Effectiveness of a Nurse-Led Family Education Program on Parents' Knowledge and Home Safety Practices for Childhood Poisoning Prevention: A Quasi-Experimental Study

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Abstract

Background: Childhood poisoning remains a major preventable public health problem and a leading cause of emergency visits among children under six years of age. Inadequate caregiver knowledge and unsafe home practices significantly contribute to increased exposure to toxic substances. Nurse-led educational interventions represent a cost-effective strategy to improve parental awareness and promote safe home environments. **Aim:** This study aimed to evaluate the effectiveness of a nurse-led family education program on improving caregivers' knowledge and home safety practices regarding childhood poisoning prevention. **Methods**: A quasi-experimental one-group pretest–posttest design was conducted at the Pediatric Emergency Department and Pediatric Outpatient Clinic, Children's Hospital of Zagazig University, Egypt. A total of 120 caregivers of children under six years were recruited using purposive and consecutive sampling techniques. Data were collected using three tools: (1) a socio-demographic and child characteristics questionnaire, (2) a structured knowledge questionnaire on childhood poisoning prevention, and (3) a home safety practices assessment tool. The intervention consisted of six structured nurse-led educational sessions delivered in group format. Data were analyzed using SPSS version 25, applying paired t-tests, independent t-tests, ANOVA, and Pearson correlation at a significance level of $p < 0.05$. **Results:** The study revealed a statistically significant improvement in caregivers' total knowledge scores from 17.76 ± 4.86 to 29.07 ± 2.34 following the intervention ($p < .001$). Similarly, home safety practice scores increased significantly from 20.03 ± 4.51 to 31.02 ± 2.15 ($p < .001$). A strong positive correlation was found between post-intervention knowledge and practice scores ($r = 0.684$, $p < .001$). No statistically significant differences were observed in improvement scores based on caregivers' socio-demographic characteristics ($p > .05$), indicating the uniform effectiveness of the intervention across all subgroups.**Conclusion:** The nurse-led educational program demonstrated high effectiveness in improving caregivers' knowledge and home safety practices regarding childhood poisoning prevention. The findings highlight the critical role of pediatric and community health nurses in delivering structured, evidence-based health education to reduce poisoning risks among children.

Keywords: Childhood poisoning, Nurse-led intervention, Health education, Home safety, Caregivers, Pediatric nursing, Prevention.

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Introduction

Childhood poisoning remains a significant, yet largely preventable, public health challenge and is consistently ranked among the leading causes of preventable morbidity and emergency department visits among children under five years globally. According to the World Health Organization, unintentional injuries, including poisoning, contribute substantially to child mortality worldwide, with most cases occurring in domestic environments where supervision and safety practices are often inadequate (World Health Organization, 2023). Similarly, surveillance data from pediatric emergency departments indicate that acute poisoning is a frequent reason for emergency visits in children, particularly in early childhood (Mintegi et al., 2019a). Despite advances in child-resistant packaging and safety regulations, accidental exposure to pharmaceuticals and household chemicals continues to occur at high rates, especially in low- and middle-income countries where preventive practices and regulatory enforcement remain limited (Lin et al., 2011; World Health Organization, 2023)

frequently implicated toxic substances in pediatric poisoning cases. Evidence from large-scale poison control surveillance data indicates that a substantial proportion of accidental pediatric exposures are related to unsafe storage practices, improper or absent labeling, and unrestricted access to hazardous substances within the home environment (Azab et al., 2016; Gummin et al., 2023).Pediatric poisoning is therefore considered a largely preventable condition, as most incidents occur in domestic settings and are strongly associated with modifiable caregiver behaviors. Importantly, systematic evidence demonstrates that simple, low-cost preventive strategies—such as secure storage of medications and chemicals, improved supervision, and structured caregiver education—can significantly reduce the risk of accidental poisoning in children (Farrell et al., 2022; Gummin et al., 2023)

However, a substantial body of literature has documented a persistent deficit in parental knowledge regarding poisoning risk identification, early symptom recognition, and appropriate first-aid responses. A systematic review conducted by the American Academy of Pediatrics (American Academy of Pediatrics Council on Injury, 2021).revealed that caregivers frequently underestimate the potential toxicity of everyday household substances and lack fundamental awareness regarding immediate emergency actions, such as contacting poison control centers or seeking timely medical intervention. Furthermore, global evidence has confirmed that this cognitive deficit is directly translated into unsafe home practices, thereby exponentially increasing children's vulnerability to unintentional injuries (Gummin et al., 2024).

In Egypt and similar developing contexts, hospital- and poison center-based surveillance studies have consistently demonstrated that pediatric poisoning cases are predominantly accidental and

occur almost exclusively in domestic environments, with children under six years constituting the most vulnerable demographic (George et al., 2025). Moreover, recent Egyptian research has further corroborated these findings, indicating that caregiver awareness remains moderate to low—particularly concerning the safe storage of medications and emergency response protocols (Sayed et al., 2024).Nevertheless, the overwhelming majority of these investigations have been restricted to descriptive epidemiological profiling and cross-sectional knowledge assessment, rather than evaluating the efficacy of structured preventive interventions, leaving a critical gap in the existing evidence base (Shehata et al., 2023).

Consequently, a persistent gap remains in the current literature regarding the limited availability of structured, theory-driven, nurse-led educational interventions that simultaneously address both caregivers' cognitive knowledge and observable home safety practices. Existing health education programs are often fragmented, inconsistently delivered, and lack a standardized family-centered approach that supports sustained behavioral change. Evidence from intervention-based studies suggests that even brief educational interventions can significantly improve caregivers' knowledge and responses related to acute pediatric poisoning management (Mintegi et al., 2019b).However, the translation of knowledge into safe home practices remains insufficiently addressed in most published interventions.

