

**Effectiveness of an Educational  
Intervention on Basic Life  
Support in Caregivers of Infants  
Under One Year of Age: A  
Randomized Crossover Clinical  
Trial.**

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## TABLE OF CONTENTS

ABSTRACT .....	5
1. INTRODUCTION .....	6
1.1. study rationale .....	7
2. HYPOTHESIS AND OBJECTIVES .....	7
3. METHODOLOGY .....	8
3.1. study design .....	8
3.2. study setting .....	9
3.3. eligibility criteria.....	9
3.4. intervention and comparator.....	10
3.5. variables .....	11
3.7. sample size.....	12
3.8. sequence generation.....	13
3.9. allocation concealment mechanism .....	13
3.10. implementation.....	13
3.11. blinding .....	13
3.12. statistical methods .....	13
4. RESULTS.....	15
4.1. participants and study flow .....	15
4.2. baseline characteristics of the sample .....	16
4.3. immediate effectiveness of the intervention .....	17
4.3.1. knowledge .....	17
4.3.2. knowledge on choking management .....	18
4.4. perceived self-efficacy.....	18
4.4.1. overall self-efficacy.....	18
4.4.2. exploratory item-level analysis .....	18
4.5. longitudinal evolution and retention .....	19
5. DISCUSSION .....	23
6. STUDY LIMITATIONS .....	26
7. CONCLUSION.....	27
8. REFERENCES .....	28
9. APPENDICES .....	30



## ABSTRACT

**Introduction:** Training parents and caregivers in pediatric cardiopulmonary resuscitation (CPR) and foreign body airway obstruction (FBAO) management is essential, as most emergencies occur at home and require immediate action.

**Methods:** Randomized crossover trial with 63 parents of infants under 6 months. A theoretical-practical workshop was compared with an explained informational leaflet. Knowledge and self-efficacy were assessed via pre- and post-intervention questionnaires, with follow-up at one month. ANCOVA and linear mixed models were used to analyze immediate effectiveness and longitudinal evolution.

**Results:** The theoretical-practical workshop significantly increased knowledge of CPR and FBAO compared to the leaflet, with an adjusted mean difference of 4.47 points ( $p < 0.001$ ). In self-efficacy, the largest effects were observed in perceived confidence to act in choking and cardiopulmonary arrest situations, and in the sense of preparedness to respond correctly, with moderate to large effect sizes (partial  $\eta^2 = 0.450$ – $0.619$ ;  $p < 0.001$ ). One-month follow-up showed partial retention of learning, with improvements maintained above baseline values.

**Conclusion:** The practical workshop is more effective than written information in improving knowledge and caregiver confidence in emergency situations involving infants, with immediate effects and short-term retention.

**Keywords:** Cardiopulmonary Resuscitation/Education; Foreign-body Aspiration/Therapy; Parents; Self Efficacy; Patient Education as Topic; Cross-Over Studies.

## 1. INTRODUCTION

Foreign body airway obstruction (FBAO), commonly known as choking, occurs when an object enters the airway and prevents the normal passage of air to the lungs. This triggers a rapid physiological response, with coughing acting as the primary defense mechanism to expel the obstruction (1).

Foreign body aspiration represents a serious health risk for young children, whose airways are narrower and whose swallowing and chewing coordination is still developing. In Spain, the incidence of episodes requiring hospital care due to foreign body aspiration is approximately 15 cases per 100,000 children under 14 years of age per year. Children aged 1 to 3 years represent the largest group affected, and choking is considered the second leading cause of accidental death in this age group (2). In 2022, eight deaths due to choking were reported in children under 3 years of age in Spain (3).

In most cases, the foreign bodies responsible for choking are organic, particularly nuts, which are involved in 60–80% of cases, especially peanuts. Among this age group, infants under 12 months have the highest mortality rate related to choking, with 90.5 cases per 100,000 inhabitants. From 6 months of age, children become more vulnerable to foreign body aspiration as they begin to develop gross pincer grasp and are able to pick up objects independently (4).

Choking accounts for 40% of accidental deaths in children under one year of age and may not only cause immediate death but also severe neurological sequelae, such as hypoxic

encephalopathy secondary to aspiration (2). If the airway obstruction is not promptly resolved, it can lead to cardiac arrest (CA) (1).

Cardiac arrest is defined as the sudden, usually unexpected, and potentially reversible cessation of blood circulation and spontaneous breathing. In pediatric patients, it is most often the result of deterioration in respiratory or circulatory function secondary to illness or injury. It is associated with high mortality, and prognosis depends on multiple factors (duration, cause, location, age), generally being worse than in adults (5).

Globally, the incidence of pediatric cardiac arrest ranges from 22 to 80 cases per 100,000 children. In 2017, 70 cases per 100,000 were reported in infants, compared to only 5 per 100,000 in adolescents. Survival rates were 4.7% and 7.7%, respectively (6).

These emergencies frequently occur in out-of-hospital settings, where parents or caregivers are the first responders. The prompt and effective application of basic life support (BLS) maneuvers is associated with improved survival rates. Therefore, it is essential that caregivers possess adequate knowledge and skills in these techniques (7). However, despite medical advances, the prognosis of pediatric cardiac arrest has not significantly improved, largely due to delays in initiating resuscitation maneuvers (6).

The American Heart Association (AHA) emphasizes the importance of training the general population in cardiac arrest management, highlighting that appropriate education can reduce morbidity and mortality by up to 20% (4). According to this organization, effective education is a key factor in improving survival outcomes. Short, frequent training sessions have been shown to enhance performance in simulations and reduce neonatal mortality, particularly in low-resource settings (8).

The effectiveness of resuscitation is directly related to the rescuer's level of training and response time. Therefore, training in pediatric cardiopulmonary resuscitation (CPR) for non-healthcare individuals should be considered a cost-effective strategy and a key component in preventing cardiac arrest (6).

