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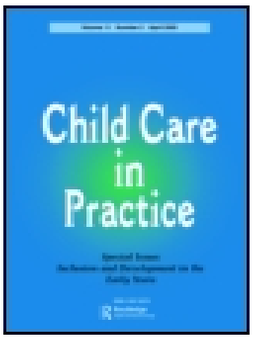

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REVIEW

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Health Education, its Methods and Effects on Parents' Knowledge, Attitudes, and Behaviours to Prevent Unintentional Child Injuries at Home: A Systematic Review

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ABSTRACT

Thousands of young children die or sustain life changing disabilities every year because of unintentional child injury (UCI) at home. Many injuries could be prevented if parents and caregivers were more aware of risks and accident-avoidance strategies. The aim of this review was two-fold. First, we explored whether health education modified parent or caregiver knowledge, attitudes, or behaviour related to injury awareness and prevention. Our secondary aim was to describe strategies used when delivering health education. Intervention studies using quantitative methods published after 2010 were included. The participants were caregivers or parents of children younger than six years of age. A systematic search of multiple databases yielded twelve studies. The risk of bias (ROB) was assessed using the Cochrane ROBINS-I for non-randomised and ROB-2 for randomised studies. Data synthesis was performed following the steps described in the SWiM guideline. We followed PRISMA guidelines to report the process and results. Interventions were usually one-off, multifaceted, and interactive using printed materials, discussion, didactic teaching, video, and games. Improvement of knowledge ranged from 12.5% to 85%. Attitude improvement was noted in five studies and ranged from 6.6% to 28%. Self-reported behavioural change was noted in six studies. Follow up duration varied from less than one month to six months. The observed changes have not been linked to the numbers or severity of UCI. Health education is beneficial, but the true long-term impact has yet to be fully explored. Studies that provided the greatest improvements used theories of behaviour change and interventions that were designed for the specific needs of the target population. Our review provides health care professionals with evidence of the potential benefits of health education in enhancing parents' awareness regarding preventing UCI and information about how to deliver health education, that can guide the review of prevention practices of UCI.

KEYWORDS

Child accidents; child safety; health education; health promotion; home; prevention; unintentional child injury

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Introduction

Unintentional child injury (UCI) in children under five years of age is considered one of the most disturbing public health issues globally (Peden et al., 2009). It causes the death of thousands of children daily (Hyder & David, 2012; Sleet, 2018) and the hospitalisation of millions (Adeloye et al., 2018; Hogan et al., 2018). The time and resources needed for rehabilitation (Polinder et al., 2010) and management of psychological consequences (De Young et al., 2014; van Meijel et al., 2020) place a social and economic burden on the family (Dalal & Svanström, 2015).

The financial consequences impact health systems. The United States of America (USA) has a population of more than 23 million under-fives. It costs more than 15 billion US Dollars per year to manage the consequences of 1.6 million injuries in children between 0–4 years (CDC, 2020). The United Kingdom (UK) has a population of 3.7 million children under 5 years with 100,000 annual admissions due to UCI costing £150 million per year (Patel et al., 2017). A rapidly developing country such as Oman, a country in the Middle East with a population of 382,000 children under 5 years, has observed a significant number of UCI, reporting 86 deaths and 2614 hospital admissions in 2018 (Mehmood et al., 2018; MOH, 2018).

Nearly three-quarters of UCI occur at or close to home (Hashemi et al., 2017; Mehmood et al., 2018; Wynn et al., 2016). Socio-economic, environmental, and behavioural factors influence the rate of UCI at home (Baron-Epel & Ivancovsky, 2015). Good child supervision and maintenance of a safe environment reduce the risk of UCI (Falcone et al., 2016; Kendrick et al., 2016; Schnitzer et al., 2015; Watson & Errington, 2016). Caregiver knowledge, attitudes, beliefs, and behaviours influence their approach to UCI prevention (Al-Hajj et al., 2020; İnce et al., 2017; Younesian et al., 2016) increasing the complexity and challenge of promoting adherence to preventive practices (İnce et al., 2017; Lafta et al., 2014; Sutchritpongsa et al., 2013).

Health professionals have a considerable role in educating and raising caregiver awareness of child safety (Hanna et al., 2022) through health education; a health promotion approach using different strategies and models to enhance knowledge and attitudes (Glanz et al., 2008). Health education can take place in the community, primary care centre, or home (Habermehl et al., 2019; Silva et al., 2016) and may involve individual, group, or online training. High-income countries such as the UK and US have well-developed programmes with demonstrable impact on rates of injury (Duffee et al., 2017; Kendrick et al., 2013; Patel et al., 2017). However, in rapidly developing countries like Oman (Al Rumhi et al., 2020) and other neighbouring countries (Alkhamis & Abdulkader, 2020), where there is no established parenting programme or home visit, an alternative context-related programme, needs to be considered. Countries that look forward to establishing or developing the UCI prevention programme need evidence to guide their decision on approaches. Pooled knowledge concerning its effectiveness and ability to influence caregiver knowledge, behaviour and attitudes is lacking. Health practitioners who want to start health education programmes need to be able to evaluate the different approaches so that they can choose the suitable method for their population.

Aim

The purpose of our review was to identify the effect of health education on parental knowledge, attitudes, and behaviour towards UCI prevention. We identify the

methods used to undertake and evaluate health education, including settings, length of the intervention, tools, and assessments to provide evidence toward developing educational guidelines for child safety and injury prevention by healthcare practitioners.

Methods

Review process and design

The review is reported according to PRISMA guidelines (Page et al., 2021), and conducted according to Cochrane Handbook for Systematic Reviews of Interventions (Higgins et al., 2008). The protocol was registered in the International Prospective Register of Systematic Reviews (PROSPERO 2020 CRD42020200183).