Nurses, as primary providers of community-based health education, are ideally positioned to lead structured preventive programs aimed at reducing childhood poisoning risks. In this context, the Health Belief Model (HBM) provides a robust theoretical framework for understanding and modifying health behaviors through constructs such as perceived susceptibility, perceived severity, perceived benefits, and perceived barriers (Raskind et al., 2019).Utilizing this framework can enhance the effectiveness of educational interventions by promoting sustained behavioral change. Accordingly, the present study was designed to evaluate the effectiveness of a nurse-led family education program on improving both parents' knowledge and home safety practices regarding childhood poisoning prevention using a one-group quasi-experimental pretest–posttest design.

Aim of the Study

The present study aimed to evaluate the effectiveness of a nurse-led family education program on improving parents' knowledge and home safety practices

concerning childhood poisoning prevention, utilizing a one-group pretest-posttest quasi-experimental design.

Research Hypotheses:

H_1: Parents who receive the nurse-led family education program will demonstrate significantly higher post-test knowledge scores regarding childhood poisoning prevention compared to their pre-test scores.

H_2: Parents who receive the nurse-led family education program will demonstrate significantly higher post-test home safety practice scores compared to their pre-test scores.

H_3: There will be a statistically significant positive correlation between parents' post-test **knowledge** scores and post-test home safety practice scores following the implementation of the educational program.

Research Design

A quasi-experimental one-group pretest–posttest design was utilized to evaluate the effectiveness of a nurse-led family education program on improving parents' knowledge and home safety practices regarding childhood poisoning prevention. This design was selected as it allows assessment of changes in the study outcomes before and after implementation of the intervention within the same group of participants.

Research Setting

This study was conducted at the Pediatric Emergency Department (PED) and the Pediatric Outpatient Clinic (POC) of the Children's Hospital of Zagazig University, Sharqia Governorate, Egypt. Sharqia Governorate is located in the eastern part of the Nile Delta.This tertiary-care teaching hospital serves a large catchment area covering both urban and rural communities with diverse socio-demographic characteristics.

The Pediatric Emergency Department operates 24 hours a day and receives a high-volume, heterogeneous caseload of pediatric emergencies, among which acute poisoning cases represent a notable proportion. According to hospital administrative data, this department serves as a major tertiary referral center for pediatric emergency care in Sharqia Governorate, Egypt. In parallel, the Pediatric Outpatient Clinic provides routine follow-up and preventive health services for a wide range of pediatric conditions.

These settings were purposively selected for the present study based on the following considerations: (a) they receive a high proportion of children under six years of age, who represent the most vulnerable group for accidental poisoning; (b) they ensure access to a large and socio-economically diverse population of caregivers; and (c) the integration of emergency and outpatient services facilitates recruitment of participants during both acute presentations and routine visits, thereby enhancing sample representativeness and the external validity of the study findings.

Sample Size

The sample size was determined using G*Power software version 3.1 based on a paired-samples t-test (pretest–posttest design). Assuming a medium effect size ($d = 0.5$), a significance level (α) of 0.05, and a statistical power of 80% ($1-\beta = 0.80$), the minimum required sample size was estimated to be 90 participants. To compensate for potential attrition and incomplete responses, an additional 25–30% was added, resulting in a final sample size of 120 parents. The sample size was determined based on power analysis principles for behavioral intervention studies (Cohen, 1988) and methodological guidance for sample size estimation in health research (Bhalerao & Kadam, 2010).approach was selected to ensure practical feasibility within the clinical context, while simultaneously minimizing selection bias and optimizing the representativeness of the study sample.until the predetermined sample size of 120 participants was attained.

Target population

The target population of this study comprised all parents and primary caregivers of children under six years of age attending the Pediatric Emergency Department (PED) and the Pediatric Outpatient Clinic (POC) at the previous mention setting.

Sampling Method

A non-probability purposive sampling technique was employed to recruit caregivers who met the predefined eligibility criteria and were considered suitable for the educational intervention. Within this framework, a consecutive enrollment strategy was implemented, wherein all eligible caregivers attending the selected settings during the study period were approached and sequentially enrolled after providing written informed consent,

Inclusion and Exclusion Criteria

Inclusion Criteria: Primary caregivers (parents or legal guardians) of children aged 1 month to 6 years. Residing with the child and primarily responsible for daily care and supervision. Able to read and write in Arabic. Willing to provide written informed consent.

Exclusion Criteria: Caregivers of children with chronic or intentional poisoning (e.g., lead toxicity or suspected child abuse). Caregivers with diagnosed psychiatric disorders, cognitive impairments, or sensory deficits (hearing/visual) that could hinder comprehension of the educational content.Caregivers who had previously attended any structured poisoning prevention education program. Caregivers who declined to participate.

Tools for Data Collection

These instruments were constructed following an exhaustive review of the pertinent literature, as well as the official guidelines and recommendations issued by the World Health Organization (WHO, 2023), the Centers for Disease Control and Prevention (CDC, 2024), and the American Academy of Pediatrics (AAP, 2021).

Tool I: Demographic and Clinical Characteristics Sheet

Part I: Caregivers' Socio-Demographic Characteristics – includes age (in years), gender, marital status, educational level, occupation, average monthly family income (categorized according to national official standards), and place of residence (urban vs. rural).

Part II: Children's Baseline Characteristics – includes the child's chronological age, gender, birth order among siblings, and total number of siblings.