### **1.1. Study Rationale**

Theoretical and practical knowledge of CPR and FBAO management is essential to improve survival rates in emergency situations. Although there is increasing public awareness of the importance of learning these techniques, most training programs are aimed at adults and primarily focus on care for older individuals or adolescents.

In the pediatric field, especially in infants under one year of age, evidence on the effectiveness of training programs for caregivers remains limited. No community-based interventions or structured training programs specifically targeting parents of this population have been identified, despite the fact that the first minutes of response in an emergency are critical for the child's survival.

Furthermore, numerous studies report that parents experience fear, anxiety, and insecurity when facing the possibility of managing choking or cardiac arrest situations in their children (9, 10). This perceived vulnerability highlights the need to design and implement training programs with both theoretical and practical components tailored to caregivers of infants under one year of age. The aim is to strengthen their knowledge and skills, promoting a rapid and effective response to emergencies, which may contribute to reducing infant morbidity and mortality. Despite the clinical and social relevance of this issue, no scientific literature has been identified that specifically addresses self-efficacy and knowledge levels in CPR and FBAO management among caregivers of infants under one year of age. Most available

studies focus on pediatric populations with underlying clinical conditions or on training professionals in the educational sector, leaving a knowledge gap in this particularly vulnerable group. This lack of evidence highlights the urgent need for research to assess caregivers' competencies and preparedness in order to develop effective, tailored educational strategies.

## **2. HYPOTHESIS AND OBJECTIVES**

### **General Hypothesis**

A theoretical–practical training workshop on pediatric cardiopulmonary resuscitation and foreign body airway obstruction management is more effective than the provision and explanation of an informational leaflet in improving knowledge and self-efficacy among caregivers of children under one year of age.

### **Null Hypothesis ( $H_0$ )**

There is no significant difference in knowledge levels or self-efficacy among caregivers of children under one year of age after attending a theoretical–practical workshop compared to receiving and reviewing an informational leaflet on pediatric CPR and FBAO management.

### **Alternative Hypothesis ( $H_1$ )**

There are significant differences in knowledge and self-efficacy levels among caregivers of children under one year of age after attending a theoretical–practical workshop compared to receiving and reviewing an informational leaflet, with higher levels achieved following the workshop.

### **Objective**

To evaluate and compare the effectiveness of a theoretical–practical workshop versus the provision and explanation of an informational leaflet in improving knowledge and self-efficacy in pediatric CPR and FBAO management among caregivers of children under one year of age.

## **3. METHODOLOGY**

This project was designed following the CONSORT 2025 guidelines for randomized clinical trials (11).

The study was approved by the Primary Care Management of Cantabria and by the Research Ethics Committee with Medicines of Cantabria (protocol code: 2025.404). Participation was voluntary, informed consent was obtained from all participants, and the study adhered to the ethical principles outlined in the Declaration of Helsinki.

### **3.1. Study Design**

A randomized crossover clinical trial was conducted, consisting of two intervention periods separated by a one-month washout period. Participants were randomly assigned in a 1:1 ratio to one of two intervention sequences (AB or BA), ensuring that each participant received both educational strategies in a different order.

A crossover design was selected due to its ability to reduce interindividual variability, as each participant serves as their own control. This approach allows for more precise estimation of intervention effects and optimizes resource use by requiring a smaller sample size. Random allocation of intervention order minimizes sequence effects, while the washout period reduces potential carryover effects.

Additionally, this design ensured that all participants received the experimental intervention (CPR and FBAO workshop), supporting both scientific validity and ethical considerations focused on participant benefit.

### **3.2. Study Setting**

The study was conducted in three Primary Care Health Centers in Cantabria, representing different geographical settings: rural, peri-urban, and urban.

Participant recruitment, intervention delivery, and data collection took place between December 2025 and March 2026.

### **3.3. Eligibility Criteria**

Participants were parents or caregivers of infants under 6 months of age enrolled in the Child Health Program. Only one caregiver per child was included.

#### **Inclusion Criteria**

Parent or close caregiver of an infant under 6 months

Registered in one of the selected health centers

Signed informed consent

#### **Exclusion Criteria**

Previous formal training in pediatric CPR

Participant recruitment was carried out during routine visits of the Child Health Program, from the newborn check-up to the 6-month visit, between December 2025 and January 2026, with slight variations depending on the health center.

Although the study targeted children under one year of age, participants were included if they had infants younger than 6 months at the time of recruitment or, if they were already 6 months old, had not yet attended the corresponding check-up. This criterion was established because, during the 6-month visit, caregivers are routinely provided with information on the introduction of complementary feeding, as well as instructions and educational materials on choking management, which could interfere with the study objectives. To avoid bias, it was agreed with the healthcare professionals involved that this information would not be provided during that visit to participants included in the study. This approach made it possible to include participants attending the 6-month check-up while ensuring that they had not

previously received training that could influence the results. Furthermore, throughout the study, it was verified that participants attending this visit did not receive such information, thereby maintaining consistency in the procedure across all included subjects.

### **3.4. Intervention and Comparator**

The study included two educational strategies: Intervention A (explained informational leaflet) and Intervention B (theoretical–practical workshop). Both interventions were carried out in the three participating Primary Care Health Centers between December 2025 and February 2026. Specifically, the workshops were conducted in December and January, while the informational leaflet was delivered between December and February, depending on the participants' assigned sequence.

#### **Intervention A**

This intervention consisted of the provision and brief explanation of an informational leaflet on how to respond to a choking episode in infants, based on current recommendations from the European Resuscitation Council (ERC, 2021) (12). This content is routinely provided to families during the 6-month child health visit within the Child Health Program in Cantabria. It is important to note that the leaflet focuses exclusively on choking management, as the program does not include training in cardiopulmonary resuscitation (CPR).

Within the context of this study, the leaflet was only delivered at the time corresponding to Intervention A. Both the explanation and delivery were carried out by the nurses responsible for pediatric consultations at each participating health center.

#### **Intervention B**

This intervention consisted of a structured training workshop. Each session lasted between 60 and 90 minutes, with a maximum of 13 participants per group, and was delivered by three pediatric nursing residents who remained consistent across all sessions to ensure homogeneity.

