Zagazig University Medical Journal
www.zumj.journals.ekb.eg
https://doi.org/10.21608/zumj.2024.261080.3100 Volume 30, Issue 1.1, - January 2024, Supplement Issue

Manuscript ID ZUMJ-2401-3100 (R1)
DOI 10.21608/ZUMJ.2024.261080.3100

Original article

Interventional Safety Program about Sudden Infant Death Syndrome among Egyptian Infants' Mothers

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Submit Date 06-01-2024
Revise Date 09-01-2024
Accept Date 11-01-2024

Abstract

Background: A more successful approach to reducing the incidence of Sudden Infant Death Syndrome (SIDS) was active caregiver education regarding safe sleep recommendations. Therefore, the purpose of this study was to assess the impact of an interventional safety program about SIDS on mothers' knowledge, attitude, and practice in order to enhance mothers' behaviors toward SIDS.

Methods: Between December 1, 2019, and March 31, 2022, an interventional study was conducted in the family health care centers and units located in the Al Sharqia Governorate, Egypt. In this study, 144 mothers with infants under a year old were split into two equal groups. The researcher conducted structured self-designed questionnaire interviews with all included mothers. The first questionnaire focused on socio demographic and clinical characteristics of the infant, while the second one (pre/post intervention) assessed mothers' knowledge, attitudes, and practices regarding safety measures to prevent SIDS.

Results: A highly statistically significant difference was found between them post-intervention where (90.3%, 26.4%), (87.5%, 23.6%), and (80.6%, 9.70%) of them had adequate total knowledge, attitude, and practice scores, respectively. There was no statistically significant difference between the two groups regarding total scores of knowledge, attitude, and practice pre-intervention where only (22.2%, 25.0%), (13.9%, 23.6%), and (12.5%, 16.7%) of them had adequate total knowledge, attitude, and practice scores, respectively.

Conclusions: There is a major state of inadequate levels of knowledge, attitude, and practice toward SIDS & its prevention between infants' mothers and implementation of an interventional safety program leads to highly significant improvement.

Key words: Intervention Program, Safety Measures, Sudden Infant Death Syndrome, Mothers.

INTRODUCTION

The definition of sudden infant death syndrome (SIDS) is the sudden, unexplained death of a baby younger than one year of age following a comprehensive investigation, a full autopsy, a review of the medical history, and an examination of the death scene. Since most SIDS cases involve babies sleeping in cribs, SIDS is also commonly referred to as crib death [1].

The United States of America (USA) saw 3,600 sudden unexpected infant deaths (SUIDs) in 2017, according to the Centers for Disease Control and Prevention (CDC) [2]. It appears that Native Alaskans, American Indians, and African

Americans have higher rates of SUID [1]. For most racial/ethnic groups, SIDS deaths accounted for the highest percentage of SUIDs; ranging from 40% of SUID among Hispanic infants to 47% of SUID among American Indian/Alaska Native infants. SIDS rates declined considerably from 130.3 deaths per 100,000 live births in 1990 to 35.4 deaths per 100,000 live births in 2017 [2]. In wealthy nations, SIDS is the most common cause of death for newborns [3]. Due to a lack of data from Egyptian national statistics and the fact that autopsy is typically not done, it is difficult to determine the exact incidence of SIDS among Egyptian infants [4, 5].

A proposed risk factors for SIDS as mentioned by Colson et al., included firstly: subclinical tissue damage from infection; Secondly: environmental triggers, such as poor nutrition and medical care; and thirdly: poor postnatal development of reflexes and responses. Additionally, the contemporary triple risk model proposes that when three conditions are present parallel, a SIDS occurs. These conditions are: first, the vulnerable infant (preterm birth, exposure to maternal smoking during pregnancy). Second a life-threatening development period (two to four months of age); the third is an exogenous stressor such as prone sleeping, head covering, co-sleeping, infection and overheating. Moreover, in epidemiological studies have shown that, when the infant placed on their stomachs to sleep at home, low birth weight or preterm babies may be at higher risk for SIDS than babies born at or after 37 weeks' gestational age [6].

In order to lower the risk of SIDS, the American Academy of Pediatrics (AAP) advises supine positioning, a solid sleep surface, room sharing without bed sharing, and staying away from soft bedding and excessive heat. The avoidance of exposure to tobacco, alcohol, and illicit drugs; breastfeeding; regular vaccinations; and the use of pacifiers are further recommended. The use of bedside and in-bed sleepers, sleeping on sofas and armchairs and in sitting devices, and using soft bedding after four months of age are all supported by new research [1].

Many initiatives have been made to inform families about this recommended baby sleep practices; nevertheless, their success has varied, particularly when it comes to populations who are more likely to experience SIDS [7]. If healthcare professionals and educational materials highlighted the rationale behind the guidelines and addressed typical parental concerns, adherence to safe sleep recommendations would be improved [8].

Maternal education about safe sleep and SIDS risk reduction recommendations resulted in decreasing this risk. Up To our knowledge the role of educational program on improving knowledge, attitude, practice of mothers toward it not be studied in Al Sharqia Governorate and with including control group not be studied in Egypt. So, this study aimed to assess the impact of an interventional safety program about SIDS on mothers' knowledge, attitude, and practice in order to enhance mothers' behaviors toward SIDS.

METHODS

Study Design and Setting:

An interventional research was done through period of 28 months from the beginning of December 2019 to the end of March 2022 in the family health care centers and units in Al Sharqia Governorate, Egypt.

Study participants:

Mothers of infants with age less than one year old were included in this study as SIDS occurs among infants less than one year old [1], and mothers coming to the primary health care (PHC) with their infants during the routine infants' vaccination sessions. All mothers of infants with diagnosed or possible health problems (e.g. congenital anomalies, chronic diseases, disabilities) detected through health records and examination were excluded.

Sampling:

Based on the assumption that mothers' knowledge of the risk of sleep-related infant death changed from 55.8% to 82.2% after participating in a health education program [9], the sample size was calculated to be 144 mothers, divided into two groups (72 mothers in the intervention group and 72 mothers in the control group). The sample was calculated using the Open Epi program at confidence interval 95%, power of test 80%, and dropout rate 25%.

The mothers who were chosen for inclusion were selected using a multistage random sampling technique as follows: The Zagazig and Belbeis health districts were chosen randomly to symbolize the 19 administratively split health districts that make up the Al Sharqia Governorate. Zagazig health district includes only one urban family health center & 31 rural family health units; the urban one was taken (Al-nahhal health center) & one from rural units was selected randomly by simple random technique (Guezera Al-ssada unit) to represent both urban & rural.

The Belbeis health district has 33 rural family health units and one urban family health center. To represent both urban and rural areas, one urban family health center (Belbeis family health center) was chosen, and one rural family health unit (Oulad Sif unit) was chosen by random procedure. Subsequently, participants were selected from the four selected health institutions based on a proportional allocation determined by each facility's attendance rate. Thus, 86 mothers from the urban area and 58 mothers from the rural area were participated. Ultimately, a basic random procedure was used to choose the study participants.