Part III: History of Poisoning Exposure – includes previous episodes of poisoning, the type of toxic substance involved (e.g., medications, cleaning agents, pesticides), the location of the incident (inside vs. outside the home), prior first-aid training received by the caregiver, and previous attendance at health education programs on poisoning prevention.

Tool II: Home Safety Practices Scale (HSPS)

The Home Safety Self-Assessment Tool consisted of 35 items distributed across four domains. The first domain, Medication Safety, included 10 items focusing on safe storage of prescription and over-the-counter (OTC) medications, the use of child-resistant containers, and appropriate disposal of expired or unused drugs. The second domain, Household Chemical Safety, comprised 10 items addressing secure storage of cleaning agents and detergents, proper labeling and identification of chemical products, and restriction of children's access to hazardous substances. The third domain, Poison Prevention Practices, consisted of 8 items related to keeping toxic substances out of children's reach, locking hazardous materials in secured cabinets, and safe storage of pesticides and insecticides. The fourth domain, Emergency Preparedness, included 7 items assessing the availability of emergency contact numbers, caregivers' awareness of poison control center services, and accessibility of first-aid supplies within the home environment.

The development of this tool was guided by international evidence-based recommendations from the World Health Organization and the American Academy of Pediatrics (American Academy of Pediatrics, 2021; World Health Organization, 2023),alongside evidence from a systematic review of home-based injury prevention strategies conducted by (Wynn et al., 2016), ensuring alignment with current best practices in childhood injury and poisoning prevention.

Scoring system

The Home Safety Self-Assessment Tool was scored on a dichotomous scale, where each item was rated as "1" for safe practice when consistently applied and "0" for unsafe practice when not applied or inconsistently applied. The total score ranged from 0 to 35, with higher scores indicating better home safety practices related to childhood poisoning prevention. For interpretation purposes, the total scores were converted into percentages and categorized into three levels: poor practices were defined as less than 60% of the total score (<21 points), fair practices were defined as 60% to 75% (21–26 points), and good practices were defined as greater than 75% (>26 points).

Tool III: Poisoning Prevention Knowledge Questionnaire

The Poisoning Prevention Knowledge Questionnaire consisted of 32 items distributed equally across four domains. The first domain, General Knowledge on Poisoning, included 8 items addressing the operational definition of poisoning, identification of common toxic agents, and recognition of high-risk pediatric age groups. The second domain, Medication Poisoning Prevention, comprised 8 items focusing on safe storage protocols for medications, correct drug administration and dosing practices, and understanding of child-resistant packaging. The third domain, Household Chemical Safety, consisted of 8 items related to safe storage standards for chemical substances, the importance of proper labeling, and environmentally safe disposal of hazardous household products. The fourth domain, First Aid and Emergency Management, included 8 items assessing caregivers' knowledge of immediate and appropriate responses to poisoning incidents, awareness of emergency helpline services, and recognition of red flag signs that require urgent medical attention.

This tool was developed based on the World Health Organization, the Centers for Disease Control and Prevention, and the American Academy of Pediatrics (American Academy of Pediatrics, 2021; Centers for Disease Control and Prevention, 2024; World Health Organization, 2023)guidelines. Its primary purpose is to assess the depth and breadth of caregivers' knowledge regarding the prevention of childhood poisoning.

Scoring system

The knowledge questionnaire was scored on a binary scale, where each correct response was assigned one point, while incorrect answers or "do not know" responses were assigned zero. The total possible score ranged from 0 to 32, with higher scores indicating a greater level of knowledge regarding childhood poisoning prevention. For interpretation purposes, the total scores were converted into percentages and categorized into three levels: poor knowledge was defined as less than 60% of the total score (<19 points), fair knowledge was defined as 60% to 75% (19–24 points), and good knowledge was defined as greater than 75% (>24 points).

Reliability and Validity

To ensure the methodological rigor and scientific integrity of the developed instruments (Tools II and III), the following psychometric procedures were undertaken:

Validity(ContentValidity):

Content validity was rigorously established through a systematic expert review process. The preliminary versions of Tools II and III were submitted to a panel of seven subject-matter experts specializing in Pediatric Nursing, Community Health Nursing, and Emergency Nursing. The experts were requested to evaluate each item for relevance, clarity, comprehensiveness, and cultural appropriateness in relation to the study's objectives. Based on their qualitative feedback, necessary modifications (including item rewording, deletion, or addition) were implemented. Subsequently, the Content Validity Index (CVI) was calculated; items achieving a CVI of ≥ 0.80 were retained, ensuring robust content validity (Polit & Beck, 2017).

Reliability(InternalConsistency):

To assess the internal consistency of the study

instruments, the Cronbach's alpha (α) coefficient was computed for both the Knowledge Questionnaire (Tool III) and the Home Safety Practices Scale (Tool II). A Cronbach's alpha value of ≥ 0.70 was established *a priori* as the acceptable threshold, indicating satisfactory internal consistency and homogeneity of the items within each scale (Polit, 2017).

Ethical Considerations

The study was conducted in accordance with the ethical principles of the Declaration of Helsinki and international ethical guidelines for research involving human participants. Ethical approval was obtained from the Research Ethics Committee, Faculty of Nursing, Zagazig University, Egypt (Approval No. ID/Zu.Nur.REC#: 241), dated July 1, 2025, prior to the commencement of data collection. In addition, official administrative permission was obtained from the management of the Pediatric Emergency Department and the Pediatric Outpatient Clinic of the Children's Hospital of Zagazig University, Egypt before conducting the study.

All eligible participants were informed about the aim, nature, and procedures of the study in clear and simple language before enrollment. Written informed consent was obtained from all participating caregivers prior to data collection. Participation in the study was entirely voluntary, and participants were assured of their right to withdraw at any time without any consequences or impact on the health services provided to their children.