The workshop was divided into two components:

Theoretical component:

Content was organized into two main blocks:

- Choking: common causes, primary prevention, and management of choking episodes in infants.
- Pediatric CPR: recognition of cardiac arrest, CPR sequence and protocol, and when to contact emergency services.

Practical component:

Participants were divided into three subgroups, each guided by one nurse and using a pediatric simulation mannequin. Each participant individually managed a simulated choking scenario that progressed to cardiac arrest.

Both theoretical content and practical activities were designed in accordance with the official European Resuscitation Council (ERC, 2021) guidelines (12).

During recruitment visits, nurses explained the study and provided informed consent forms to interested caregivers. Once signed, participants were randomly assigned to one of two groups (AB or BA) using a computer-generated randomization sequence implemented by the research team.

The study procedures were then carried out according to group allocation:

#### **Group AB**

1. Pretest
2. Intervention A: informational leaflet with explanation
3. Immediate post-test 1 (after Intervention A)
4. Approximately one month later: Intervention B (workshop)
5. Immediate post-test 2 (after the workshop)
6. One month after the workshop: delayed post-test sent by email

#### **Group BA**

1. Pretest
2. Intervention B (workshop)
3. Immediate post-test 1 (after the workshop)
4. Approximately one month later: Intervention A (informational leaflet with explanation)
5. Immediate post-test 2 (after Intervention A)
6. One month after the second intervention: delayed post-test sent by email

### **3.5. Variables**

An ad hoc questionnaire (Appendix 3) was used, common to both groups and all assessment time points, consisting of three sections:

#### **Sociodemographic data:**

Health center, gender, age, educational level, relationship to the child, child's age, and number of siblings.

#### **Theoretical knowledge:**

Eleven multiple-choice questions with four response options, based on the recommendations of the European Resuscitation Council (ERC, 2021). Each correct answer was awarded 1 point, resulting in a total score ranging from 0 to 11. Of these 11 questions, four specifically assessed knowledge related to choking management in infants.

#### **Perceived self-efficacy:**

Five items measured on a 5-point Likert scale (1 = minimal confidence, 5 = maximum confidence). The overall self-efficacy score was calculated by summing the five items (range 5–25). In addition, each item was analyzed individually, including one specific item on choking, to explore perceived ability across different emergency situations.

### 3.6. Outcomes

The primary outcome of the study was the total score of theoretical knowledge on CPR and choking management (0–11).

Secondary outcomes included:

- Specific score of the 4 items on knowledge about responding to choking (0–4).
- Total global self-efficacy score (sum of the 5 items, 5–25).
- Choking-specific self-efficacy (1 exclusive item, 1–5).
- Analysis of individual self-efficacy items to explore perceived ability in other emergency situations.

All outcomes were measured at four time points: pretest, immediate posttest after the first intervention, immediate posttest after the second intervention, and delayed posttest one month after the second intervention, allowing assessment of both immediate effectiveness and persistence of learning.

### 3.7. Sample Size

To calculate the sample size, a previous quasi-experimental pre/post educational intervention study on CPR in parents of children attending swimming classes was used as a reference, in which correct responses on the knowledge questionnaire increased from 47.3% in the pre-test to 93.5% in the post-test (13). Accepting an alpha risk of 0.05 and a statistical power greater than 0.8 in a two-tailed test, 27 subjects per group (54 in total) were required, assuming that the initial proportion of events was 0.47 and the final proportion 0.93. A 20% loss-to-follow-up rate was estimated. The sample size calculation was performed using the GRANMO version 8.0 sample size calculator. The sample size distribution was determined according to the number of newborns in the last 6 months of 2024 per center (Table 1).

**Table 1. Sample size distribution by center.**

Center	NB 2024	% poblation	N to include
El Alisal	69	41,6	22 (11 per group)
Bezana	65	39,2	22 (11 per group)
Altamira	32	19,3	10 (5 per group)
Total	166	100	54

**Note.** NB: number of newborns in the last 6 months of 2024 at each health center.

### 3.8. Sequence Generation

The random allocation sequence to determine the order of intervention application (group AB or BA) was generated using randomization software by a researcher external to the recruitment and intervention process. Allocation was performed with a 1:1 ratio between the two possible sequences. This procedure

ensured that sequence generation was independent of the researchers who recruited or assessed participants, thereby minimizing the risk of selection bias.

### **3.9. Allocation Concealment Mechanism**

To ensure allocation concealment, the generated sequence was implemented using opaque, sealed, and sequentially numbered envelopes, each containing the assignment to one of the two possible intervention sequences. The envelopes were kept securely until the inclusion of each participant and were opened only after the informed consent was signed. This mechanism prevented researchers or healthcare professionals from knowing the assignment prior to participant enrollment.

### **3.10. Implementation**

The nurses in charge of pediatric consultations recruited and enrolled the participants. After signing the consent form, the nurse opened the corresponding envelope and informed the participant of the intervention schedule according to the assigned sequence (AB or BA). In this way, the assignment was implemented independently of sequence generation, ensuring a transparent and bias-free process.

### **3.11. Blinding**

Since this is an educational intervention study, it was not possible to blind participants or the professionals delivering the interventions. However, outcome assessors remained blinded to the intervention order received by each participant to minimize the risk of bias in data collection and analysis.

### **3.12. Statistical Methods**

A descriptive analysis was performed for all study variables. Qualitative variables were summarized using absolute frequencies and percentages, while quantitative variables were summarized using mean and standard deviation (SD) or median and interquartile range, depending on their distribution. The normality of quantitative variables was assessed through graphical inspection and normality tests.

Since this is an educational intervention and learning acquired after the first intervention may persist over time, a potential carryover effect between periods was considered. For this reason, the main analysis of immediate effectiveness was defined based on the first intervention period (immediate posttest 1), comparing post-intervention scores between participants who initially received the theoretical-practical workshop and those who initially received the explained information sheet (equivalent to the comparison between BA vs AB sequences in the first period).