Information source

A preliminary search was undertaken to identify keywords through indexed terms, text words and controlled vocabularies in each database. A systematic search was undertaken in September 2020 and updated in June 2022 using CINAHL Plus, MEDLINE, Cochrane Library, PsycINFO, ProQuest Central, ERIC, SCOPUS and Embase. In addition, the reference lists of each eligible paper were hand-searched for relevant research reports. Search operators were used to broaden the search, including truncation, stemming, wildcards, exact phrase searching, and word adjacency proximity strategies. Keywords were combined or excluded for advanced search using "Boolean operators" such as "and", "or", and "not". An example search was undertaken in Medline (Ovid) and is presented in Table 1.

Eligible studies for inclusion were defined as any interventional primary research study conducted after 2010 and published in English or Arabic. The eligibility concerning population was limited to parents or caregivers of children under the age of six years. Studies conducted on disabled children and children of parents with mental illnesses were excluded from the review to provide a homogenous population for the synthesis.

Assessment of risk of bias

Each study was assessed independently by MJ and BD for risk of bias using ROBINS-I for non-randomised studies of interventions (Sterne et al., 2016) and RoB2 for randomised trials (Sterne et al., 2019). The results were collated, and discussion was used to achieve consensus. Additional reviewers were available to mediate should consensus not be readily achieved but this was not needed.

Data extraction

Data extraction was carried out using a tool adapted by the reviewers from "Cochrane data collection tool" (Li et al., 2019). It included two parts: first, for the study information necessary to determine the study's eligibility for final analysis. Second, to collect details about publication, researchers, study purposes, design, participants, settings, context, interventions, outcome measures, outcomes, and results. Our review focused specifically

Table 1. Example search using Medline.

Medline (OVID) Search terms
1. unintentional, child, injury/
2. unintentional, child, accidents/
3. unintentional, child, home injury/
4. "unintentional child injury"
5. "child home accidents"
6. "child home injury"
7. (unintentional adj3 child injur*).ab,ti.
8. (unintentional adj4 child injur*).ab,ti.
9. (unintentional adj5 child injur*).ab,ti.
10. (child adj3 accident*).ab,ti.
11. (child adj4 accident*).ab,ti.
12. (child adj5 accident*).ab,ti.
13. injury or unintentional injury or domestic injury or home injury or home accident or trauma or preventable injury.
14. injur* or unintentional injur* or domestic injur* or home injury* or home accident* or trauma or preventable injur*
15. children or pediatric or child or childhood
16. child* or p?diatric
17. "health education"
18. (heath adj3 education).ab,ti
19. (health adj4 education).ab,ti.
20. health education or heath awareness or health teaching or child safety education
21. 1or 2 or 3 &15 & 19.
22. 5 or 6 & 17
23. 17 &18
24. 13&16&19

on changes in the caregivers' knowledge, attitudes, behaviour relating to UCI prevention and health education approaches. An Excel spreadsheet (Microsoft Corporation, 2021) was used to record and organise the extracted data.

Data synthesis

There was heterogeneity in the outcome measures used in the studies that prevented meta-analysis. Therefore, descriptive analysis and synthesis were undertaken and reported following the Synthesis Without Meta-analysis (SWiM) reporting guidelines (Campbell et al., 2020). This guidance has been developed to provide a robust reporting method for synthesis when meta-analysis is not possible and can be used as an extension to PRISMA. There are nine reporting items included in this method that ensure that authors provide a rationale for grouping the studies, selection of a standardised metric across the studies and how transformation were conducted, description of the synthesis methods used, prioritisation of studies in creating results and drawing conclusions, methods used to explore heterogeneity, assessment of the certainty of the findings, description of data presentation methods, reporting or results and limitations.

In our review grouping allowed comparison of the method of health education delivery, the use of health psychology models, and knowledge, attitudes, and behaviour outcomes according to the authors definitions. Mean and standard deviation were extracted as provided when possible. In one case the overall mean and standard deviation for knowledge, attitudes and behaviours were created from the individual items reported in the results (Ihalahewage et al., 2018) using an online statistics tool. We also calculated the percentage change in knowledge, attitude, and behaviours using the formula (post-measure – pre-

measure/pre-measure)*100. The results for knowledge, attitude and behaviours were tabulated for each study and then presented as a descriptive summary and identification of notable examples such as greatest and least change. These results are considered in terms of the approach to development of the intervention, the method of delivery of the intervention and the context including cultural factors.

Risk of bias

The risk of bias was moderate to severe in most studies (Table 2). The most significant issue was participant selection. Two RCTs were included, one of which had no description of the randomisation process (Cheraghi et al., 2014) and the other used cluster randomisation with the unit being pre-schools (Ning et al., 2019). Participants were recruited using convenience methods and often from a health centre in all other studies.

Most studies relied on parents' self-reports to assess knowledge, attitudes and behaviour changes, potentially biasing outcome quality and overestimating the interventions' effect. Additionally, most reports made no discussion of engagement with educational materials following the introductory session, meaning that the dose of education and compliance was not identified.

Many studies evaluated the impact of the intervention using a self-designed questionnaire that was piloted and provided validity and reliability data (Afshari et al., 2017; Cheraghi et al., 2014; El Seifi et al., 2018; Fardazar et al., 2016). In some cases, a validated questionnaire was used (Kahriman & Karadeniz, 2018; Ning et al., 2019; Silva et al., 2016). However, some studies used self-designed questionnaires and did not report validity of reliability data (Amini et al., 2021; Furman et al., 2020; Habermehl et al., 2019; Ihalahewage et al., 2018; Setien et al., 2014). A lack of psychometric data introduces a high risk of bias (Paterson & Britten, 2005; Scott, 1997).

Some studies used psychological health theories in the design of questionnaires and interventions. This provides a transparency and theoretical basis for decision-making relating to data collection and reporting of results that can reduce bias in interpretation and help to avoid other forms of bias such as those resulting from social pressure leading to reporting bias (van der Steen et al., 2019).