Study tools:

A) Questionnaires:

First interviewing questionnaire:

A structured questionnaire was self designed after reviewing the related literature and divided into two parts to collect data about socio-demographic characteristics and clinical characteristics of infant.

Part I: socio-demographic characteristics was guided by Fahmy et al., and included: name, age & marital status of mother, age of father, name, age & sex of infant, residence, address, telephone number, education, occupation, computer use, family size, crowding index, per capita income, sewage disposal, garbage disposal. Social class was divided into three levels: low (<19.2), medium (19.2- <33.6), and high (33.6-48) depending on the total score calculated was (48) [10].

Part II: clinical characteristics of infant was included questions about: pregnancy problems, delivery problems, type of delivery, gestational age at delivery, birth weight, having twins, infant's order, dead siblings, dead siblings due to SIDS, and family history of SIDS.

Second interviewing questionnaire:

A structured questionnaire was self designed following a study of the relevant literature. It was used pre / post intervention (after three months) to assess knowledge, attitude &practice of mothers as regard safety measures to prevent SIDS according to the AAP's guidelines for good sleep practices and lowering the risk of SIDS [1] and was guided by [9, 11, 12].

Part I: knowledge regarding SIDS and safety measures for its prevention to cover definition, causes, age of occurrence, importance, non modifiable & modifiable risk factors& behaviors, prevention & risk reduction and parents' role in prevention of SIDS.

Part II: attitude regarding safety measures for prevention of SIDS to cover the opinion of mothers about definition, age of occurrence, causes, changing several risk behaviors prevents SIDS, waiting more than two years between pregnancies, following antenatal care regularly, not taking drugs except with physician's prescription during pregnancy, not smoking and not taking alcohol and illicit drugs by mother through pregnancy & after birth, not smoking, not taking alcohol and illegal substances by father or any other household member during pregnancy and after birth, following breastfeeding, using pacifier during sleep, following routine immunization, non exposure of infant to multiple infections, sleeping infant in supine positions everyday, room sharing, non bed sharing and sleeping crib, sleeping surface &bedding, non covering infant's head or face and body with loose cover during sleep, non wrapping with covers during sleep, non exposure of infant to overheating during sleep, observation at intervals during sleep and parents' role in the risk reduction of SIDS.

Part III: practice regarding safety measures for prevention of SIDS to cover the following practice of mothers: following breastfeeding, using pacifier during sleep, following routine immunization, non exposure of infant to multiple infections, sleeping infant in supine positions everyday, room sharing, non bed sharing and sleeping crib, sleeping surface &bedding, non covering infant's head or face and body with loose cover during sleep, non wrapping with covers during sleep, non exposure of infant to overheating during sleep, and observation at intervals during sleep.

Total score of all knowledge items was (42), attitude was (32), practice was (22) on the base of scoring the answers as **(**Incorrect= 0, Correct =1). Adequacy of knowledge, attitude, and practice was as follows: cutoff point was 60% as less than 60% was considered as inadequate knowledge, attitude, or practice and equal or more than 60% was considered as adequate knowledge, attitude, or practice based on the previous literature [12]. Percent of changes in knowledge, attitude, and practice were calculated by using this equation: (after intervention score - before intervention score)/ pre intervention score x100 and the same cut off was used for categorized change to unsatisfactory and satisfactory.

B) Intervention safety program:

It was designed to cover the gap in the risk behaviors and to change knowledge, attitude, and practices of mothers regarding these risks based on reviewing the related literature and the recommendations of AAP on safe sleep & SIDS risk reduction in the intervention group only [1].

The following method was used to validate the questionnaires: back-translation of the English terms into the questionnaires was done. The original English surveys were translated into Arabic by five professionals. The Arabic version of the questionnaires was translated back into English by a bilingual individual. The questionnaires' original and back-translated versions were compared, paying close attention to the grammar and semantics. Therefore, five experts deemed the surveys to be legitimate (content validity).

Operational Design:

Before starting to collect the final data, a pilot study was conducted on 10% of the sample size (15 mothers) to test the feasibility of the study, as well as the clarity of the tool and to estimate the time needed to fill the questionnaire. The pilot study findings showed that the questionnaire was clear, relevant, and no adjustment was needed. The reliability of part II of first questionnaire was good with Cronbach's $\alpha = 0.870$. Also, the reliability of overall second questionnaire was excellent with Cronbach's $\alpha = 0.955$. The mothers selected in pilot study were included in the main sample.

The activities started with building the initial rapport with all chosen mothers and obtaining each mother's informed written permission. Then, all participants were interviewed and the questionnaires were filled for both groups by the researcher. Time was taken to fill the questionnaires about 30 minute.

Then, application of an interventional safety program by the researcher for each mother in the intervention group only. Each educational session lasted for 15 minute. The educational session was conducted through in-person interviews and one-on-one conversations by using the message and educational materials. The delivered message contained information about definition, age of occurrence, causes, importance, risk factors and behaviors (non modifiable & modifiable), prevention and risk reduction of SIDS. Educational materials (brochures and booklets) were used during the sessions and delivered to every woman in the group receiving intervention only to remind them with the needed information. During the following two months, each mother in the intervention group only received a phone call every two weeks to remind her with the needed information.

After three months, reassessment of knowledge, attitude and practice of each mother in both groups through filling the post test questionnaire that was the same pre test questionnaire. Filling the post test was done by the researcher and taken about 30 minute.

Administrative & Ethical Design:

The Institutional Review Board (IRB) at Zagazig University's Faculty of Medicine accepted the study protocol (ZU-IRB#5728/20-11-2019). The managers of the selected health care facilities and units as well as the family medicine department at Zagazig University's Faculty of Medicine provided the formal authorization. To get their assistance, the goals of the study were communicated to them. All mothers gave written informed consent, and they were free to leave the study at any moment without it having an adverse effect on their medical care. The participant's identity would be kept completely confidential, but the study's findings might be published in a scientific journal.

Statistical analysis:

The Statistical Package for Social Science (SPSS) (Version 20.0. Armonk, NY: IBM Corp) was used to analyze the data that were gathered. Frequencies and percentages were used to present qualitative data. Chi square ($\chi 2$) was utilized to identify differences between groups and the relationship between various qualitative factors. To find differences between the same group before and after the intervention, the MC Nemar test (MN) was employed. To correlate the percentage of changes in knowledge, attitude, and practice, Pearson correlation (r) was employed. P value of less than or equal to 0.05* was regarded as statistically significant.

We gave the control group educational messages and distributed brochures and booklets after this study was completed and after preliminary analysis of the data. This was deemed ethically necessary due to the low pre intervention knowledge, attitude, and practice among the control group and the demonstrated effect of the intervention on improving them.