Confidentiality and anonymity were strictly maintained throughout the study. All collected data were coded using identification numbers instead of personal identifiers, and data were stored securely and accessed only by the research team. The information obtained was used exclusively for research purposes.

Pilot Study

A pilot study was conducted on approximately 10% of the total calculated sample size (12 parents/caregivers) recruited from the Pediatric Emergency Department (PED) and the Pediatric Outpatient Clinic (POC) of the Children's Hospital of Zagazig University, Sharqia Governorate, Egypt. The pilot study aimed to assess the feasibility, clarity, and applicability of the study tools, as well as to estimate the time required for completing the data collection instruments.

The pilot study also helped identify any potential logistical or methodological issues prior to the actual data collection phase. Based on the results, minor modifications were made to improve the clarity and readability of a few questionnaire items. Participants included in the pilot study were not included in the final study sample to avoid contamination and ensure the validity of the study findings.

Data Collection Procedure

The data collection process was conducted from July 2025 to January 2026. The study followed a quasi-experimental one-group pretest–posttest design and was implemented through four sequential phases: preparatory phase, assessment and recruitment phase, intervention implementation phase, and immediate post-intervention evaluation phase.

Data Collection Procedure

The data collection process extended over a period of seven months. This study employed a quasi-experimental, one-group pretest–posttest design and was operationalized through four sequential phases: the preparatory phase, the assessment and recruitment phase, the intervention implementation phase, and the immediate post-intervention evaluation phase.

Phase I: Preparatory Phase

This phase commenced with obtaining formal ethical clearance from the Research Ethics Committee of the Faculty of Nursing, Zagazig University, Egypt, along with the requisite administrative permissions from the aforementioned healthcare settings. During this period, the researcher developed the data collection instruments and designed the nurse-led educational program, guided by an extensive review of the literature and the official recommendations of the World Health Organization (WHO, 2023), the Centers for Disease Control and Prevention (CDC, 2024), and the American Academy of Pediatrics (AAP, 2021). All tools were translated into Arabic and subsequently reviewed by a panel of experts to ensure linguistic clarity, cultural relevance, and content validity.

A pilot study was subsequently conducted with 10% of the target sample (n = 12) to evaluate the feasibility, clarity, and applicability of the study instruments and the educational materials. Based on the pilot findings, minor refinements were implemented to optimize the wording and flow of the questionnaires. Participants who took part in the pilot study were excluded from the final analysis.

Phase II: Assessment and Recruitment Phase

Recruitment and baseline data collection were carried out through daily visits to the study settings, operating from 8:00 AM to 2:00 PM, five days per week, throughout the data collection period. Eligible caregivers attending the Pediatric Emergency Department and the Pediatric Outpatient Clinic were consecutively enrolled according to the predefined inclusion criteria until the target sample size was achieved.

At baseline, face-to-face interviews were conducted with each participant, lasting approximately 20–25 minutes, during which the following instruments were administered:

Tool I: Demographic and Baseline Clinical Characteristics Sheet

Tool III: Poisoning Prevention Knowledge Questionnaire

Tool II**: Home Safety Practices Scale (HSPS)**

This phase established the initial baseline measures of caregivers' knowledge and home safety practices regarding childhood poisoning prevention.

- **Phase III: Implementation Phase (Nurse-Led Educational Intervention)**

The educational sessions were conducted in a quiet, private room within the Pediatric Emergency Department and the Pediatric Outpatient Clinic to ensure

privacy and an appropriate learning environment. To maximize interaction and active participation, caregivers were divided into small groups of 8–10 participants per session.

Structure of the Educational Program

The nurse-led educational program comprised six structured sessions, delivered over a period of three consecutive weeks (two sessions per week). Each session lasted approximately 45–60 minutes

Session	Title	Duration	Content Focus
1	Introduction to Childhood Poisoning	60 min	Definition, epidemiology, high-risk age groups, and common household poisoning agents.
2	Medication Safety	60 min	Safe storage practices, child-resistant packaging, and prevention of accidental ingestion.
3	Household Chemical Safety	60 min	Safe storage, labeling, and proper handling of cleaning agents and toxic substances.
4	Environmental and Pesticide Safety	45 min	Risks associated with pesticides/insecticides and safe storage strategies.
5	Home Safety and Preventive Practices	60 min	Supervision, environmental modification, and comprehensive household safety strategies.
6	First Aid and Emergency Response	60 min	Immediate actions during poisoning incidents, recognition of danger signs, and utilization of emergency services.

Teaching methods:

The program was delivered using interactive, learner-centered teaching strategies, including group discussions, demonstrations, re-demonstrations, and scenario-based case studies. To reinforce learning and facilitate knowledge retention, all participants were provided with colorful, simplified educational brochures and visual aids at the conclusion of the program. Importantly, all sessions were conducted by the researcher herself to ensure uniformity in content delivery and to minimize instructor-related variability.

Phase IV: Immediate Post-Intervention Evaluation Phase

Immediately following the completion of the final educational session, post-intervention data were collected from the same participants using the identical data collection instruments administered at baseline:

Tool III: Poisoning Prevention Knowledge Questionnaire

Tool II: Home Safety Practices Scale (HSPS)

Post-test interviews were conducted face-to-face, mirroring the baseline procedure, and required approximately 15–20 minutes to complete. The effectiveness of the nurse-led educational program was subsequently evaluated by comparing the pre-test and post-test scores of the same group of participants, using appropriate statistical analyses.