Duration of follow-up ranged from immediately after the intervention (Silva et al., 2016) to six months (Ning et al., 2019). Loss to follow up ranged from zero (Afshari et al., 2017; Cheraghi et al., 2014; Ihalahewage et al., 2018; Setien et al., 2014) to 40% (Furman et al., 2020; Ning et al., 2019), but some studies did not provide data about this and it was not possible to infer the loss to follow up from the data presented in the report (Amini et al., 2021; El Seifi et al., 2018; Fardazar et al., 2016; Kahriman & Karadeniz, 2018).

Results

Four hundred and fifty-four research papers were retrieved (Figure 1) and exported to reference management software (Endnote™ 20, Clarivate), where 77 duplicates removed. A further 377 papers were exported for inclusion-exclusion screenings to the Rayyan online systematic review platform (Ouzzani et al., 2016). Two reviewers (MJ/BD) independently screened the papers by title and abstract, which resulted in

Table 2. Risk of Bias (ROB) summary.

ROB 2 for RCT	Bias arising from the randomisation process	Bias due to deviations from intended interventions	–	–	Bias due to missing outcome data	Bias in measurement of the outcome	Bias in selection of the reported result	Overall ROB
Cheraghi et al. (2014)	Moderate	High			Low	Some concern	High	High
Ning et al., 2019	Some concern	Low			Low	Low	Some concern	Some concern
ROBINS-I for Non-RCT	Bias due to confounding	Bias in selection of participants into the study	Bias in classification of interventions	Bias due to deviations from intended interventions	Bias due to missing data	Bias in measurement of outcomes	Bias in selection of the reported result	
Ihalahewage et al. (2018)	Low	Moderate	Low	Low	Low	Low	Low	Moderate
Afshari et al. (2017)	Low	Moderate	Low	Low	Moderate	Low	Moderate	Moderate
El Seifi et al. (2018)	Low	Moderate	Low	Low	Moderate	Low	Moderate	Moderate
Furman et al. (2020)	Low	Moderate	Low	Low	Low	Low	Low	Moderate
Setien et al. (2014)	Low	Moderate	Low	Low	Low	Low	Low	Moderate
Habermehl et al. (2019)	Low	Moderate	Low	Low	Low	Low	Low	Moderate
Silva et al. (2016)	Low	Moderate	Low	Low	Low	Low	Low	Moderate
Kahriman and Karadeniz (2018)	Low	Moderate	Low	Low	Low	Low	Low	Moderate
Fardazar et al. (2016)	Low	Moderate	Low	Low	Low	Low	Low	Moderate
Amini et al. (2021)	Low	Moderate	Low	Low	Low	Low	Low	Moderate

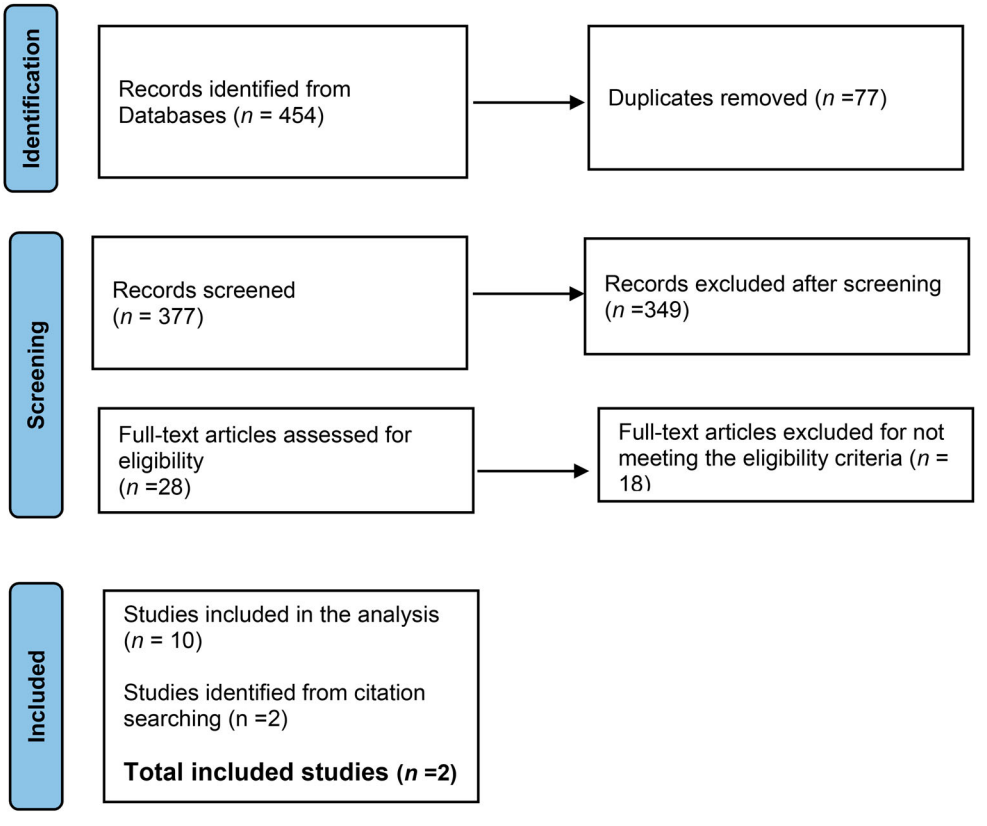

Figure 1. PRISMA flow chart of the search process.

identification of 28 papers. Full-text screening led to a final total of ten articles. Scrutiny of reference lists identified a further two papers.

All were published in English between 2010 and 2020 and were conducted in Iran (n = 4), the United States of America (n = 3), Turkey (n = 1), Egypt (n = 1), Sri Lanka (n = 1), Brazil (n = 1), and China (n = 1) (Table 3). There was a mix of urban and rural settings, and most studies focused on low-income families and education interventions delivered in the community (El Seifi et al., 2018; Furman et al., 2020; Ihalahewage et al., 2018; Kahriman & Karadeniz, 2018).