For this primary analysis, a general linear model (ANCOVA) was used, with the post-intervention knowledge score (0–11) as the dependent variable, the intervention received in the first period (workshop vs information sheet) as the fixed factor, and the baseline score (pretest) as a covariate. Additionally, the health center was included as a covariate/factor to control for possible differences in care context. Adjusted means, adjusted mean differences between interventions, 95% confidence intervals (CI), p-values, and effect sizes (partial  $\eta^2$ ) were reported.

As secondary analyses, the same approach was applied to:

- The specific score on choking response, calculated from the first four questions of the knowledge section of the questionnaire (Annex 3).

- Global self-efficacy, calculated as the sum of the 5 items on the Likert scale (total range: 5–25 points).

An exploratory analysis by individual self-efficacy items was also conducted, using analogous models adjusted for the baseline score of the corresponding item. Due to the multiple nature of these comparisons, item-level results were interpreted as exploratory, and a multiple comparison correction was applied using the Tukey method for post hoc comparisons.

To leverage information from all assessment points (pretest, immediate posttest 1, immediate posttest 2, and delayed posttest), a secondary longitudinal analysis was planned using linear mixed models with a random intercept for each participant. Fixed effects in these models included assessment time, intervention sequence (AB/BA), the time × sequence interaction, and the health center. This analysis allowed description of the temporal evolution of knowledge and self-efficacy, as well as exploration of the persistence of the intervention effect and potential sequence differences. Estimated coefficients ( $\beta$ ), their 95% confidence intervals (CI), and p-values were reported. The  $\beta$  coefficients represent the mean change in the dependent variable relative to the baseline (pretest).

Losses to follow-up were described by sequence (AB/BA) and assessment time. The primary analysis was conducted with participants with available data for the first period (complete-case analysis for the primary outcome), while longitudinal mixed models allowed inclusion of all available information per participant under the assumption of missing-at-random data.

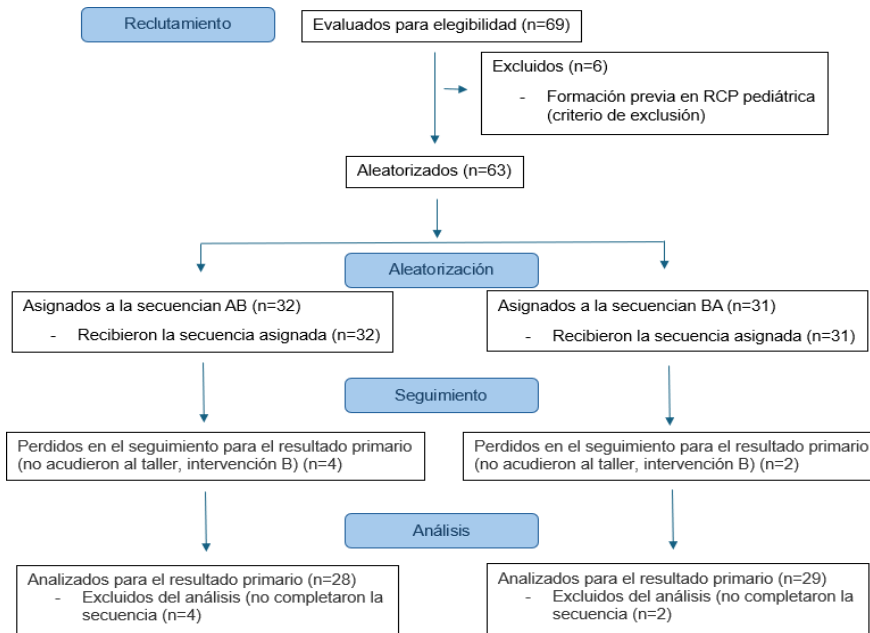
Statistical analysis was performed using jamovi software (version 2.7.6). A two-sided significance level of  $p = 0.05$  was established. Results are presented as point estimates with their corresponding 95% confidence intervals (CI).

## 4. RESULTS

### 4.1. Participants and Study Flow

A total of 63 participants were initially recruited, of whom 32 were assigned to sequence AB and 31 to sequence BA. Ultimately, 57 participants completed the preliminary outcome analysis, with 6 losses to follow-up, mainly due to incomplete questionnaire responses. The participant flow diagram is shown in Figure 1.

**Figure 1. Flow diagram**



#### 4.2. Baseline Characteristics of the Sample

The analyzed sample consisted of 63 parents of infants under 6 months of age, with a mean age of  $34.4 \pm 4.75$  years, predominantly women (85.7%). The sociodemographic and clinical characteristics of the total sample (and by AB/BA sequence) are presented in Table 2. No relevant differences were observed between sequences for the main baseline variables ( $p > 0.05$ ).

**Table 2. Sociodemographic characteristics of the sample.**

Variable	Categoría	n (%) / Media $\pm$ DT Total	n (%) / Media $\pm$ DT Grupo AB	n (%) / Media $\pm$ DT Grupo BA
Centro de salud	Altamira	13 (20,6%)	8 (12,7%)	5 (7,9%)
	Bezana	25 (39,7%)	12 (19,0%)	13 (20,6%)
	El Alisal	25 (39,7%)	13 (20,6%)	12 (19,0%)
Género	Mujer	54 (85,7%)	30 (47,6%)	24 (38,1%)
	Hombre	9 (14,3%)	3 (4,8%)	6 (9,5%)