RESULTS

A total of 144 mothers having infants of up to one year of age during the routine infants' vaccination sessions were included and split into two equal groups (72 mothers in intervention group and 72

mothers in control group) with no significant difference between them as regard all socio demographic and all infant clinical characteristics; ensuring comparability of both groups.

On studying knowledge, attitude & practice regarding SIDS and safety measures for its prevention among intervention and control groups pre intervention, there was no significant difference among both groups toward all items of knowledge, attitude, and practice where the highest correct answers were non following routine immunization increases risk of SIDS (43.1%, 50.0%), following routine immunization decreases risk of SIDS (40.3%, 48.6%), and following routine immunization (100%, 100%), while the lowest correct answers were smoking or taking alcohol or illicit drugs by father or any other household member during pregnancy increases risk of SIDS (5.60%, 8.30%), not smoking& not taking alcohol and illicit drugs by father or any other household member during pregnancy decrease risk of SIDS (5.60%, 8.30%), and non bed sharing (11.1%, 8.30%) among both groups respectively (Tables 1, 2, 3).

In addition, no significant difference was found between the two groups regarding the pre intervention total knowledge, attitude, practice scores where only (22.2%, 25.0%), (13.9%, 23.6%), and (12.5%, 16.7%) of them had adequate total scores respectively (Tables 1, 2, 3).

On the other hand, studying knowledge, attitude, and practice after intervention showed that there was highly significant difference between both groups toward all items except for wrapping with covers during sleep increases risk of SIDS, non wrapping with covers during sleep decreases risk of SIDS, and non wrapping with covers during sleep statistically significant difference was found respectively and all studied groups followed routine immunization (Tables 4, 5, 6).

Also, there was highly significant difference in between intervention and control groups regarding total knowledge, attitude, and practice scores post intervention where (90.3%, 26.4%), (87.5%, 23.6%), and (80.6%, 9.70%) of them had adequate scores respectively (Tables 4, 5, 6).

Pre-post intervention comparisons among the intervention group showed that highly significant improvement was showed toward all items and total scores of knowledge, attitude, practice where the highest correct answers were non room sharing increases risk of SIDS (97.2%), room sharing decreases risk of SIDS (97.2%), and non putting soft objects on crib during sleep (93.1%), while the lowest correct answers were wrapping with covers during sleep increases risk of SIDS (69.4%), not smoking& not taking alcohol and illicit drugs by father or any other household member during pregnancy decrease risk of SIDS (61.1%), and sleep on new/old intact crib (59.7%) post intervention respectively. On the other hand, the control group did not show any statistically significant preference for any of the questions or the overall knowledge, attitude, practice scores pre/post intervention.

As regard percent of change in total scores of knowledge, attitude, and practice among the intervention group, the majority (86.1%), (83.3%), and (79.2%) of them had satisfactory changes respectively (Figure 1).

Relationship between all socio demographic characteristics and percent of change in overall scores of knowledge, attitude & practice among the group of intervention showed that there was no statistically significant association except for crowding index where participants with ≥2-<4 crowding index were (4.7) and (3.9) times more likely to have unsatisfactory changes in attitude, and practice respectively.

Moreover, relationship between all infant clinical characteristics and percent of change in total scores of knowledge, attitude, and practice among the intervention group showed that there was no significant association except for family history of SIDS, dead siblings, and dead siblings due to SIDS where participants with positive findings were (10.1, 6.2, 4.9), (10.6, 4.5, 7), and (15.6, 8.8, and 4.8) times more likely to have unsatisfactory changes in knowledge, attitude, and practice respectively.

Finally, highly significant positive correlation was obtained between percent of change in total knowledge& attitude, total knowledge& practice, and total attitude& practice scores among the group of intervention (Figures S1, 2, 3 in supplementary file).

Table 1: Knowledge regarding SIDS and safety measures for its prevention among the studied groups pre intervention (n=144)

Correct knowledge	Intervention (n=72)		Control (n=72)		[a] P value
	No	%	No	%	
SIDS is the death of infant that can't be explained after a thorough case investigation	14	19.4	13	18.1	0.831
SIDS occurs with age < 1 year old	10	13.9	6	8.30	0.289
SIDS remains one of the leading causes of infants' mortality	31	43.1	35	48.6	0.503
Multiple factors and behaviors increase risk	20	27.8	22	30.6	0.714
Young age of parents increases risk	9	12.5	8	11.1	0.796
Pregnancy problems increases risk	8	11.1	11	15.3	0.460
Delivery problems increases risk	15	20.8	20	27.8	0.331
Preterm infant more liable	17	23.6	21	29.2	0.449
Low birth weight infant more liable	15	20.8	16	22.2	0.839
Twins more liable	11	15.3	17	23.6	0.206
Previous and family histories increase risk of recurrence	29	40.3	26	36.1	0.607
Short period between pregnancies increases risk	8	11.1	7	9.70	0.785
Non following antenatal care regularly increases risk	16	22.2	18	25.0	0.695
Taking nonprescribed drugs during pregnancy increases risk	5	6.9	7	9.70	0.546
Smoking or alcohol or illicit drugs by mother during pregnancy increases risk	13	18.1	9	12.5	0.354
Smoking or taking alcohol or illicit drugs by father or any other household member during pregnancy increases risk	4	5.60	6	8.30	0.512
Smoking or taking alcohol or illicit drugs by mother after birth increases risk	14	19.4	11	15.3	0.509
Smoking or taking alcohol or illicit drugs by father or any other household member after birth increases risk	7	9.70	7	9.70	1.00
Non breastfeeding increases risk	25	34.7	24	33.3	0.860
Non using pacifier during sleep increases risk	25	34.7	19	26.4	0.278
Non following routine immunization increases risk	31	43.1	36	50.0	0.404
Infant exposure of multiple infections increases risk	26	36.1	29	40.3	0.607
Sleep in non-supine positions increases risk	18	25.0	22	30.6	0.457
Non room sharing increases risk	23	31.9	24	33.3	0.859
Bed sharing increases risk	22	30.6	19	26.4	0.580
Sleep on old non intact crib increases risk	20	27.8	25	34.7	0.369
Sleep on open sided crib increases risk	30	41.7	27	37.5	0.609
Sleep on crib with portable rails increases risk	28	38.9	26	36.1	0.731
Sleep on a couch/armchair increases risk	16	22.2	18	25.0	0.695
Sleep in sitting devices increases risk	15	20.8	12	16.7	0.522
Sleep on soft surface or mattress increases risk	13	18.1	17	23.6	0.412
Putting soft objects on crib during sleep increases risk	23	31.9	25	34.7	0.724
Using loose bedding during sleep increases risk	27	37.5	23	31.9	0.484
Leaving toys on crib during sleep increases risk	30	41.7	26	36.1	0.494
Dangling cords or electric wires during sleep increases risk	19	26.4	18	25.0	0.849
Covering infant's head or face during sleep increases risk	30	41.7	32	44.4	0.736
Covering infant's body with loose cover during sleep increases risk	22	30.6	25	34.7	0.594
Wrapping with covers during sleep increases risk	29	40.3	32	44.4	0.613
Infant exposure to overheating during sleep increases risk	20	27.8	25	34.7	0.369
Non observing during sleep at intervals increases risk	27	37.5	29	40.3	0.732
SIDS prevented by controlling many risk factors and behaviors	19	26.4	21	29.2	0.710
Parents responsible for controlling many factors& behaviors that increase SIDS risk	21	29.2	16	22.2	0.340
Total score: Inadequate (<60%) Adequate (≥60%)	 56 16	 77.8 22.2	 54 18	 75.0 25.0	0.695