The interventions were delivered to families, caregivers or parents. In several studies, the gender of the caregiver(s) or parent(s) were not provided (Furman et al., 2020; Habermehl et al., 2019; Ihalahewage et al., 2018; Ning et al., 2019; Setien et al., 2014). However, most studies only recruited mothers (Afshari et al., 2017; Amini et al., 2021; Cheraghi et al., 2014; El Seifi et al., 2018; Fardazar et al., 2016; Kahriman & Karadeniz, 2018; Silva et al., 2016).

The time spent on education varied between ten minutes (Habermehl et al., 2019) to four hours (Afshari et al., 2017; Amini et al., 2021; Cheraghi et al., 2014). The delivery method was not well described in any of the studies (Table 4) but usually included some form of information delivery and a discussion or question and answer session. Most studies provided the participants with materials to take home in the form of written pamphlets. Two studies also provided the participants with child safety equipment such as socket protectors and cabinet clips (Furman et al., 2020; Habermehl et al., 2019).

Table 3. Summary of included studies.

Author, year & Country	Design + population	Sample and setting	Outcome measure(s)	Study duration/ Follow up (Drop out from follow up %)	Findings summary
Afshari et al. (2017) Twiserkan, Iran	*Design*: Pre- and post-intervention study	Mothers of under 5 children: Intervention group $n = 36$ Control group $n = 36$ *Settings*: Health House[1] Rural	*Tool*: Pre-post-test three parts questionnaire: Part 1: sociodemographic factors Part 2: Injury history Part 3 (based on PRECEDE) Knowledge: 14 MCQ Attitudes: 15 Likert scale range from (very much agree to – not at all agree) Behaviour: 30 Q (YES-NO). *Validation*. Validity: Pilot study on 30 mothers *Reliability*: alpha coefficient used to measure reliability	2 months (0%)	Effective in improving mothers' awareness of injury prevention
Amini et al. (2021) Hamadan, Iran	*Design:* Pre- and post-intervention study	Mothers with toddlers. Intervention $n = 58$ Control $n = 58$ *Setting:* Comprehensive health centres[2] Urban	*Tools:* *Awareness* assessed using 23 items- 2-point score (correct – incorrect answer) *Behaviour:* *Perceived behaviour*: assessed using 10 items- 4-point scale ranging from 1 (little control) to 4 (complete control). *Behaviour intention*: 9 items- 4 points scale ranging from 1 (strongly disagree) to 4 (strongly agree) *Attitude*: measured using 16 items 4-point scale ranging from 1 (strongly disagree) to 4 (strongly agree).	2 months (No data given)	Training using TPB is effective in making changes on mother behaviour towards prevention of UCI.
Cheraghi et al. (2014) Hamadan City, West Iran	*Design*: Randomised controlled trial	Mothers of children <5years. Intervention $n = 60$ Control $n = 60$ *Settings:* Local Health Centre[2] Urban	*Tool:* three parts questionnaires: Part 1: sociodemographic Part 2: mother knowledge (15) MCQ + 20 Yes/ No question + 23 Q based on Health Belief Model designed using six points Likert scale (agree to disagree) *Validation:* Validity assessed by experts Reliability measured using Cronbach's alpha coefficients of 0.84	Two months (0%)	Education health programme based on HBM can be used to promote safety in children aged <5 years

El Seifi et al. (2018) Zagazig district-Egypt	*Design*: Pre-post-test design	Mothers with at least one child <5 years *n* = 244 *Settings:* Home visit Rural	*Measurement:* Pre- and post-test self-administered questionnaire adopted from questionnaire used in previous studies. Part 1: sociodemographic characteristics Part 2: Knowledge measured with 25 Y/N/Don't know questions Attitudes: an elven 3 points Likert scale questions (agree-neutral- disagree). Validation: Validity: Pilot study done on 24 participants Reliability: Questionnaire reliability was measured in previous studies with a Cronbach's α coefficient equal to 0.82 & 0.85 for knowledge and attitude respectively.	Two months (no data given)	Health education improves knowledge and attitudes of home injury
Fardazar et al. (2016) Joibar city, Iran	*Design:* Controlled interventional study.	Mothers of children <5 years. Control *n* = 95 Interventional *n* = 95 Settings: Two Health centres[2] Urban	*Tool:* A questionnaire designed by the researcher. Knowledge: 23 questions based on Motivation Protection Theory. Behaviour: 15 questions. *Validation:* Validity checked using content analysis method. *Reliability* checked using Cronbach's alpha	Two months (no data given)	Health education guided by Motivation Protection Theory can improve injury prevention behaviours among mothers.
Furman et al. (2020) Pittsburgh, USA	Design: interventional study	Parents or guardians aged over 18 of children <18 years. *n* = 50 Setting: community events open to the public. Low-income neighbourhoods. Urban	• Tool: Questionnaire modified from an assessment tool used to evaluate home safety knowledge at a hospital at the university of Pittsburgh, USA. It included: 12 Q demographics • 5 Q: MCQ home safety knowledge • 17 Q: home safety behaviour	1: 4 weeks (42%) 2: 6 months (40%)	Education programme through Mobile Safety Centre improves mother knowledge and behaviour.
Habermehl et al. (2019) Cleveland, Ohio, USA	*Design:* Interventional study	Caregivers of children aged 1–4 years. *n* = 200 *Setting*: waiting area in paediatric primary care	*Tool: Survey administered post intervention* 1st part immediately after intervention: demographic data, session satisfaction, new knowledge. (Other information not they	Two weeks (16%)	93% of participants made safety changes at home

(*Continued*)

Table 3. Continued.