<b>Edad (años)</b>		34,4 ± 4,75	34,7 ± 4,33	34,1 ± 5,23
<b>Nivel educativo</b>	Estudios universitarios	32 (50,8%)	18 (28,6%)	14 (22,2%)
	Formación profesional	22 (34,9%)	12 (19,0%)	10 (15,9%)
	Bachillerato	6 (9,5%)	2 (3,2%)	4 (6,3%)
	ESO	2 (3,2%)	0 (0,0%)	2 (3,2%)
	Educación Primaria	1 (1,6%)	1 (1,6%)	0 (0,0%)
<b>Parentesco con el bebé</b>	Padre/Madre	63 (100%)	33 (52,4%)	30 (47,6%)
<b>Edad del bebé</b>	< 1 mes	4 (6,3%)	4 (6,3%)	0 (0,0%)
	1 mes	14 (22,2%)	5 (7,9%)	9 (14,3%)
	2 meses	11 (17,5%)	6 (9,5%)	5 (7,9%)
	3 meses	9 (14,3%)	5 (7,9%)	4 (6,3%)
	4 meses	14 (22,2%)	8 (12,7%)	6 (9,5%)
	5 meses	8 (12,7%)	3 (4,8%)	5 (7,9%)
	6 meses	3 (4,8%)	2 (3,2%)	1 (1,6%)
<b>Número de hermanos</b>	0	40 (63,5%)	24 (38,7%)	16 (25,8%)
	1	21 (33,3%)	9 (14,5%)	11 (17,7%)
	2	1 (1,6%)	0 (0,0%)	1 (1,6%)
	>3	1 (1,6%)	0 (0,0%)	1 (1,6%)
<b>Puntuación Conocimientos Pretest</b>		4,97 ± 1,45	5,09 ± 1,53	4,84 ± 1,37
<b>Puntuación Autoeficacia Pretest</b>		9,79 ± 3,38	9,84 ± 3,19	9,74 ± 3,62

**Note.** Data are presented as frequency and percentage for categorical variables, and as mean  $\pm$  standard deviation (SD) for continuous variables.

### 4.3. Immediate Effectiveness of the Intervention

#### 4.3.1. Knowledge

In the primary analysis (first period), the theoretical-practical workshop showed a post-intervention knowledge score significantly higher than that of the explained information sheet, after adjusting for baseline score (and health center). The adjusted mean difference was 4.47 points (95% CI: 4.06 to 4.88), with  $p < 0.001$  and partial  $\eta^2 = 0.772$ .

The observed (unadjusted) means were  $9.38 \pm 1.05$  points for the workshop and  $5.04 \pm 1.65$  for the information sheet. The adjusted means were 9.44 (95% CI: 8.98–9.91) for the workshop and 4.97 (95% CI: 4.49–5.45) for the information sheet (Table 3).

**Table 3. Comparative effectiveness of the theoretical-practical workshop versus the information sheet on knowledge scores.**

Intervención	Media observada $\pm$ DT	Media ajustada (IC95%)	F (1,53); $\eta^2$ parcial; p	Diferencia ajustada (IC 95%)
Hoja informativa (Grupo AB)	5,04 $\pm$ 1,65	4,97 (4,49; 5,45)	F= 179,5; $\eta^2$ parcial= 0,772; p<0,001	4,47 (4,06 a 4,88)
Taller teórico-práctico (Grupo BA)	9,38 $\pm$ 1,05	9,44 (8,98; 9,91)		

Note. Values are presented as mean  $\pm$  standard deviation of the post-intervention knowledge score. The intervention effect was evaluated using analysis of covariance (ANCOVA) (F), with intervention (theoretical-practical workshop vs. information sheet) as a fixed factor and pretest knowledge score as a covariate. Partial  $\eta^2$ : effect size indicating the proportion of variance in the dependent variable explained by the intervention. 95% CI: 95% confidence interval. In the first period, sequence assignment was equivalent to the comparison between interventions (BA group: workshop; AB group: information sheet).

#### 4.3.2. Knowledge on Choking Response

In the analysis restricted to choking-related items, the workshop also showed a superior effect compared to the information sheet, with an adjusted mean difference of 1.43 points (95% CI: 1.08 to 1.78),  $p < 0.001$ , and partial  $\eta^2 = 0.556$ .

### 4.4. Perceived Self-Efficacy

#### 4.4.1. Global Self-Efficacy

Global self-efficacy (aggregate score of 5 items) was significantly higher after the theoretical-practical workshop than after the information sheet, adjusting for baseline score. The adjusted mean difference was 5.41 points (95% CI: 4.06 to 6.75),  $p < 0.001$ , and partial  $\eta^2 = 0.540$ .

#### 4.4.2. Exploratory Item-Level Analysis

In the exploratory item-level analysis, the workshop showed higher scores across all self-efficacy items. The largest effects were observed in items related to confidence in acting during a cardiopulmonary arrest ( $F(1,53) = 86.30$ ; partial  $\eta^2 = 0.619$ ;  $p < 0.001$ ), confidence in responding to choking ( $F(1,53) = 43.30$ ; partial  $\eta^2 = 0.450$ ;  $p < 0.001$ ), feeling prepared to act correctly in an emergency ( $F(1,53) = 50.23$ ; partial  $\eta^2 = 0.487$ ;  $p < 0.001$ ), and ability to make decisions in an emergency situation ( $F(1,53) = 31.60$ ; partial  $\eta^2 = 0.374$ ;  $p < 0.001$ ). Significant, though smaller, improvements were also observed in the ability to remain calm during an emergency ( $F(1,53) = 12.50$ ; partial  $\eta^2 = 0.191$ ;  $p < 0.001$ ) (Table 4).

After applying the Tukey correction for multiple comparisons ( $p < 0.001$ ), all individual items remained statistically significant.