SIDS: Sudden infant death syndrome, [a]Chi square test, statistically significant (P≤0.05*), Highly significant (P≤0.001**)

Table 2 : Attitude regarding safety measures for SIDS prevention among the studied groups pre intervention (n=144)

Correct attitude	Intervention (n=72)		Control (n=72)		[a] P value
	No	%	No	%	
SIDS is death of infants with age <1 year, can't be explained after a thorough case investigation	13	18.1	11	15.3	0.655
Changing several risk behaviors prevents SIDS	17	23.6	20	27.8	0.567
Waiting >2 years between pregnancies decreases risk	5	6.90	4	5.60	0.731
Following antenatal care regularly decreases risk	11	15.3	17	23.6	0.206
Not taking drugs except with physician's prescription during pregnancy decreases risk	5	6.90	6	8.30	0.754
Not smoking& not taking alcohol and illicit drugs by mother during pregnancy decrease risk	12	16.7	8	11.1	0.335
Not smoking& not taking alcohol and illicit drugs by father or any other household member during pregnancy decrease risk	4	5.60	6	8.30	0.512
Not smoking& not taking alcohol and illicit drugs by mother after birth decrease risk	12	16.7	10	13.9	0.643
Not smoking& not taking alcohol and illicit drugs by father or any other household member after birth decrease risk	7	9.70	7	9.70	1.000
Breastfeeding decreases risk	25	34.7	24	33.3	0.860
Using pacifier during sleep decreases risk	24	33.3	19	26.4	0.363
Following routine immunization decreases risk	29	40.3	35	48.6	0.314
Non exposure of infant to multiple infections decreases risk	23	31.9	25	34.7	0.724
Sleep in supine position everyday decreases risk	17	23.6	21	29.2	0.449
Room sharing decreases risk	25	34.7	28	38.9	0.604
Non bed sharing decreases risk	18	25.0	16	22.2	0.695
Sleep on new/old intact crib decreases risk	23	31.9	26	36.1	0.598
Sleep on close sided crib decreases risk	28	38.9	27	37.5	0.864
Not sleep on crib with portable rails decreases risk	27	37.5	25	34.7	0.729
Not sleep on a couch/armchair decreases risk	13	18.1	17	23.6	0.412
Not sleep in sitting devices decreases risk	9	12.5	7	9.70	0.596
Sleep on firm surface or mattress decreases risk	12	16.7	14	19.4	0.665
Not putting soft objects on crib during sleep decreases risk	20	27.8	22	30.6	0.714
Using fitted bedding during sleep decreases risk	24	33.3	23	31.9	0.859
Not leaving toys on crib during sleep decreases risk	29	40.3	25	34.7	0.491
Non presence of dangling cords and electric wires during sleep decrease risk	18	25.0	16	22.2	0.695
Non covering infant's head and face during sleep decrease risk	27	37.5	30	41.7	0.609
Covering infant's body with a fitted cover during sleep decreases risk	21	29.2	24	33.3	0.590
Non wrapping with covers during sleep decreases risk	27	37.5	29	40.3	0.732
Non exposure of infant to overheating during sleep decreases risk	18	25.0	23	31.9	0.356
Observing infant during sleep at intervals decreases risk	25	34.7	26	36.1	0.862
Parents have a very important role in risk reduction of SIDS	18	25.0	14	19.4	0.423
Total score: Inadequate (<60%) Adequate (≥60%)	 62 10	 86.1 13.9	 55 17	 76.4 23.6	0.135

SIDS: Sudden infant death syndrome, [a]Chi square test, statistically significant (P≤0.05*), Highly statistical significant (P≤0.001**)

Table 3 Practice regarding safety measures for SIDS prevention among the studied groups pre intervention (n=144)

Correct practice	Intervention (n=72)		Control (n=72)		[a] P value
	No	%	No	%	
Following breastfeeding	31	56.9	33	54.2	0.737
Using pacifier during sleep	23	31.9	17	23.6	0.264
Following routine immunization	72	100	72	100	-
Non exposure of infant to multiple infections	19	26.4	24	33.3	0.363
Sleep in supine position everyday	17	23.6	20	27.8	0.567
Room sharing	29	40.3	33	45.8	0.501
Non bed sharing	8	11.1	6	8.30	0.574
Sleep on new/old intact crib	28	38.9	22	30.6	0.294
Sleep on close sided crib	21	29.2	25	34.7	0.475
Non sleep on crib with portable rails	25	34.7	26	36.1	0.862
Non sleep on a couch/armchair	12	16.7	15	20.8	0.522
Non sleep in sitting devices	22	30.6	16	22.2	0.257
Sleep on firm surface or mattress without gap	9	12.5	13	18.1	0.354
Non putting soft objects on crib during sleep	14	19.4	21	29.2	0.174
Using fitted bedding during sleep	24	33.3	22	30.6	0.721
Non leaving toys on crib during sleep	27	37.5	21	29.2	0.289
Non sleep in room with dangling cords or electric wires	15	20.8	16	22.2	0.839
Non covering infant's head or face during sleep	18	25.0	16	22.2	0.695
Covering infant's body with a fitted cover during sleep	21	29.2	18	25.0	0.574
Non wrapping infant with covers during sleep	26	36.1	27	37.5	0.863
Non exposure of infant to overheating during sleep	15	20.8	23	31.9	0.130
Observation during sleep at intervals	24	33.3	26	36.1	0.726
Total score: Inadequate (<60%) Adequate (≥60%)	 63 9.0	 87.5 12.5	 60 12	 83.3 16.7	0.479

SIDS: Sudden infant death syndrome, [a]Chi square test, statistically significant (P≤0.05*), Highly statistical significant (P≤0.001**)

Table 4 : Knowledge regarding SIDS and safety measures for its prevention among the studied groups post intervention (n=144)