Author, year & Country	Design + population	Sample and setting	Outcome measure(s)	Study duration/ Follow up (Drop out from follow up %)	Findings summary
		clinic Urban	would like to learn). 2nd part: to evaluate changes made at home		
Ihalahewage et al. (2018) Sri Lanka	*Design*: quasi experimental *Population*: 71 families. *Intervention group:* 36 families	Families with children <5 years. Control $n = 36$ Intervention $n = 36$ Setting: home visits Rural	*Tool:* Pre -post-test questionnaire Knowledge: questionnaire. Injury incidence: a history record index Household practice: a 30 Q Likert scale checklist (very attentive – not attentive at all)	Three months (0%)	1/3rd of caregivers reported and improve of UCI prevention knowledge, practice, and attitudes
Kahriman and Karadeniz (2018) Turkey	*Design:* A quasi-experimental single group	Mothers of children <6 years. $n = 300$ Setting: primary health centre Urban	Measurement Tools: Tool 1: 33 items questionnaire for sociodemographic factors Tool 2 attitudes: 40 items 5 points Likert scale - "The 0–6-year-old Children's Mothers' Identification Scale of Safety Precautions for the Prevention of Paediatric Injuries" (Cinar 1999). Cronbach's alpha 0.78. Tool 3 a checklist- The Risk Assessment Form for Paediatric Injuries (no author details, possibly Cinar).	One month (No data given)	Training was effective to raise mother's awareness of child safety at home.
Ning et al. (2019) Changsha, China	*Design:* RCT	Primary caregivers of children aged 3–6 years. Control $n = 1285$ Intervention $n = 1406$ Setting: Home Urban	Scales Adapted from the Injury Behaviour Checklist (IBC) (Morrongiello and House 2004). Worry Assessment and Risk Estimation (WARE) (Will et al. 2009). *Validation.* Test-retest reliability Attitudes: rs=0.69, behaviours: rs=0.64,	Three months (Intervention 23% Control 24%) Six months (Intervention 31%, Control 39%)	Health education using phone app significantly improved caregiver's safety behaviours. The intervention had no significant change in attitudes.
Setien et al. (2014) Hidalgo County, Texas, USA	*Design:* Pre-post-test intervention.	Hispanic family with child aged 1-14years. $n = 88$ households Setting: Community centres. Urban.	Tool: Self-administered True/False questionnaire post-test: 10 questions	Two months (0%)	Changes in safety behaviours reported

Silva et al. (2016) Imperatriz, State of Maranhão, Brazil	*Design:* quasi-experimental intervention study- pre and post-test- no comparison group	Mothers of children <5 years. $n = 155$ Setting: Primary Care Centre[2] Urban	1. *Tools*: self-administered pre- post-test questionnaire MCQ for sociodemographic 2. Knowledge and attitudes: Pre-post- "Mortality Reduction by Accidents and Violence" (Brazilian Ministry of Health 2001) *Validation:* Pilot Study	Immediate (0%)	Significant changes in participants knowledge

[a]A health house is a local centre shared by a small number of villages in rural Iran focused mainly on health promotion and illness prevention. These are the first point of contact with the Iranian health service for most people.
[b]Comprehensive health centres and/or local health centres affiliated with a university are primary care settings that manage greater complexity than a health house.

Table 4. Summary of Education Intervention

Study ID	Duration (group size)	Framework used in design or delivery of education	Delivery methods	Aim of intervention when discernible	Content if discernible
Afshari et al. (2017)	4 h	PRECEDE (Green and Kreuter, 2005)	Lecture Group Discussion Q&A Instructional booklet	To motivate and modify inappropriate performance.	Factors associated with injury in the home identified from Rezapur-Shahkolai et al. (2017)
Amini et al. (2021)	4 h (10–15)	Theory of Planned Behaviour (Ajzen 1991)	Lectures, Group discussion Q&A Instructional booklet		Developmental stages of toddlers, common injuries, preventative strategies, ability to control risk factors.
Cheraghi et al. (2014)	4 h	Health Belief Model (Rosenstock et al., 1988)	Lecture Group Discussion	To present factors affecting mothers' practices and knowledge. To address perceived severity, perceived barriers, cues to action and self-efficacy regarding child safety.	Safety promotion and injury prevention informed by the scientific literature.
El Seifi et al. (2018)	45 min (8–10)	–	Lecture Group discussion Q&A Videos Instructional booklet	Increasing knowledge and self-efficacy.	Scientific message based on Centres for Disease Control and Prevention child safety and injury prevention guidance (Centres for Disease Control and Prevention 2019). Risk factors for injuries and methods of prevention.
Fardazar et al. (2016)	90 min (15)	Protection Motivation Theory (Rogers and Prentice-Dunn, 1997)	Lecture Q&A Video	Increase perceived vulnerability and severity in children under 5 years. Increase self-efficacy and behaviours in injury prevention.	Child development and injury risks, prevention strategies.
Furman et al. (2020)	20 min (Small groups or one-to-one)	Standardised curriculum developed by the Safety Centre at UPMC Children's Hospital, Pittsburgh, US.	No detail of teaching method. Provision of safety equipment (smoke detector, outlet covers, doorknob covers, cabinet latches, gun lock).	Increased used of safety equipment including that provided as part of the programme	

(*Continued*)

Table 4. Continued.

Study ID	Duration (group size)	Framework used in design or delivery of education	Delivery methods	Aim of intervention when discernible	Content if discernible
Habermehl et al. (2019)	10 min(One to one)	American Academy of Pediatrics recommendations.	No detail of teaching method but it involved a learned script. Provision of safety toolkit (handouts, poison control magnet, window locks, outlet covers)	Provision of age-specific injury prevention information	Car safety, fall safety, home safety, injury prevention, poison control.
Ihalahewage et al. (2018)	Two occasions, no duration given. (18)	Health Belief Model (Rosenstock et al., 1988)	Discussion stimulated by use of visual aids. Collation of knowledge	Improved understanding of the determinants of poor safety.	Risks in the home, role of family support, attitudes and beliefs relating to injuries.
Kahriman and Karadeniz (2018)	One occasion, no duration given. (One to one)	–	Discussion stimulated by use of visual aids.	Raising awareness and knowledge of prevention of injury	Dangerous situations and how to prevent them.
Ning et al. (2019)	No duration given. (One)	Theory of Planned Behaviour (Ajzen 1991) Haddon Matrix (Barnett et al., 2005) Framework for Rational Analysis of Mobile Education (FRAME) (Yin et al., 2013)	Information delivery (text, cartoons, video). Interactive games.	Effectiveness of using an app-based mobile phone intervention to prevent unintentional injury.	Parenting skills, unintentional injury prevention, paediatric disease risk.
Setien et al. (2014)	2 h.	Raising Safe Kids: One stage at a Time (Safe Kids USA 2009)	No detail	Improvement of knowledge and behaviour in parents.	Burns, falls, household fires, choking, suffocation, drowning, falls, vehicular accidents, poisoning, hazardous household products, firearms, sports.
Silva et al. (2016)	30 min	–	Information giving. Discussion with use of visual aids.	Understanding mothers' knowledge about prevention of accidents.	Prevention of burns, poisoning, drowning and falls.