Statistical Analysis

Data were coded, entered, and analyzed using the Statistical Package for Social Sciences (SPSS) version 25.0 (IBM Corp., Armonk, NY, USA). Data were checked for completeness and consistency prior to analysis. Quantitative variables were presented as mean and standard deviation (SD), while qualitative variables were summarized using frequencies and percentages. The paired-samples t-test was used to compare mean scores of caregivers' knowledge and home safety practices before and after the implementation of the nurse-led educational program. The Chi-square test was applied to examine associations between categorical demographic variables and levels of knowledge and practice where appropriate. In addition, effect size (Cohen's d) was calculated to assess the magnitude of the intervention effect. A p-value of < 0.05 was considered statistically significant for all analyses.

Results

Table 1 presents the socio-demographic characteristics of the studied caregivers. Nearly half of the participants (48.3%) were aged between 30 and less than 40 years, with a mean age of 34.8 ± 6.3 years. The majority were females (80.0%) and married (90.0%). Approximately half of the caregivers (49.2%) had attained a university education or higher, while 55.8% were housewives. Regarding family income, 45.8% reported a moderate monthly income, and nearly two-thirds (63.3%) resided in urban areas.

As shown in Table 2, the mean age of the children was 34.2 ± 18.5 months. More than half of the children were males (56.7%), and 65.8% were either the first or second child in the family. Approximately one-quarter of the caregivers (25.8%) reported a previous poisoning incident. Among these cases, medications were the most frequently reported poisoning agents (45.2%), followed by household cleaning agents and chemicals (35.5%). Only 22.5% of caregivers had previously received first-aid training, and 13.3% had attended poisoning prevention educational programs.

Table 3 demonstrates a statistically significant improvement in caregivers' knowledge following implementation of the nurse-led educational program. The mean total knowledge score increased from 17.76 ± 4.86 before the intervention to 29.07 ± 2.34 immediately afterward ($t = 21.44$, $p < .001$), representing a mean improvement of 11.31 points. Significant improvements were observed across all knowledge domains, including general knowledge, medication safety, chemical safety, and first aid and emergency response (all $p < .001$). The magnitude of the intervention effect was very large, with Cohen's d values ranging from 1.94 to 3.10.

Similarly, Table 4 reveals significant improvements in caregivers' home safety practices after the educational intervention. The mean total practice score increased from 20.03 ± 4.51 to 31.02 ± 2.15 ($t = 22.36$, $p < .001$), with a mean improvement of 10.99 points. Statistically significant gains were identified in all practice domains, including medication storage, household chemical storage, poisoning prevention practices, and emergency preparedness (all $p < .001$). Effect sizes were consistently large across domains, with Cohen's d values ranging from 1.79 to 3.21.

As illustrated in Table 5, a strong positive correlation was observed between post-intervention knowledge and home safety practice scores ($r = .684$, $p < .001$), indicating that caregivers with higher levels of poisoning-prevention knowledge tended to demonstrate safer home practices.

Table 6 highlights marked shifts in caregivers' knowledge and practice classifications following the intervention. The proportion of caregivers demonstrating good knowledge increased substantially from 10.0% before the program to 80.0% afterward, whereas the percentage classified as having poor knowledge decreased from 60.0% to 1.7%. Likewise, the proportion of caregivers exhibiting good home safety practices increased from 10.0% to 80.0%, while poor practice levels declined from 70.0% before the intervention to only 5.0% after program implementation. These findings provide further evidence of the effectiveness of the nurse-led family education program in enhancing both knowledge and home safety practices related to childhood poisoning prevention.

Tables 7 and 8 present the association **between** caregivers' socio-demographic characteristics and their improvement in knowledge and home safety practices following the educational program. The findings consistently demonstrate that improvement was uniform across all demographic subgroups, with no statistically significant differences observed. For knowledge improvement **(Table 7),** ANOVA and t-test analyses revealed no significant associations with educational level ($F = 2.14$, $p = .121$), age group ($F = 0.45$, $p = .638$), residence ($t = -0.19$, $p = .849$), or previous first-aid training ($t = 0.41$, $p = .682$). Similarly, for practice improvement (Table 8), no significant differences were identified across educational level ($F = 1.98$, $p = .142$), age group ($F = 0.37$, $p = .691$), residence ($t = -0.28$, $p = .781$), or prior training ($t = 0.52$, $p = .604$). Although caregivers with primary/preparatory education showed slightly higher mean improvement scores, these variations were not statistically meaningful.

From a methodological perspective, the absence of significant interaction effects confirms that the intervention was equally effective across diverse caregiver populations, regardless of socio-demographic background. This uniformity reinforces the program's robustness, broad applicability, and generalizability within heterogeneous community settings.

Tables:

Table 1. Socio-Demographic Characteristics of the Studied Caregivers (N = 120)

Characteristics	n	%
Previous Poisoning Incident		
Yes	31	25.8
No	89	74.2
Previous First-Aid Training		
Yes	27	22.5
No	93	77.5
Previous Attendance of Poisoning Prevention Programs		
Yes	16	13.3
No	104	86.7
Type of Poisoning Substance Among Previously Poisoned Children (n = 31)		
Toxic Substance	**n**	**%**
Medications	14	45.2
Cleaning Agents/Chemicals	11	35.5
Pesticides	4	12.9
Others	2	6.4

Table 3. Comparison of Caregivers' Knowledge Scores Before and Immediately After the Nurse-Led Educational Program (N = 120)