Correct knowledge	Intervention (n=72)		Control (n=72)		[a] P value
	No	%	No	%	
SIDS is the death of infant that can't be explained after a thorough case investigation	68	94.4	14	19.4	<**0.001****
SIDS occurs with age < 1 year old	67	93.1	6	8.30	<**0.001****
SIDS remains one of the leading causes of infants' mortality	64	88.9	35	48.6	<**0.001****
Multiple factors and behaviors increase risk	66	91.7	22	30.6	<**0.001****
Young age of parents increases risk	59	81.9	9	12.5	<**0.001****
Pregnancy problems increases risk	58	80.6	11	15.3	<**0.001****
Delivery problems increases risk	60	83.3	20	27.8	<**0.001****
Preterm infant more liable	67	93.1	21	29.2	<**0.001****
Low birth weight infant more liable	61	84.7	16	22.2	<**0.001****
Twins more liable	56	77.8	17	23.6	<**0.001****
Previous and family histories increase risk of recurrence	62	86.1	26	36.1	<**0.001****
Short period between pregnancies increases risk	51	70.8	10	13.9	<**0.001****
Non following antenatal care regularly increases risk	60	83.3	18	25.0	<**0.001****
Taking nonprescribed drugs during pregnancy increases risk	55	76.4	8	11.1	<**0.001****
Smoking or alcohol or illicit drugs by mother during pregnancy increases risk	65	90.3	9	12.5	<**0.001****
Smoking or taking alcohol or illicit drugs by father or any other household member during pregnancy increases risk	53	73.6	6	8.3	<**0.001****

Correct knowledge	Intervention (n=72)		Control (n=72)		[a] P value
	No	%	No	%	
Smoking or alcohol or illicit drugs by mother after birth increases risk	66	91.7	11	15.3	<0.001**
Smoking or taking alcohol or illicit drugs by father or any other household member after birth increases risk	57	79.2	7	9.7	<0.001**
Non breastfeeding increases risk	69	95.8	24	33.3	<0.001**
Non using pacifier during sleep increases risk	62	86.1	21	29.2	<0.001**
Non following routine immunization increases risk	70	97.2	34	47.2	<0.001**
Infant exposure of multiple infections increases risk	59	81.9	29	40.3	<0.001**
Sleep in non-supine positions increases risk	67	93.1	22	30.6	<0.001**
Non room sharing increases risk	70	97.2	24	33.3	<0.001**
Bed sharing increases risk	67	93.1	18	25.0	<0.001**
Sleep on old non intact crib increases risk	54	75.0	26	36.1	<0.001**
Sleep on open sided crib increases risk	63	87.5	27	37.5	<0.001**
Sleep on crib with portable rails increases risk	58	80.6	26	36.1	<0.001**
Sleep on a couch/armchair increases risk	68	94.4	18	25.0	<0.001**
Sleep in sitting devices increases risk	61	84.7	13	18.1	<0.001**
Sleep on soft surface or mattress increases risk	68	94.4	17	23.6	<0.001**
Putting soft objects on crib during sleep increases risk	69	95.8	26	36.1	<0.001**
Using loose bedding during sleep increases risk	62	86.1	24	33.3	<0.001**
Leaving toys on crib during sleep increases risk	67	93.1	27	37.5	<0.001**
Dangling cords or electric wires during sleep increases risk	52	72.2	17	23.6	<0.001**
Covering infant's head or face during sleep increases risk	64	88.9	32	44.4	<0.001**
Covering infant's body with loose cover during sleep increases risk	56	77.8	28	38.9	<0.001**
Wrapping with covers during sleep increases risk	50	69.4	32	44.4	0.002*
Infant exposure to overheating during sleep increases risk	68	94.4	24	33.3	<0.001**
Non observing during sleep at intervals increases risk	57	79.2	29	40.3	<0.001**
SIDS prevented by controlling many risk factors and behaviors	64	88.9	21	29.2	<0.001**
Parents responsible for controlling many factors& behaviors that increase SIDS risk	62	86.1	17	23.6	<0.001**
Total score:					
Inadequate (<60%)	7.0	9.70	53	73.6	<0.001**
Adequate (≥60%)	65	90.3	19	26.4	

SIDS: Sudden infant death syndrome, [a]Chi square test, statistically significant (P≤0.05*), Highly significant (P≤0.001**)

Table 5: Attitude regarding safety measures for SIDS prevention among the studied groups post intervention (n=144)

Correct attitude	Intervention (n=72)		Control (n=72)		[a] P value
	No	%	No	%	
SIDS is death of infants with age <1 year, can't be explained after a thorough case investigation	66	91.7	11	15.3	<0.001**
Changing several risk behaviors prevents SIDS	63	87.5	20	27.8	<0.001**
Waiting > 2 years between pregnancies decreases risk	48	66.7	6	8.30	<0.001**
Following antenatal care regularly decreases risk	58	80.6	17	23.6	<0.001**
Not taking drugs except with physician's prescription during pregnancy decreases risk	50	69.4	7	9.70	<0.001**
Not smoking& not taking alcohol and illicit drugs by mother during pregnancy decrease risk	59	81.9	8	11.1	<0.001**
Not smoking& not taking alcohol and illicit drugs by father or any other household member during pregnancy decrease risk	44	61.1	6	8.30	<0.001**
Not smoking& not taking alcohol and illicit drugs by mother after birth decrease risk	62	86.1	10	13.9	<0.001**
Not smoking& not taking alcohol and illicit drugs by father or any other household member after birth decrease risk	46	63.9	7	9.70	<0.001**

Correct attitude	Intervention (n=72)		Control (n=72)		[a] P value
	No	%	No	%	
Breastfeeding decreases risk	64	88.9	24	33.3	<0.001**
Using pacifier during sleep decreases risk	61	84.7	21	29.2	<0.001**
Following routine immunization decreases risk	67	93.1	34	47.2	<0.001**
Non exposure of infant to multiple infections decreases risk	57	79.2	25	34.7	<0.001**
Sleep in supine position everyday decreases risk	64	88.9	20	27.8	<0.001**
Room sharing decreases risk	70	97.2	28	38.9	<0.001**
Non bed sharing decreases risk	63	87.5	16	22.2	<0.001**
Sleep on new/old intact crib decreases risk	52	72.2	25	34.7	<0.001**
Sleep on close sided crib decreases risk	56	77.8	24	33.3	<0.001**
Not sleep on crib with portable rails decreases risk	55	76.4	25	34.7	<0.001**
Not sleep on a couch/armchair decreases risk	65	90.3	16	22.2	<0.001**
Not sleep in sitting devices decreases risk	60	83.3	8	11.1	<0.001**
Sleep on firm surface or mattress decreases risk	65	90.3	14	19.4	<0.001**
Not putting soft objects on crib during sleep decreases risk	67	93.1	23	31.9	<0.001**
Using fitted bedding during sleep decreases risk	59	81.9	23	31.9	<0.001**
Not leaving toys on crib during sleep decreases risk	67	93.1	26	36.1	<0.001**
Non presence of dangling cords and electric wires during sleep decrease risk	48	66.7	15	20.8	<0.001**
Non covering infant's head and face during sleep decrease risk	64	88.9	30	41.7	<0.001**
Covering infant's body with a fitted cover during sleep decreases risk	53	73.6	26	36.1	<0.001**
Non wrapping with covers during sleep decreases risk	46	63.9	29	40.3	0.005*
Non exposure of infant to overheating during sleep decreases risk	65	90.3	20	27.8	<0.001**
Observing infant during sleep at intervals decreases risk	47	65.3	24	33.3	<0.001**
Parents have a very important role in risk reduction of SIDS	55	76.4	14	19.4	<0.001**
Total score:					
Inadequate (<60%)	9.0	12.5	55	76.4	<0.001**
Adequate (≥60%)	63	87.5	17	23.6	