Change in knowledge, attitudes, and behaviours in response to health education.

Pre- and post-measurement of knowledge, attitudes, and behaviours (Table 5) were conducted using structured questionnaires with some also using a checklist.

Changes in knowledge

Eight studies reported a statistically significant increase in caregivers' knowledge relating to child safety and injury prevention in the intervention group but not the control group (Afshari et al., 2017; Amini et al., 2021; Cheraghi et al., 2014; El Seifi et al., 2018; Furman et al., 2020; Setien et al., 2014; Silva et al., 2016) (Table 5). The greatest change in knowledge was a 110% improvement (Ihalahewage et al., 2018) who used the framework of the Health Beliefs Model (Rosenstock et al., 1988) to design their intervention as well as using a co-production approach with caregivers. The intervention took the form of a practitioner-facilitated discussion group where caregivers identified poor safety practices and ways to reduce injury. The least change in knowledge was 4% (Setien et al., 2014) where the researchers designed the intervention alone based on risks associated with each developmental stage of the child. The intervention was a two-hour training session delivered by trained members of the Latino community (promotoras).

This is a small number of studies and so it is difficult to tell whether the use of a theoretical framework makes a difference to the outcomes. Two studies used the Health Beliefs Model and produced a 56% improvement in knowledge (Cheraghi et al., 2014) and a 110% improvement in knowledge (Ihalahewage et al., 2018). One study used the Theory of Planned Behaviour and identified a nine percent improvement in knowledge (Amini et al., 2021).

Changes in attitudes

When attitude was measured, an improvement was demonstrated. A statistically significant improvement was identified in six studies (Afshari et al., 2017; Amini et al., 2021; El Seifi et al., 2018; Ihalahewage et al., 2018; Ning et al., 2019; Setien et al., 2014) (Table 5). Ihalahewage et al. (2018) created the greatest improvement with their small group discussion process. El Seifi et al. (2018), also demonstrated a large improvement in attitudes, with a mean difference of 98%. Their intervention was a 45-minute lecture and discussion with a booklet to take home for groups of 8–10 women who lived with or near each other in a rural village setting. The intervention was based on 2016 guidelines from the Centers for Disease Control and Prevention (CDC, 2019) and no theoretical framework was described.

Generally, the change in attitudes was smaller than the changes in knowledge. Four of seven studies providing attitude change scores described improvements less than 15% (Afshari et al., 2017; Kahriman & Karadeniz, 2018; Ning et al., 2019; Setien et al., 2014). There was no consistent difference in approach between that group and those who saw a change of more than 30%.

Changes in behavior

Safety practice behaviour was reported in seven studies (Afshari et al., 2017; Fardazar et al., 2016; Ihalahewage et al., 2018; Kahriman & Karadeniz, 2018; Ning et al., 2019; Setien et al., 2014) (Table 5). Safety modifications made at home in response to the knowledge gained were confirmed through home visits (Ihalahewage et al., 2018; Kahriman & Karadeniz, 2018), phone follow up (Furman et al., 2020; Habermehl et al., 2019;

Table 5. Change in parent/caregiver knowledge, attitudes and behaviours associated with health education intervention.

		KNOWLEDGE					ATTITUDE					BEHAVIOR				
	Intervention (I) Control (C)	Pre-Mean (SD)	Post Mean (SD)	% change	Within group *p*	Between group *p*	Pre Mean (SD)	Post Mean (SD)	% change	Within group *p*	Between group *p*	Pre Mean (SD)	Post Mean (SD)	% change	Within group *p*	Between group *p*
Afshari et al. (2017)	I	10.00 (2.44)	12.67 (0.99)	26	<0.001	<0.001	67.06 (5.77)	72.31 (3.12)	8	<0.001	<0.001	22.31(4.30)	29.17 (0.775)	30.7	<0.001	<0.001
	C	9.47 (3.26)	9.75 (1.67)	3	0.439		61.75 (6.35)	65.42 (5.3)	6	0.040		23.81 (5.35)	22.81 (4.452)	0	0.194	
Amini et al. (2021)	I	18.4 (1.5)	20.2 (2.27)	9	<0.001	0.004	17.86 (3.62)	23.2 (6.82)	30	<0.001						
	C	18.84 (1.73)	18.86 (1.85)	0	0.058		19.33 (5.86)	18.7 (5.68)	0	0.089						
Cheraghi et al. (2014)	I	8.43 (3.77)	13.15 (1.09)	56	0.001	0.001										
	C	7.17 (2.26)	7.90 (2.27)	10	0.028											
El Seifi et al., 2018							4.05 (1.1)	8.05 (1.5)	99	<0.001						
Fardazar et al. (2016)	I											7.89 (2.36)	12.91 (2.11)	63.6	0.001	
	C											8 (2.46)	8.07 (2.38)	0.87	0.3	
Furman et al. (2020)		3.9 (0.6)	4.4 (0.5)	13	0.01											
Ihalahewage et al. (2018)[3]	I	15 (46.16)	31.57 (87.35)	110			13.66 (43.42)	31.83 (87.96)	133			36.25 (5.7)	43.72 (6.3)	20.6	<0.001	
	C	18.57 (58.66)	19.85 (63.20)	7			18 (53.49)	20 (62.05)	11			39.94 (4.98)	41.69 (5.12)	4.3%	<0.001	
Kahriman and Karadeniz (2018)							165.81 (16.36)	176.76 (12.97)	7	<0.001		14.6 (9.8)	8.0 (2.0)	-	0.362	
Ning et al. (2019)	I						6.6	6.8	3			47	48.9	4.04		
	C						6.6	6.7	2			47.2	48	1.6		
Setien et al. (2014)		12.4 (0.85)	12.9 (0.63)	4	< 0.001							83%	96%	13		
Silva et al. (2016)		78.16%	90.7%	13	≤ 0.05											

[a]Blank cells denote that a technique was not directly mentioned or implied. A series of blank cells indicates that no methods of delivery were given.
[b][(post- pre)/pre] *100 (rounded to nearest integer).
[c]Reasons for injury occurrence combined means and standard deviations using online software (http://www.obg.cuhk.edu.hk/ResearchSupport/StatTools/CombineMeansSDs_Pgm.php).