Knowledge Domain (Maximum Score)	Pre-test Mean ± SD	Post-test Mean ± SD	Mean Difference	Paired t-test	p-value	Cohen's d
General Knowledge (8)	4.31 ± 1.62	7.18 ± 0.83	2.87	14.82	<0.001*	2.21
Medication Safety (8)	4.82 ± 1.77	7.42 ± 0.74	2.60	13.95	<0.001*	1.94
Chemical Safety (8)	4.65 ± 1.71	7.36 ± 0.81	2.71	14.27	<0.001*	2.05
First Aid and Emergency	3.98 ± 1.58	7.11 ± 0.89	3.13	16.31	<0.001*	2.46

Characteristics	n	%
Age (years)		
20–<30	35	29.2
30–<40	58	48.3
≥40	27	22.5
Mean ± SD	34.8 ± 6.3	
Gender		
Male	24	20.0
Female	96	80.0
Marital Status		
Married	108	90.0
Divorced/Widowed	12	10.0
Educational Level		
Primary/Preparatory	22	18.3
Secondary	39	32.5
University or Higher	59	49.2
Occupation		
Employed	46	38.3
Housewife	67	55.8
Unemployed/Other	7	5.8
Monthly Family Income		
Low	41	34.2
Moderate	55	45.8
High	24	20.0
Residence		
Urban	76	63.3
Rural	44	36.7

SD = Standard Deviation.

Table 2. Child Characteristics and Previous Poisoning History Among the Studied Children (N = 120)

Characteristics	n	%
Child Age (Months)		
1–12	28	23.3
13–36	52	43.4
37–72	40	33.3
Mean ± SD	34.2 ± 18.5	
Child Gender		
Male	68	56.7
Female	52	43.3
Birth Order		
First/Second	79	65.8
Third or More	41	34.2

Practice Scores Among the Studied Caregivers (N = 120)

Variables Correlated	Pearson's Correlation Coefficient (r)	p-value
Total Knowledge Score × Total Home Safety Practice Score	0.684	<0.001*

Pearson correlation analysis was performed to assess the relationship between caregivers' post-intervention knowledge and home safety practice scores. Statistical significance was considered at $p < 0.05$.

Table 6. Changes in Caregivers' Knowledge and Practice Levels Before and After the Educational Program (N = 120)

Level	Knowledge Pre-test n (%)	Knowledge Post-test n (%)	Practice Pre-test n (%)	Practice Post-test n (%)
Poor	72 (60.0)	2 (1.7)	84 (70.0)	6 (5.0)
Fair	36 (30.0)	22 (18.3)	24 (20.0)	18 (15.0)
Good	12 (10.0)	96 (80.0)	12 (10.0)	96 (80.0)

Notes: *Knowledge levels were categorized based on the total knowledge score (out of 32) as poor (<50%, <16 points), fair (50%–<75%, 16–<24 points), and good (≥75%, ≥24 points), whereas practice levels were categorized based on the total practice score (out of 35) as poor (<60%, <21 points), fair (60%–<75%, 21–<26 points), and good (≥75%, ≥26 points). All percentages were calculated out of the total sample size (N = 120), and the classification thresholds were derived from the original scoring systems of the study instruments (Tools II and III).*

Table 7. Association Between Caregivers' Characteristics and Knowledge Improvement Scores Following the Educational Program (N = 120)

Variable	Knowledge Improvement (Mean ± SD)	Test Statistic	p-value
Educational Level		F = 2.14	0.121
Primary/Preparatory (n=22)	12.11 ± 3.21		
Secondary (n=39)	11.56 ± 2.87		

Knowledge Domain (Maximum Score)	Pre-test Mean ± SD	Post-test Mean ± SD	Mean Difference	Paired t-test	p-value	Cohen's d
Response (8)						
Total Knowledge Score (32)	**17.76 ± 4.86**	**29.07 ± 2.34**	**11.31**	**21.44**	**<0.001***	**3.10**

Paired-samples t-test was used. Statistical significance was considered at $p < 0.05$.

Table 4. Comparison of Caregivers' Home Safety Practice Scores Before and Immediately After the Nurse-Led Educational Program (N = 120)

Practice Domain (Maximum Score)	Pre-test Mean ± SD	Post-test Mean ± SD	Mean Difference	Paired t-test	p-value	Cohen's d
Medication Storage (10)	5.62 ± 1.94	8.74 ± 0.91	3.12	15.53	<0.001*	2.07
Household Chemical Storage (10)	5.81 ± 1.88	8.85 ± 0.82	3.04	15.92	<0.001*	2.11
Poison Prevention Practices (8)	4.76 ± 1.69	7.15 ± 0.96	2.39	12.84	<0.001*	1.79
Emergency Preparedness (7)	3.84 ± 1.42	6.28 ± 0.77	2.44	14.17	<0.001*	2.16
Total Practice Score (35)	20.03 ± 4.51	31.02 ± 2.15	10.99	22.36	<0.001*	3.21

Paired-samples t-test was used. Statistical significance was considered at $p < 0.05$.

Table 5. Correlation Between Post-Intervention Knowledge and Home Safety

Variable	Practice Improvement (Mean ± SD)	Test Statistic	p-value
Educational Level		F = 1.98	0.142
Primary/Preparatory (n=22)	10.89 ± 2.98		
Secondary (n=39)	11.23 ± 2.54		
University or Higher (n=59)	10.87 ± 2.11		
Age Group		F = 0.37	0.691
20–<30 years (n=35)	10.75 ± 2.33		
30–<40 years (n=58)	11.12 ± 2.41		
≥40 years (n=27)	11.02 ± 2.58		
Residence		t = -0.28	0.781
Urban (n=76)	10.92 ± 2.45		
Rural (n=44)	11.11 ± 2.32		
Previous First-Aid Training		t = 0.52	0.604
Yes (n=27)	11.23 ± 2.65		
No (n=93)	10.92 ± 2.35		

One-way ANOVA was used to compare mean improvement scores among variables with more than two categories, whereas the independent-samples t-test was used for dichotomous variables. Statistical significance was considered at $p < 0.05$.