SIDS: Sudden infant death syndrome, [a]Chi square test, statistically significant (P≤0.05*), highly statistical significant (P≤0.001**)

Table 6 : Practice regarding safety measures for SIDS prevention among the studied groups post intervention (n=144)

Correct practice	Intervention (n=72)		Control (n=72)		[a] P value
	No	%	No	%	
Following breastfeeding	56	77.8	29	40.3	<0.001**
Using pacifier during sleep	59	81.9	15	20.8	<0.001**
Following routine immunization	72	100	72	100	-
Non exposure of infant to multiple infections	54	75.0	21	29.2	<0.001**
Sleep in supine position everyday	57	79.2	18	25.0	<0.001**
Room sharing	65	90.3	34	47.2	<0.001**
Non bed sharing	49	68.1	6	8.30	<0.001**
Sleep on new/old intact crib	43	59.7	21	29.2	<0.001**
Sleep on close sided crib	54	75.0	23	31.9	<0.001**
Non sleep on crib with portable rails	53	73.6	23	31.9	<0.001**
Non sleep on a couch/armchair	62	86.1	15	20.8	<0.001**
Non sleep in sitting devices	60	83.3	12	16.7	<0.001**
Sleep on firm surface or mattress without gap	64	88.9	11	15.3	<0.001**
Non putting soft objects on crib during sleep	67	93.1	18	25.0	<0.001**
Using fitted bedding during sleep	58	80.6	20	27.8	<0.001**
Non leaving toys on crib during sleep	66	91.7	19	26.4	<0.001**
Non sleep in room with dangling cords or electric wires	44	61.1	15	20.8	<0.001**
Non covering infant's head or face during sleep	63	87.5	16	22.2	<0.001**
Covering infant's body with a fitted cover during sleep	52	72.2	14	19.4	<0.001**
Non wrapping infant with covers during sleep	45	62.5	26	36.1	0.002*

Correct practice	Intervention (n=72)		Control (n=72)		[a] P value
	No	%	No	%	
Non exposure of infant to overheating during sleep	65	90.3	20	27.8	**<0.001****
Observation during sleep at intervals	46	63.9	25	34.7	**<0.001****
Total score:					
Inadequate (<60%)	14	19.4	65	90.3	**<0.001****
Adequate (≥60%)	58	80.6	7.0	9.70	

SIDS: Sudden infant death syndrome, [a]Chi square test, statistically significant (P≤0.05*), Highly statistical significant (P<0.001**)

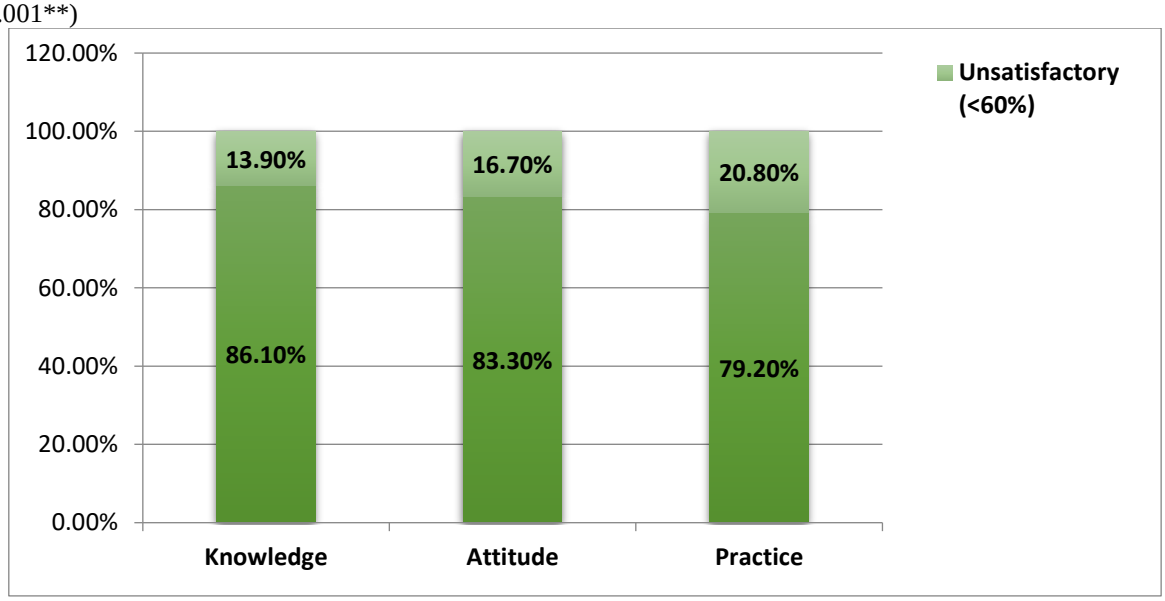

Figure 1 Compound bar for percent of change in total score of knowledge, attitude and practice regarding SIDS and safety measures for its prevention among intervention group (n=72), SIDS: Sudden infant death syndrome

DISCUSSION

SIDS continues to be one of the top causes of infant death worldwide [13]. More successful SIDS risk reduction was achieved through active caregiver education regarding safe sleep guidelines [11]. Therefore, the purpose of this study was to assess the impact of an interventional safety program about SIDS on mothers' knowledge, attitude, and practice in order to enhance mothers' behaviors toward SIDS.

Only (22.2%, 25.0%), (13.9%, 23.6%), and (12.5%, 16.7%) of the intervention and control groups had adequate total knowledge, attitude, practice scores regarding SIDS and safety measures for its prevention prior to the intervention with no statistically significant difference between the both groups regarding all items and total scores of them.

The inadequate levels of knowledge, attitude, and practice can be related to the fact that the parents' education is the responsibility of the medical team who considered the main source of knowledge to influence their practices, but the medical team may not have enough time to educate mothers with proper knowledge due to their shortage and increase workload.

Similarly, a study conducted by Elbilgahy et al., applying safe sleep intervention program for prevention of SIDS at Neonatal Intensive Care Unit at Mansoura University Children's Hospital and from Maternal and child health center at Met-Badr Khamis Egypt, demonstrated that the majority of mothers had poor knowledge, attitude, and practice about recommendation for safe sleep practice and SIDS prevention before intervention [12].