Setien et al., 2014) or self-administered questionnaire (Ning et al., 2019). In the Habermehl et al. (2019) study, 60% of the participants' used the products provided by the researchers, and 40% of them bought new child safety items. Similarly, in the study of Furman et al. (2020), a free safety device was distributed to study participants, and they responded positively and installed the devices at their homes.

The greatest improvement in behaviour was seen in Fardazar et al. (2016) who used the Protection Motivation Theory (Rogers & Prentice-Dunn, 1997) as their framework. Their intervention was delivered in two 45-minute sessions spaced one week apart with five mothers in each group session. In the first session perceived vulnerability and perceived severity of accidents in children aged younger than five years was the focus. The second session focused on self-efficacy, response-efficacy and prevention behaviours of the mothers.

Discussion

This review aimed to identify health education interventions and their effects on caregivers' knowledge, attitudes, and behaviours of preventing unintentional child injury (UCI) in and around the house. Twelve interventional studies were identified, analysed and synthesised. This review shows that a range of approaches to health education positively affect caregivers' knowledge, attitudes, and behaviours towards UCI prevention. There are too few studies to determine whether one approach is better than another and the choice of how to deliver education will depend on the target population and local factors. The review suggests that the interventions that make the greatest contribution to positive change use of behavioural change theories to guide interventions and ensure that the intervention is designed with the target population in mind in terms of materials, environment and education strategies.

The use of behavioural change theories

Behavioural change depends on personal knowledge and attitudes, which are usually influenced by social and cultural norms. For example, parental child safety behaviours such as inadequate supervision (Schnitzer et al., 2015) may happen due to socioeconomic factors such as parents' age and level of knowledge (Mayes et al., 2014; Morrongiello et al., 2006). Low education attainment in caregivers is an often-cited risk factor in unintentional injury (Eren et al., 2019; Morrongiello et al., 2006; Morrongiello & House, 2004; Nour et al., 2018; Thein et al., 2005; Villalba-Cota et al., 2004). The strong links between poverty and education (Liu et al., 2021) make it unsurprising that low income is also a common risk factor, cited alone or in conjunction with education (Chowdhury et al., 2009; Karb et al., 2016; Vecino-Ortiz et al., 2018). Young mothers, especially those with low educational levels (Morrongiello et al., 2006; Nour et al., 2018), and those of low or moderate socioeconomic status, were identified as a high-risk group (Campbell et al., 2019).

It is difficult to draw conclusions from such a small number of studies, some of which have limitations due to the lack of validation of their data collection instruments and reliance on self-reported improvement by the participants. However, the strategies demonstrating the greatest change tended to make use of theoretical frameworks. The

Health Beliefs Model (Rosenstock et al., 1988) emerged from the work of a group of social psychologists in the 1950s and 60s who were looking for solutions to public health problems (Rosenstock, 1974). The focus of this work was to develop an understanding of preventive health behaviour. It was rooted in the principle that to avoid an illness the person must believe that they are personally susceptible to it, that having the disease was worth avoiding due to the likely negative impact of it, and that taking action would be beneficial despite the costs in terms of pain, embarrassment, or convenience. The appropriateness of this model is clear. The two studies that used this model (Cheraghi et al., 2014; Ihalahewage et al., 2018) focused their education on perceived severity, perceived barriers, cues to action and self-efficacy. The application of the HBM to the educational intervention and questionnaire was more transparent in the Cheraghi et al. study, and improvements in all areas were seen.

Two studies (Amini et al., 2021; Ning et al., 2019) use the Theory of Planned Behaviour (Ajzen, 1985, 1991). The principle behind this theory is that most volitional human behaviour is goal directed such that actions are largely governed by intentions. There are causal links between beliefs, attitudes, intentions, and behaviours, which Ajzen terms a theory of reasoned action. This theory is extended by a second component of the model which explores goal-directed behaviours that are influenced by internal and external factors. This is termed the theory of planned behaviour which considers perceived and actual control an individual may have over their behaviour. It allows consideration of constraints on action and models why intentions do not always lead to actions (Armitage & Conner, 2001). Like the HBM this model allows the researchers to examine the relationship between knowledge, attitudes, and actions and the two studies included in this review that used this model evaluated behavioural changes by parental self-report.

Fardazar et al. (2016) used Protection Motivation Theory in their design and evaluation. This theory, developed by Rogers (1975) explains how fear of the consequences of ill-health can act as a motivation to alter behaviour. Similar to HBM and TPB this model explains a relationship between the perceived severity of the threat, the probability of its occurrence and the efficacy of the recommended coping response (Maddux & Rogers, 1983). The training in the reviewed paper comprised of two 45-minute sessions. In the first the mothers were educated about the severity of injury and vulnerability of children. In the second session the focus was on effective prevention strategies and involved an attempt to increase their self-efficacy in preventative behaviours.