**Table 4. Analysis of perceived self-efficacy: comparison between theoretical-practical workshop and information sheet.**

Efecto	F (1,53)	$\eta^2$ parcial	p	IC 95%	
				Intervención A (hoja informativa)	Intervención B (taller teórico-práctico)
Autoeficacia global	73,70	0,582	<0,001	10,1 a 11,8	15,2 a 16,8
Seguridad para actuar ante un atragantamiento	43,3	0,450	<0,001	1,94 a 2,39	2,98 a 3,41
Seguridad para actuar ante una parada cardiorrespiratoria	86,30	0,619	<0,001	1,54 a 1,97	2,95 a 3,37
Capacidad para tomar decisiones en una emergencia	31,60	0,374	<0,001	2,02 a 2,53	3,02 a 3,51
Sensación de preparación para actuar correctamente	50,23	0,487	<0,001	2,03 a 2,43	3,04 a 3,43
Capacidad para mantener la calma en una emergencia	12,50	0,191	<0,001	2,30 a 2,77	2,89 a 3,35

Note. Global self-efficacy (sum of the 5 items on the Likert scale) and each individual item were analyzed using ANCOVA models, adjusting for the corresponding pretest score. In the first period of the crossover design, the comparison between interventions is equivalent to the comparison between sequences (BA group: theoretical-practical workshop; AB group: explained information sheet). The 95% CI values represent the estimated adjusted means for each intervention. The item-level analysis was considered exploratory, and a multiple comparison correction was applied using the Tukey method for post hoc comparisons. Partial  $\eta^2$ : effect size. 95% CI: 95% confidence interval.

#### 4.5. Longitudinal Evolution and Retention

In the longitudinal analysis using linear mixed models, a significant effect of time on knowledge scores was observed ( $p < 0.001$ ), as well as a significant time  $\times$  sequence interaction ( $p < 0.001$ ). The evolution of scores suggests an immediate improvement following the intervention and an additional increase after the second intervention, regardless of the order in which they were received.

For global self-efficacy, the mixed models showed a significant effect of time ( $p < 0.001$ ) and a significant time  $\times$  sequence interaction ( $p < 0.001$ ), indicating a progressive increase in perceived self-efficacy following the educational interventions. Additionally, partial retention of improvement was observed at the one-month delayed posttest, with no significant differences between sequences, suggesting a convergence of the effects of both interventions over time. The estimated model coefficients for global self-efficacy are also shown in Table 5.

**Table 5. Longitudinal linear mixed models for knowledge and self-efficacy.**

Variable	Efecto	$\beta$ (IC95%)	p
Conocimientos totales	Post1 vs Pretest	2,22 (1,70; 2,74)	<0,001
	Post2 vs Pretest	3,64 (3,12; 4,16)	<0,001
	Post 1 mes vs Pretest	3,39 (2,87; 3,91)	<0,001
	Secuencia (AB vs BA)	-0,74 (-1,29; -0,19)	0,011
	Interacción Post1 $\times$ Secuencia	-4,73 (-5,77; -3,69)	<0,001
	Interacción Post2 $\times$ Secuencia	0,58 (-0,46; 1,63)	0,271
	Interacción Post 1 mes $\times$ secuencia	0,08 (-0,96; 1,13)	0,874

Conocimientos atragantamiento	Post1 vs Pretest	0,80 (0,56; 1,03)	<0,001
	Post2 vs Pretest	1,46 (1,23; 1,69)	<0,001
	Post 1 mes vs Pretest	1,39 (1,16; 1,62)	0,013
	Secuencia (AB vs BA)	-0,32 (-0,57; -0,07)	<0,001
	Interacción Post1×Secuencia	-1,24 (-1,70; -0,77)	<0,001
	Interacción Post2×Secuencia	0,51 (0,04; 0,97)	0,033
	Interacción Post 1 mes x Secuencia	0,43 (-0,03; 0,90)	0,067
Autoeficacia global	Post1 vs Pretest	3,82 (3,02; 4,61)	<0,001
	Post2 vs Pretest	6,30 (5,50; 7,10)	<0,001
	Post 1 mes vs Pretest	5,73 (4,93; 6,53)	<0,001
	Secuencia (AB vs BA)	-1,50 (-2,76; -0,25)	0,022
	Interacción Post1×Secuencia	-4,92 (-6,51; -3,33)	<0,001
	Interacción Post2×Secuencia	0,05 (-1,55; 1,64)	0,955
	Interacción Post 1 mes x Secuencia	-0,68 (-2,27; 0,92)	0,404

Note. Estimated coefficients ( $\beta$ ) were obtained from linear mixed models with a random intercept for each participant. The values represent the estimated difference relative to baseline (pretest). Time effects (Post1, Post2, and 1-month Post) indicate the mean change compared to the pretest. Sequence was coded as AB versus BA, and the time  $\times$  sequence interactions allow assessment of potential differential effects according to the order of interventions. 95% CI: 95% confidence interval.

For individual self-efficacy items, the linear mixed models also showed a significant effect of time for all items evaluated [ $p < 0.001$ ], as well as a significant time  $\times$  sequence interaction for most items [ $p < 0.05$ ], indicating a progressive increase in perceived confidence and preparedness to act in emergency situations. The evolution of scores suggests an earlier improvement in participants who initially received

the theoretical-practical workshop, as well as partial retention of improvement at the one-month delayed posttest. Estimated coefficients for each self-efficacy item are presented in Table 6.

**Table 6. Longitudinal linear mixed models for individual perceived self-efficacy items.**

Variable	Efecto	$\beta$ (IC95%)	p
Seguridad para actuar ante atragantamiento	Post1 vs Pretest	0,96 (0,71; 1,20)	<0,001
	Post2 vs Pretest	1,72 (1,48; 1,97)	<0,001
	Post 1 mes vs Pretest	1,46 (1,21; 1,70)	<0,001
	Secuencia (AB vs BA)	-0,31 (-0,58; -0,03)	0,033
	Interacción Post1×Secuencia	-0,91 (-1,40; -0,43)	<0,001
	Interacción Post2×Secuencia	0,20 (-0,29; 0,69)	0,419
	Interacción Post 1 mes x Secuencia	0,09 (-0,40; 0,57)	0,728
Seguridad para actuar ante parada cardiorrespiratoria	Post1 vs Pretest	0,97 (0,78; 1,16)	<0,001
	Post2 vs Pretest	1,58 (1,39; 1,77)	<0,001
	Post 1 mes vs Pretest	1,52 (1,33; 1,72)	<0,001
	Secuencia (AB vs BA)	-0,38 (-0,66; -0,09)	0,012
	Interacción Post1×Secuencia	-1,51 (-1,90; -1,12)	<0,001
	Interacción Post2×Secuencia	-0,01 (-0,40; 0,37)	0,940
	Interacción Post 1 mes x Secuencia	-0,33 (-0,72; 0,06)	0,094
Capacidad para tomar decisiones en una emergencia	Post1 vs Pretest	0,71 (0,48; 0,94)	<0,001
	Post2 vs Pretest	1,18 (0,95; 1,41)	<0,001
	Post 1 mes vs Pretest	1,04 (0,81; 1,27)	<0,001
	Secuencia (AB vs BA)	-0,24 (-0,52; 0,03)	0,087