In matching but with slight differences from Elsobkey, who carried out an Egyptian study for mothers' health education based on health belief model to promote health of preterm infant related to SIDS in the Neonatal Intensive Care Units at Benha Specialized Pediatric Hospital and University Hospitals showed that the total mothers' knowledge regarding SIDS indicated that (44.3%) of them had satisfactory level of knowledge before health education

implementation and this percent was higher than the present result. Also, the total reported safe sleep practice indicated that (7.1%) of them had competent sleep practice pre health education implantation where it was lower than the percent at hand [14].

In a descriptive study conducted in Egypt, Mohamed et al., evaluated mothers' knowledge and practices regarding SIDS prevention in the postnatal department of a general hospital in Kafrelsheikh City. The majority of mothers (85%) had poor knowledge, whereas only 10.6% and 4.4% of them had average and good knowledge, respectively, regarding SIDS. However, an examination of the mothers' reported activities for SIDS prevention as a whole showed that over half (55.6%) of them were satisfied with SIDS [15].

Additionally, around 63.9 percent of the respondents in Alzahrani et al.,'s 2019 study on SIDS awareness among Saudi Arabian women reported having no prior knowledge of SIDS prevention messages [16].

Algwaiz et al., conducted a study to measure Saudi Arabian mothers' knowledge about SIDS and appropriate newborn sleep behaviors. The results showed that (48.9%) of the mothers were unaware, (43.8%) had adequate awareness, and (7.3%) were totally informed [17].

Furthermore, only (21%) of eligible newborns were in a safe sleep environment, according to Voos et al.'s study, "Implementing safe sleep practices in a neonatal intensive care unit," which was carried out in Kansas City [18].

These gaps in knowledge and awareness emphasize the significance of putting educational interventions and campaigns into action to raise public understanding of safe sleeping practices and other ways to reduce the risk of SIDS.

Thus, an examination of the knowledge, attitude, and practice following the intervention revealed a highly significant difference between the two groups for every item, with the exception that the following were all routinely immunized: wrapping with covers during sleep increases the risk of SIDS, not wrapping with covers during sleep decreases the risk of SIDS, and not wrapping with covers during sleep showed a statistically significant difference. In addition, a highly statistically significant difference was discovered in their overall scores, with both groups having appropriate total knowledge, attitude, and practice scores (90.3%, 26.4%), (87.5%, 23.6%), and (80.6%, 9.70%), respectively.

Pre-post intervention comparisons among the intervention group showed highly statistical significant improvement toward all items and total scores of knowledge, attitude, and practice where the highest correct answers were non room sharing increases risk of SIDS (97.2%), room sharing decreases risk of SIDS (97.2%), and non putting soft objects on crib during sleep (93.1%), while the lowest correct answers were wrapping with covers during sleep increases risk of SIDS (69.4%), not smoking& not taking alcohol and illicit drugs by father or any other household member during pregnancy decrease risk of SIDS (61.1%), and sleep on new/old intact crib (59.7%) post intervention respectively. While, no statistically significant deference was noted among control group toward all items & pre-post intervention total scores of knowledge, attitude, and practice.

According to Elbilgahy et al., they found that all measures of mothers' knowledge and attitude on SIDS prevention varied significantly in terms of statistical significance before and after program implementation. Furthermore, a statistically significant difference was observed between the overall score and every item related to mothers' practice before and after the intervention [12].

According to Elsobkey's study, there was a highly significant improvement in mothers' awareness and reported safe sleep practices regarding SIDS after one month of implementation, with percentages of 92.7%) and 94.3%), respectively, showing improvement. Furthermore, with respect to every knowledge and practice item, there were highly statistically significant variations between before and post implementation [14].

The two previous Egyptian studies had several limitations including study design and absence of control group, study setting, and sample technique, so their results can't be generalized and indicating the need for further Egyptian studies in the same and different settings taking in considerations the previously mentioned limitations as which happened in the current study.

These results were in line with those of Hamadneh, who discovered that Jordanian parents' education improved their understanding of and behavior related to the efficacy of safe sleep practices for their newborns [19].

The United States (US) study by Hutton et al. provided additional support for the previously indicated results, stating that program implementation resulted in a significant

improvement in the total safe sleep knowledge scores [20].

The current findings demonstrated that among the intervention group, there was a highly statistically significant positive association between the percent of change in total knowledge and attitude, total knowledge and practice, and total attitude and total practice scores. These outcomes can be explained by the idea that practice and attitude are dependent on knowledge.

But a lot of these current recommendations (such the AAP recommendation for a safe sleeping environment for infants) are impractical for our community because of social, economic, and psychological factors, and it will be difficult to shift this paradigm.

The current findings, along with earlier research, emphasize how crucial it is to teach parents about lowering their child's risk of SIDS and how nurses and other healthcare professionals may serve as role models for new parents by modeling appropriate newborn sleep positions and other preventive measures.

Limitations

The study at hand had some limitations including the results were more representative for infants' mothers holding vaccination and the effect of safe sleep intervention program didn't measure the incidence of SIDS after program implementation.

Conclusions & Recommendations

This study revealed a major state of inadequate levels of knowledge, attitude, and practice toward SIDS & safety measures for its prevention between infants' mothers and application of an interventional safety program lead to highly statistical significant improvement among them with a very strong link between the overall knowledge, attitude, and stated practices scores pointing to the importance of generalized adoption of such program.

Conflict of interest: The authors declare that they have no conflict of interest.

Financial disclosures: The authors declare that they have no funding support.

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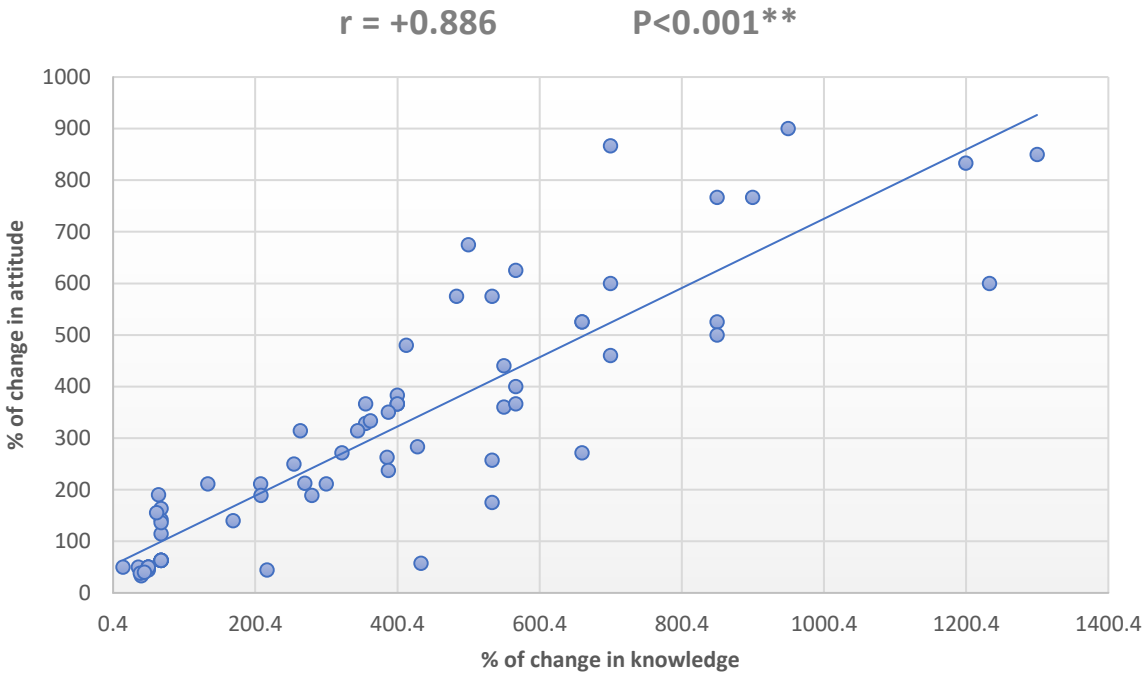
To Cite:

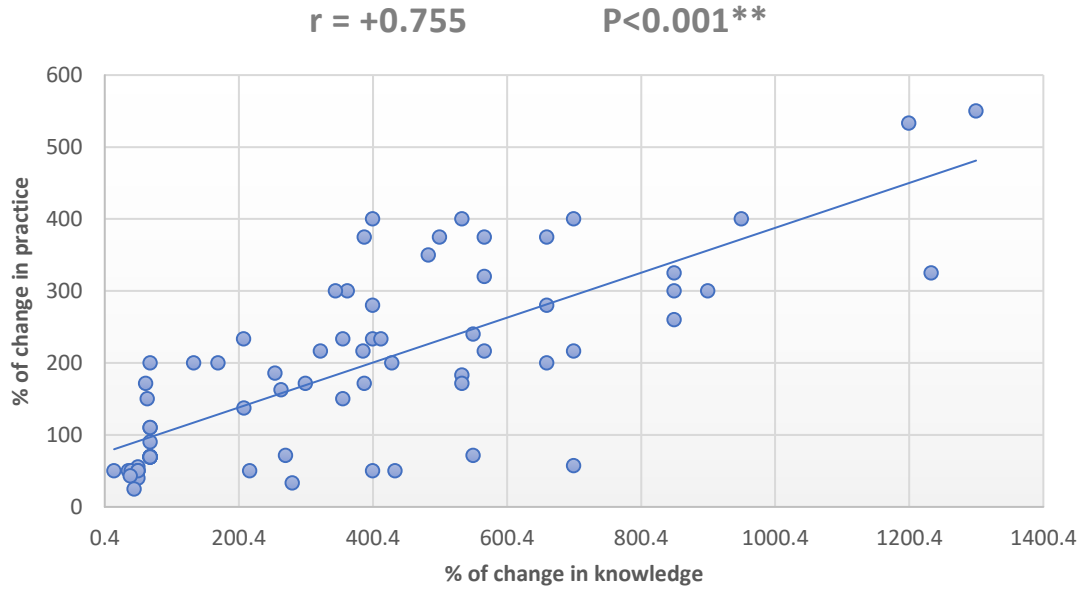
Bahgat, S., Abdelsalam, S., Elhewala, A., Foda, M. A., Hegazy, N. Interventional Safety Program about Sudden Infant Death Syndrome among Egyptian Infants' Mothers. ***Zagazig University Medical Journal*****, 2024; (352-367): -. doi: 10.21608/zumj.2024.261080.3100**

Supplementary Materials:



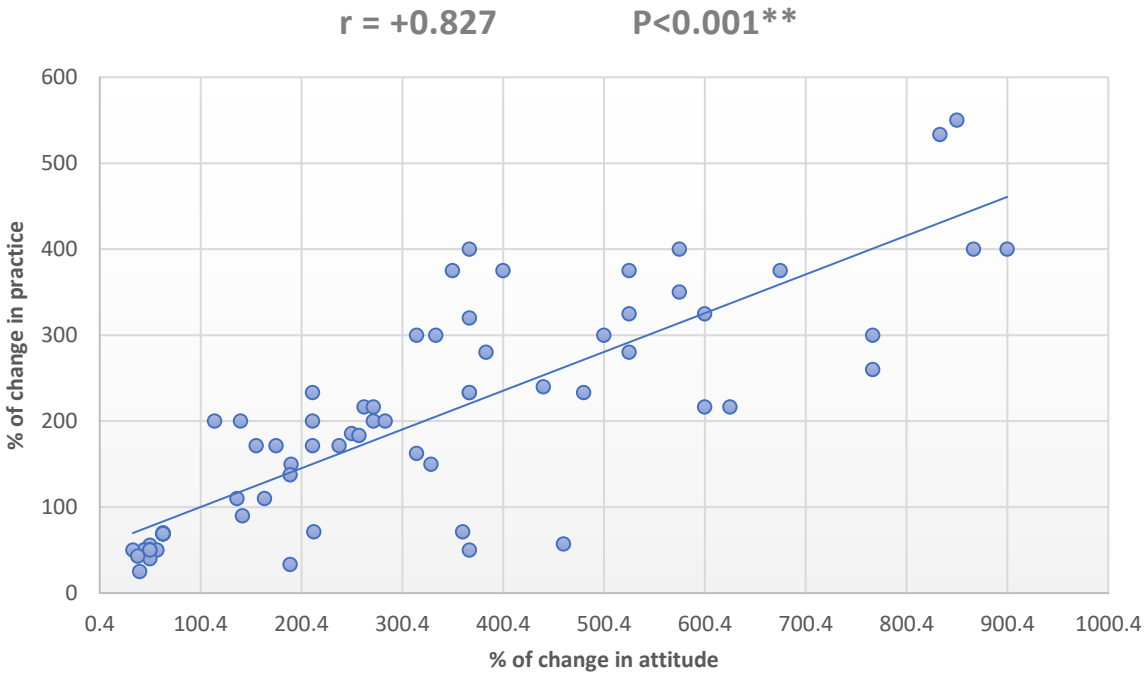
SIDS: Sudden infant death syndrome, statistically significant (P≤0.05*), Highly statistical significant (P≤0.001**)

Figure S1 Correlation between percent of change in total knowledge and in total attitude scores among intervention group (n=72).



SIDS: Sudden infant death syndrome, statistically significant (P≤0.05*), Highly statistical significant (P≤0.001**)

Figure S2: Correlation between percent of change in total knowledge and in total practice scores among intervention group (n=72).



SIDS: Sudden infant death syndrome, statistically significant (P≤0.05*), Highly statistical significant (P≤0.001**)

Figure S3: Correlation between percent of change in total attitude and in total practice scores among intervention group (n=72).