The final model employed in the reviewed studies was the PRECEDE-PROCEED model (Green, 1974; Green & Kreuter, 2005). The use of this model requires the development of an understanding of the community in which the eventual intervention will be used. Thus Afshari et al. (2017) based their intervention on a study undertaken in a similar population (Rezapur-Shahkolai et al., 2017) and a preintervention collection of data in the study. In keeping with the behavioural health theories already mentioned, this model makes use of our understanding that beneficial behaviour change is influenced by several factors that enable, predispose, or reinforce behaviours that may or may not be preventative. One of the ways of maximising the effect of education using this model is to show concern for the needs of the target audience and structure communications so that they agree with their motivations. In one of the early descriptions of this model Green (1974, p. 44) identifies one of the motivational factors as fear, one the fundamental factors that appear across all the models described thus far.

The theoretical basis of behaviour change is explicit in the studies we have discussed so far. While others have not been explicit, they all use strategies that are likely to bring about positive change. One of the common features of all interventions in the reviewed studies was the use of discussion in small homogenous groups. The degree of participant generation of discussion topics and problem solving is difficult to tell from most studies. However, Fardazar et al. (2016); Ihalahewage et al. (2018) emphasised the role of the participants in setting the agenda and this will lead to a focus on the most relevant issues for those groups. Both studies produced high levels of change as might be expected when education content is tailored to the needs of the community where change is desired. Social networking and learning in a group have a positive impact as this allows the exchange of expertise and concerns and can add social pressure to motivate change (Khanom et al., 2013; Machin et al., 2018).

In some of the populations that were targeted in the reviewed research fatalism has an influence. Fatalism is defined as a sense that the person has a lack of control over events, and there is a connection between fatalism and a lack of tacking preventative action (Perfetti, 2018). Fatalism is associated with an increased risk of UCI (Santagati et al., 2016) and may be resistant to change. Fatalism contributes to low self-efficacy for injury prevention and a behavioural health model can help to target the components of fatalism such as low self-efficacy, helplessness, meaninglessness, and inevitability.

Materials and design of education delivery

The content delivered to improve knowledge was usually identified from research or policy relevant to the local population. Previous research studies conducted to explore UCI causal factors recognised inadequate caregiver knowledge of child safety at a baseline (Akturk & Erci, 2016; Lafta et al., 2014). Inadequate knowledge of UCI prevention can be a risk factor that may lead to poor anticipation of injury risks and increase the risk of injury (Simpson et al., 2009) and low levels of pre-intervention knowledge were identified in this review.

One study in this review used a mobile phone application (app) to deliver the educational strategy (Ning et al., 2019). Phone apps have been used widely for different health education purposes (Jeffrey et al., 2019; Kang et al., 2019; Taki et al., 2019), and can positively change child safety attitudes and behaviour (McKenzie & Roberts, 2016; Ning et al., 2019; Omaki et al., 2017). However, clinicians' opinions must be sought when designing a relevant app (Fitzgerald & McClelland, 2017).

The use of apps is attractive given the interactive nature and immediacy of the messaging. However, there are a few accessibility and inclusivity issues with many people unable to access the hardware or broadband to make good use of the app, which can exacerbate health inequalities (Bol et al., 2018; Borg et al., 2019). The design of the app must also skilfully take into consideration the multitude of platforms used to access the app and the attributes of the target population including learning disabilities and digital literacy (Galinski & Giraldo Perez, 2017) and inclination to use an app for health purposes (Powell & Deetjen, 2019).

The settings for education delivery were designed with the local population in mind and were community rather than hospital based. Home visits have the advantage that

they allow assessment of behavioural changes as well as equipment installation and other home safety modifications. Many studies in this review used primary health care centres to deliver education interventions. When combined with other visits, for example, immunisation clinics, this can be a way to reach the target population. However, while Furman et al. (2020) found mobile centres were effective and helped the researchers to reach an otherwise inaccessible urban population, this increases the cost of the intervention considerably.

Two studies included safety equipment in their intervention (Furman et al., 2020; Habermehl et al., 2019). Equipment is considered a passive health promotion intervention compared to health education. The systematic review by Abbassinia et al. (2019) suggested that the use of safety equipment did not lead to a greater effect size of the intervention; the greatest effect was made by changing attitudes and knowledge, which led to changes in behaviour in terms of vigilance and self-efficacy.

Strengths and limitations

The findings of this study are relevant and applicable to children under the age of six and can be cautiously extrapolated beyond that age. We reviewed studies from different countries, which allowed some comparison of methods and results in different cultures. The outcome measures and data presented in the report did not allow for more than narrative synthesis and this means that comparison between studies is incomplete.

A lack of detail about educational intervention in most of the reports does not allow us to comment fully on the value of theoretical frameworks to guide interventions nor the method the researchers used to derive the content and delivery method of the sessions. In many cases the cultural and spiritual profile of the community may have influences their baseline and response to education and this was not well described in the studies. The review also included studies reported in English, if other languages were considered it could add additional knowledge.

Implication for practice and research

Education interventions can improve knowledge, attitudes, and behaviours in unintentional child injury prevention. The interventions can be simple and inexpensive and will work best when they are developed with a specific community in mind. The review's findings can be used as supporting evidence to assist primary health care workers on issues to be considered when initiating or reviewing UCI health education programmes. Current health education initiatives can be reviewed and updated to develop a new health education guide on child injury prevention. By implementing relevant and resourceful health education initiatives, child safety culture will be sustainable in the long term. This in turn will help to spread safety awareness within the community.

Many of the studies in this area used self-designed questionnaires based on behavioural and health beliefs models. Further work is required to create robust questionnaires that can be across different studies to allow greater comparison of results and meta-analysis.

Conclusion

Health education interventions delivered in various ways and settings will improve knowledge, attitudes, and behaviours. Simple and replicable methods are used to deliver information and answer the questions of caregivers. The published studies tended to be conducted in low-income areas where it is likely that the educational attainment of the caregivers contributes to the baseline problem. There is a cost associated with delivering health education to reduce unintentional child injury. Well conducted studies that include larger samples and cover geographical areas would determine the impact of the improvements in knowledge, attitudes, and behaviours on the incidence of injury.

Disclosure statement

No potential conflict of interest was reported by the author(s).

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