	Interacción Post1×Secuencia	-0,85 (-1,31; -0,39)	<0,001
	Interacción Post2×Secuencia	0,22 (-0,24; 0,68)	0,355
	Interacción Post 1 mes x Secuencia	0,07 (-0,39; 0,53)	0,760
Sentirse preparado para actuar correctamente	Post1 vs Pretest	0,78 (0,60; 0,96)	<0,001
	Post2 vs Pretest	1,28 (1,10; 1,46)	<0,001
	Post 1 mes vs Pretest	1,16 (0,98; 1,34)	<0,001
	Secuencia (AB vs BA)	-0,34 (-0,58; -0,11)	0,006
	Interacción Post1×Secuencia	-0,92 (-1,28; -0,56)	<0,001
	Interacción Post2×Secuencia	0,08 (-0,28; 0,44)	0,661
	Interacción Post 1 mes x Secuencia	-0,10 (-0,46; 0,26)	0,584
Capacidad para mantener la calma durante una emergencia	Post1 vs Pretest	0,40 (0,20; 0,60)	<0,001
	Post2 vs Pretest	0,54 (0,34; 0,74)	<0,001
	Post 1 mes vs Pretest	0,56 (0,36; 0,76)	<0,001
	Secuencia (AB vs BA)	-0,23 (-0,58; 0,11)	0,183
	Interacción Post1×Secuencia	-0,72 (-1,12; -0,32)	<0,001
	Interacción Post2×Secuencia	-0,44 (-0,84; -0,04)	0,033
	Interacción Post 1 mes x Secuencia	-0,40 [-0,80; -8.77e-4]	0,050

Note. Estimated coefficients ( $\beta$ ) were obtained from linear mixed models with a random intercept for each participant. The values represent the estimated difference relative to baseline (pretest). Time effects (Post1, Post2, and 1-month Post) indicate the mean change from pretest for each self-efficacy item. Sequence was coded as AB versus BA, and the time  $\times$  sequence interactions allow assessment of potential differences according to the order of interventions. 95% CI: 95% confidence interval.

## 5. DISCUSSION

This study demonstrates that the theoretical-practical workshop on pediatric CPR and FBAO management was significantly more effective than providing and explaining an information sheet, both in improving knowledge and perceived self-efficacy in parents of infants under one year of age. The magnitude of the observed effects, particularly in knowledge acquisition, highlights the educational and clinical relevance of the intervention. The randomized crossover design allowed each participant to act as their own control, reducing the influence of individual variables such as educational level or prior experience, thereby strengthening the internal validity of the results. This methodological approach provides greater robustness than simple pre-post designs or observational studies used in some previous training interventions targeting parents and caregivers, which lacked a comparison group or random allocation (6,7). Overall, these findings support that the workshop constitutes a significantly more effective training strategy than explained written information.

Regarding knowledge, our findings reinforce previous evidence on the superiority of active learning over passive educational approaches. The information sheet, similar to educational interventions commonly described in protocols for preventing foreign body aspiration (2), may support basic theoretical acquisition but does not ensure deep understanding or correct execution of maneuvers. In contrast, the workshop combines structured explanation with deliberate practice using manikin simulation, an educational strategy that has been shown to improve acquisition and retention of practical skills in CPR training (14). The effect size observed in this study (partial  $\eta^2 = 0.77$ ) suggests that the type of educational intervention accounts for a very large proportion of the variability in acquired knowledge. These results are consistent with recommendations from the American Heart Association (AHA) (8), which state that repeated practice and skills-based training improve CPR retention and quality compared to purely theoretical methods. Similarly, the European Resuscitation Council (ERC 2025) guidelines (15) emphasize simulation and immediate feedback as essential elements for effective life-support training.

The results of this study highlight a significant training gap in basic life support knowledge among caregivers of young children. This situation was previously described by Camejo et al. (7), who observed that only a minority of parents of children under five reached levels considered sufficient in CPR and airway obstruction management. This low baseline level likely reflects the general population's limited exposure to structured pediatric resuscitation training, despite the fact that most pediatric cardiac arrests occur out-of-hospital, often at home, where family members are the first responders (16). In this context, our study shows that brief, structured educational interventions with a practical component can substantially improve caregiver knowledge. Similar findings were reported by Ramos Santana et al. (6), who observed significant improvements after CPR courses aimed at parents of hospitalized neonates.

However, unlike the aforementioned study, the crossover design used in our work allows for a more precise isolation of the effect of the educational intervention, reinforcing the interpretation that the observed improvement is primarily due to the practical training conducted during the workshop.

In particular, the improvement observed in items related to choking response is especially relevant, as the information sheet used as the comparator intervention included content exclusively on foreign body airway obstruction (FBAO) and did not cover cardiopulmonary resuscitation. Therefore, the analysis of these questions provides the most direct comparison between the two educational strategies on the same content. Even in this context, the workshop achieved significantly higher scores, suggesting that

the incorporation of supervised practice facilitates a better understanding and application of the maneuvers compared to exclusively informational strategies. This finding is consistent with previous studies that have shown better outcomes when CPR training incorporates practical or simulation components compared to educational methods based primarily on theoretical teaching (17,18). This aspect is particularly relevant in the case of FBAO, a relatively common emergency in infants and a preventable cause of child morbidity and mortality (2,4), with recent data highlighting its impact in Spain (3).