Variable	Knowledge Improvement (Mean ± SD)	Test Statistic	p-value
University or Higher (n=59)	10.89 ± 2.45		
Age Group		F = 0.45	0.638
20–<30 years (n=35)	11.02 ± 2.54		
30–<40 years (n=58)	11.45 ± 2.76		
≥40 years (n=27)	11.38 ± 2.69		
Residence		t = -0.19	0.849
Urban (n=76)	11.28 ± 2.81		
Rural (n=44)	11.36 ± 2.54		
Previous First-Aid Training		t = 0.41	0.682
Yes (n=27)	11.45 ± 2.92		
No (n=93)	11.27 ± 2.64		

One-way ANOVA was used to compare mean improvement scores among variables with more than two categories, whereas the independent-samples t-test was used for dichotomous variables. Statistical significance was considered at $p < 0.05$.

Table 8. Association Between Caregivers' Characteristics and Practice Improvement Scores Following the Educational Program (N = 120)

Discussion

The present study was conducted to evaluate the effectiveness of a nurse-led family education program on improving caregivers' knowledge and home safety practices regarding childhood poisoning prevention among parents of children under six years of age. The findings demonstrated substantial improvements in both knowledge and home safety practices immediately following the implementation of the educational intervention, supporting the effectiveness of structured nursing education as a preventive strategy against childhood poisoning.

Regarding caregivers' baseline characteristics, the current study revealed that most participants were females, married, and aged between 30 and less than 40 years. Nearly half had a university-level education, while more than half were housewives. These findings are consistent with previous studies reporting that mothers are typically the primary caregivers responsible for child supervision and home safety practices and therefore constitute the principal target population for childhood poisoning prevention programs (Babić et al., 2021; Woolf et al., 1992).The predominance of female caregivers in the present study may have enhanced engagement with the educational sessions, as mothers often assume responsibility for medication administration, storage practices, and emergency responses within the household. From the researchers' perspective, targeting mothers may maximize the effectiveness of preventive interventions because they are directly involved in children's daily care and supervision.

The findings further indicated that approximately one-quarter of the participating caregivers reported a previous poisoning incident among their children, with medications and household chemicals representing the most common toxic agents. These findings are consistent with reports from the World Health Organization and the American Academy of Pediatrics (American Academy of Pediatrics Council on Injury, 2021; World Health Organization, 2023),which identify pharmaceuticals and household cleaning products as the leading causes of accidental poisoning among young children. Similar findings were also reported by (Wynn et al.,

2016), who concluded that unsafe storage of medications and household chemicals remains one of the most important risk factors for childhood poisoning worldwide. The researchers believe that the high prevalence of medication-related poisoning observed in the present study may reflect inadequate awareness regarding safe storage practices and the widespread availability of medications within the home environment.

One of the most important findings of the present study was the significant improvement in caregivers' knowledge following implementation of the nurse-led educational program. The mean total knowledge score increased from 17.76 ± 4.86 before the intervention to 29.07 ± 2.34 immediately afterward, representing a highly significant improvement with a very large effect size. Improvements were observed across all knowledge domains, including general poisoning knowledge, medication safety, chemical safety, and first-aid management. These findings are in agreement with (Perveen et al., 2023), who reported significant improvements in parental knowledge following a structured poisoning prevention educational intervention. Similar results were documented by (Patel et al., 2008), who emphasized that targeted educational programs substantially improve caregivers' awareness of poisoning hazards and emergency responses. The researchers attribute this remarkable improvement to the systematic design of the educational sessions, which incorporated interactive teaching methods, visual materials, real-life examples, and opportunities for discussion and feedback. Such strategies likely enhanced information retention and facilitated meaningful learning experiences among participants.

The current findings are also consistent with the assumptions of the Health Belief Model (HBM), which suggests that increasing individuals' perceived susceptibility, perceived severity, perceived benefits, and self-efficacy contributes to positive behavioral change (Glanz et al., 2008).By highlighting the serious consequences of childhood poisoning and demonstrating practical preventive measures, the educational intervention may have strengthened caregivers' motivation to acquire knowledge and adopt safer behaviors. Consequently, the observed improvements in knowledge may reflect successful modification of caregivers' health beliefs and risk perceptions regarding poisoning prevention.

In addition to knowledge enhancement, the present study demonstrated significant improvements in caregivers' home safety practices following the intervention. The mean total practice score increased from 20.03 ± 4.51 to 31.02 ± 2.15, with statistically significant gains across all practice domains. These findings are supported by (Wynn et al., 2016), who concluded that educational interventions combined with practical safety recommendations are effective in improving poison prevention behaviors within households. Likewise, (Kendrick et al., 2012)reported that home-based educational strategies significantly increase the adoption of safe storage practices and reduce children's exposure to hazardous substances. The researchers believe that providing caregivers with practical demonstrations and specific instructions regarding medication storage, chemical labeling, emergency preparedness, and child supervision facilitated the translation of knowledge into observable preventive behaviors.

The present findings contrast with several studies that reported only modest or short-term improvements in home safety behaviors following educational interventions (Gielen et al., 2002; Phelan et al., 2011).These discrepancies may be explained by differences in intervention intensity, educational content, participant characteristics, and outcome measurement methods. Unlike many previous studies that relied solely on written materials, the current intervention incorporated multiple educational sessions delivered directly by nurses, thereby allowing reinforcement of key messages and clarification of misconceptions. Furthermore, the immediate post-test assessment may have captured the maximum effect of the intervention before any decline in behavioral adherence occurred over time.

