, study selection, part of original version and final revision of the manuscript. Supervision of the study.

HC contributed to the conception and design of the study, study selection, part of original version and final revision of the manuscript.

NA contributed to the conception and design of the study and study selection.

MC contributed to the study selection.

Data availability

All available data is contained within this paper and supplementary files.

Ethics approval and consent to participate

Ethics approval was not required for this work since no new data was collected.

Consent for publication

Not applicable.

Competing interests

All authors declare that they have no competing interests.

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Tables

Tables are available in the Supplementary Files section.

Figures

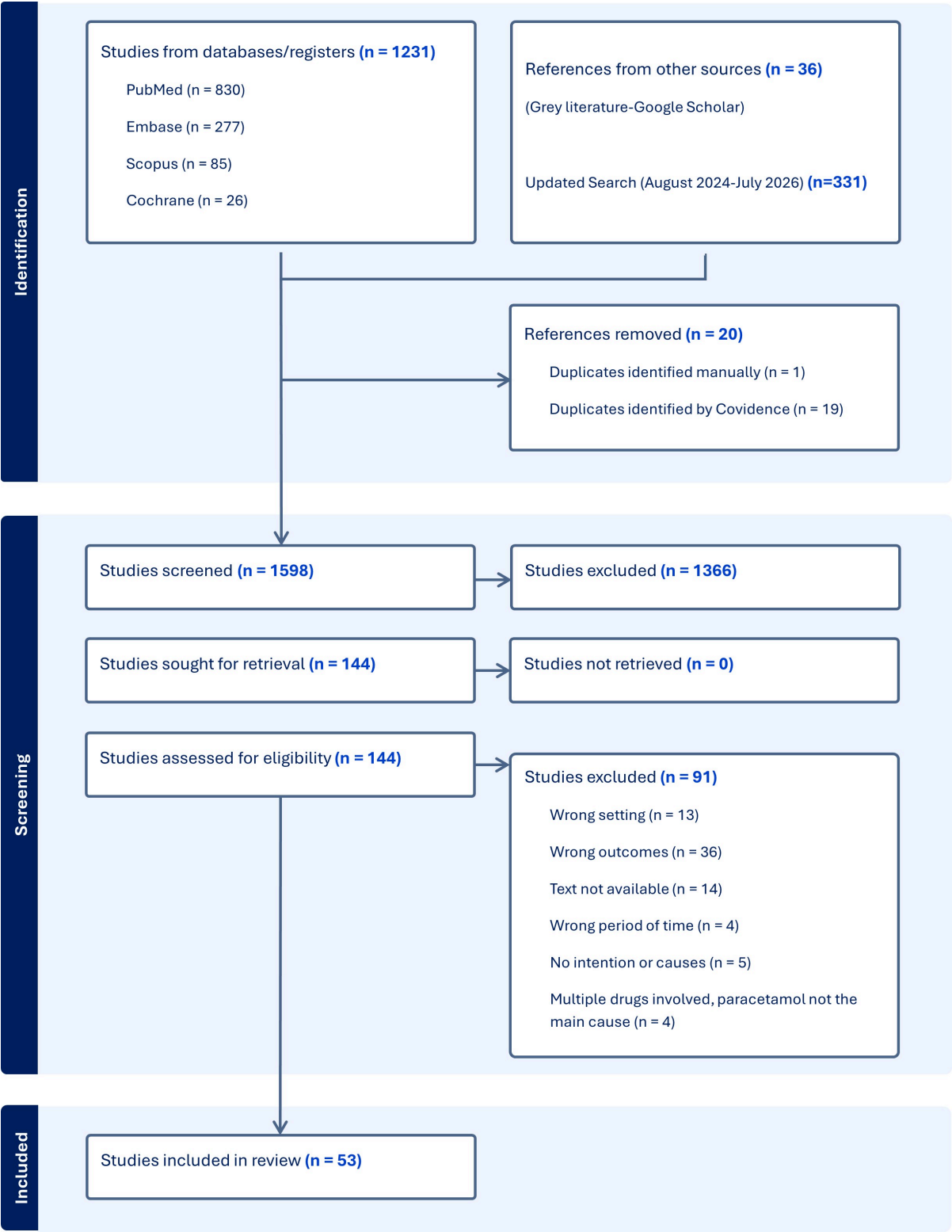


Figure 1

Prisma flow diagram



Figure 2

Classification of articles included in the systematic review.

Records were grouped by overdose intentionality (accidental, intentional, or mixed) and mapped by age category and publication period (from 1998 to 2024). Although 48 studies were included in the review, 49 entries appear in this figure because the Gunnell et al. (2013) research programme comprised multiple related publications, two of which met the inclusion criteria (STUDY 1 and STUDY 2) and are herein represented separately.

Supplementary Files

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- [SupplementalFile3DataExtractionFormParacetamolSystematicReview.pdf](#)
- [SupplementalFile2QualityAppraisalSummarySystRev.docx](#)
- [SupplementalFile1ParacetamolOverdosesSystematicReviewSearchStrategy.pdf](#)