Regarding self-efficacy, several studies have noted that fear, anxiety, and insecurity can influence the actions of family members in critical situations (9,10). In this context, the significant improvement observed in confidence to act during cardiopulmonary arrest and in decision-making ability is particularly noteworthy, as it suggests that the workshop not only conveys information but also helps reduce psychological barriers to action. Literature on family presence during invasive procedures and pediatric resuscitation has described how perceptions of vulnerability and fear can influence parental behavior (9,10). Consistently, studies on CPR training have shown that structured training programs increase participants' confidence and reduce fears associated with performing resuscitation maneuvers (19), supporting the importance of educational interventions aimed at strengthening confidence to act in emergencies.

In this regard, practical simulation can play a key role, as it allows participants to experience the maneuvers in a controlled and safe environment, helping reduce fear of causing harm and facilitating the acquisition of confidence to act, in line with studies demonstrating that simulation-based training improves performance and participant safety in performing CPR maneuvers (20). From the perspective of social cognitive theory, mastery experience constitutes the most powerful source of self-efficacy, as successful task performance reinforces the perception of ability to repeat it in real situations (21). Supervised manikin practice provides precisely this direct achievement experience, allowing participants to familiarize themselves with resuscitation maneuvers under low-risk conditions. Consistently, the American Heart Association emphasizes that rescuer confidence is a relevant component within the chain of survival (8). Thus, the workshop not only improves technical knowledge but may also strengthen one of the most vulnerable links in the out-of-hospital setting: the initial decision to take action.

Another relevant finding was the persistence of improvement in knowledge and self-efficacy in the evaluation conducted one month after the last intervention. This result suggests that learning acquired through the workshop is not limited to an immediate post-training effect but demonstrates short-term retention. In this regard, a systematic review on simulation-based training in critical emergency skills described that, although performance tends to decline gradually over time, performance levels generally remain significantly above baseline for months after training (22). This pattern is consistent with the results observed in our study, where, despite a slight decrease compared to the immediate posttest, scores at the one-month follow-up remained clearly above baseline values, suggesting partial retention of learning.

From a public health perspective, these findings are particularly relevant considering the incidence of foreign body aspiration and associated mortality reported in the literature (2–4), as well as the high burden of out-of-hospital pediatric cardiac arrest and its low survival rates (5). In this context, early intervention by the caregiver can be decisive for neurological outcomes. However, most previous studies on pediatric resuscitation training have focused on parents of children with medical conditions or in hospital settings (6), and evidence remains limited regarding educational interventions aimed at caregivers of healthy infants in primary care.

Our results suggest that health education delivered during the six-month well-child visit could evolve from a model primarily based on the provision of written material toward more active training strategies, such as brief structured simulation workshops. The feasibility of this approach has been demonstrated in the present study, conducted in health centers with rural, urban, and peri-urban characteristics. This approach aligns with preventive recommendations included in protocols such as those of the Spanish Society of Pediatric Emergency Medicine, which highlight active education of caregivers as a key prevention strategy (5). In this regard, the evaluated training model could serve as a relevant community prevention tool aimed at improving early response to pediatric emergencies.

## **6. STUDY LIMITATIONS**

This study has several limitations that should be considered when interpreting the results.

First, although the design was conceived as a crossover trial with two intervention periods and a one-month washout period, the educational nature of the intervention makes it likely that some of the learning acquired in the first phase persisted over time. Therefore, a carryover effect between periods cannot be completely ruled out. This limitation is particularly relevant for variables such as knowledge and self-efficacy, which tend to persist after a training experience. For this reason, the primary analysis focused on the first intervention period, as it was not affected by this bias.

Second, the outcome assessment was based on self-administered questionnaires, which allow measurement of knowledge and perceived self-efficacy but do not directly evaluate actual technical performance of CPR and FBAO maneuvers in a standardized simulated scenario. Therefore, the results should be interpreted as an estimate of cognitive learning and perceived confidence, not as an objective measure of practical competence.

Third, although efforts were made to minimize bias through allocation concealment and blinding of evaluators to intervention order, it was not possible to blind either participants or the professionals delivering the training. Consequently, a performance bias inherent to this type of intervention cannot be excluded.

Additionally, the study was conducted in three health centers within the same Primary Care Management unit, which supports the local applicability of the results but may limit generalizability to other healthcare contexts or populations with different sociodemographic characteristics.

Furthermore, there were losses to follow-up (8 participants out of the initially recruited 63), which could introduce bias if these losses were not random. However, the main reasons were documented (difficulty attending sessions and failure to complete questionnaires), and a longitudinal analysis using mixed models was planned to utilize all available information.

Finally, the temporal follow-up allows evaluation of short-term retention but does not provide information on the medium- or long-term persistence of knowledge and self-efficacy. Therefore, studies with longer follow-up periods and assessment of objective practical skills will be necessary to confirm the sustained effectiveness of this type of intervention.

## 7. CONCLUSION

Based on the results of our study, we can conclude that:

- The theoretical-practical workshop is significantly more effective than providing and explaining an information sheet in improving knowledge of pediatric CPR and choking management among caregivers of infants.
- The workshop also significantly enhances specific knowledge on choking response compared to the information sheet.
- Perceived self-efficacy is higher after participation in the theoretical-practical workshop, increasing confidence to act, decision-making ability, and perceived preparedness in emergency situations.
- The workshop shows superior improvements across all self-efficacy items analyzed, particularly in confidence to act during cardiopulmonary arrest and choking events.
- Both interventions are associated with improvements in knowledge and self-efficacy over time, although the workshop produces a faster and greater magnitude of improvement.
- The effects of both interventions tend to converge after both are completed, showing a convergence of outcomes over time regardless of the order of application.
- Partial retention of learning is observed one month after the intervention, with levels remaining above baseline for both knowledge and self-efficacy, although a slight decrease is noted compared to the immediate posttest.
- Implementation of theoretical-practical workshops in primary care appears to be a feasible and potentially effective strategy to enhance caregivers' preparedness and response to pediatric emergencies.