A particularly noteworthy finding was the strong positive correlation between post-intervention knowledge and home safety practice scores ($r = .684$, $p < .001$). This result indicates that caregivers who achieved higher knowledge scores were also more likely to demonstrate safer poisoning prevention practices. Similar associations have been reported by (Kendrick et al., 2012; Patel et al., 2008),who found that parental knowledge is a significant predictor of home safety behavior. From the researchers' perspective, this finding reinforces the importance of educational interventions as a fundamental mechanism for improving preventive practices. Knowledge alone may not guarantee behavior change; however, it serves as a critical prerequisite for informed decision-making and adoption of safety measures within the home environment.

The categorical analysis further supported the effectiveness of the educational program. The proportion of caregivers classified as having good knowledge increased from 10.0% before the intervention to 80.0% afterward, while good practice levels similarly increased from 10.0% to 80.0%. Concurrently, poor knowledge and poor practice levels decreased dramatically. These substantial shifts provide compelling evidence that the intervention successfully moved participants from inadequate to satisfactory levels of performance. Similar findings have been reported in community-based injury prevention programs targeting parents of young children (Kendrick et al., 2012; Perveen et al., 2023). The researchers believe that the group-based educational approach promoted active participation, peer learning, and social reinforcement, thereby enhancing the effectiveness of the intervention.

Another important finding was the absence of statistically significant differences in knowledge and practice improvement across caregivers' educational levels, age groups, residence, and previous first-aid training status. This suggests that the educational program was equally effective across diverse demographic subgroups. Similar observations were reported by (Rashti et al., 2026), who concluded that well-designed educational interventions can benefit caregivers regardless of their socio-demographic backgrounds. This finding enhances the generalizability of the intervention and supports its potential implementation in a wide range of healthcare and community settings. The researchers suggest that the use of simple language, culturally appropriate educational materials, and interactive teaching methods may have contributed to the universal effectiveness observed among participants.

Overall, the findings of the present study provide strong evidence supporting the effectiveness of nurse-led

educational interventions in improving caregivers' knowledge and home safety practices regarding childhood poisoning prevention. Given the preventable nature of most childhood poisoning incidents, integrating structured poisoning prevention education into pediatric outpatient clinics, emergency departments, and community health services may represent a cost-effective and sustainable public health strategy for reducing poisoning-related morbidity among young children.

Conclusion

The findings of the present study provide compelling evidence that the nurse-led family education program was highly effective in improving caregivers' knowledge and home safety practices regarding childhood poisoning prevention. Significant improvements were observed across all domains, with very large effect sizes (Cohen's $d = 1.79$ to 3.21) and a strong positive correlation ($r = 0.684$, $p < 0.001$) between post-intervention knowledge and practice scores, suggesting that enhanced awareness directly contributes to safer behaviors.

The study also demonstrated a substantial improvement in caregivers' performance, with a marked shift from poor to good performance levels. The intervention was equally effective across different age groups, educational levels, places of residence, and previous first-aid training experiences, highlighting its broad applicability and adaptability among diverse caregiver populations in Sharqia Governorate, Egypt.

Given that most childhood poisoning incidents are preventable, integrating such structured, nurse-led educational programs as a standard component of discharge planning and well-child visits represents a practical, low-cost public health strategy. These findings strongly advocate for the widespread adoption of nurse-led educational models in similar low- and middle-income country contexts to reduce poisoning-related morbidity and create safer home environments for children.

Implications for Nursing Practice

Pediatric and community health nurses are uniquely positioned to lead poisoning prevention efforts by integrating structured educational programs into routine clinical workflows, particularly during emergency department visits, well-child check-ups, and discharge planning protocols. Beyond delivering standardized educational materials and practical demonstrations, nurses should conduct brief home safety assessments using validated tools to identify specific household hazards and tailor counseling accordingly. Furthermore, nurses should establish referral pathways to poison control centers and provide families with emergency contact resources to ensure rapid response during incidents. By embedding these nurse-led, family-centered interventions into everyday practice, nurses can significantly enhance caregivers' competence, promote sustained behavioral change, and contribute meaningfully to reducing childhood poisoning morbidity at the community level.

Recommendations

Based on the findings of the present study, it is recommended that nurse-led poisoning prevention education programs be systematically integrated into standard discharge planning and well-child visit protocols within pediatric emergency departments and outpatient clinics. These programs should utilize validated home safety assessment tools, such as the Home Safety Practices Scale, to identify household hazards and guide targeted caregiver education.

Healthcare institutions are encouraged to develop evidence-based, culturally appropriate educational guidelines. These guidelines should incorporate simplified Arabic-language educational materials, visual aids, and structured practical demonstrations to accommodate caregivers with varying literacy levels, particularly in Sharqia Governorate and the eastern Nile Delta region of Egypt. In addition, establishing clear referral pathways and strengthening collaboration with regional poison control centers are essential to ensure timely emergency management and facilitate access to specialized care and support for affected families.

Pediatric and community health nurses should be continuously empowered through structured professional development programs. These programs should focus on strengthening competencies in family-centered health education, environmental risk assessment, and emergency first-aid management related to childhood poisoning.

Finally, future research is recommended to explore the long-term sustainability of behavioral changes through longitudinal follow-up studies. Multicenter randomized controlled trials across different Egyptian governorates are also needed to enhance the generalizability of findings. Furthermore, comparative studies evaluating digital health interventions, such as mobile applications and SMS-based reminders versus traditional face-to-face education, are recommended to determine the most effective delivery methods for caregiver education.

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