

Effectiveness of Calming Techniques on Children's Outcomes regarding Magnetic Resonance Imaging and Mothers' Satisfaction Level

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Abstract

Background: Psychological preparation for children undergoing magnetic resonance imaging can be achieved through applying different calming techniques that help anxious children to cope with the threatening situation and increased image quality. **Aim of study:** Was to evaluate effectiveness of calming techniques on children's outcomes regarding magnetic resonance imaging and mothers' satisfaction level. **Design:** A quasi-experimental design was utilized to conduct this study. **Setting:** The study was conducted at magnetic resonance imaging unit at Benha University Hospital. **Subjects:** Purposive sample of 159 children accompanied with their mothers were selected and divided equally into three groups (control group, study group1 and study group 2). **Results:** There is a significant decrease in level of anxiety and fear among children in study group1 compared with those in control group and study group2 30 minute after intervention and 1hr after performing magnetic resonance imaging. Also, there is improvement in level of knowledge and level of anxiety among mothers in study group 1 compared with those in control group and study group2 with increased level of satisfaction in study group1 1hr after applying magnetic resonance imaging. **Conclusion:** Applying calming techniques for children undergoing magnetic resonance imaging has positive effect in lowering children's anxiety, fear, mother's anxiety and increase mother's satisfaction level among study group1. **Recommendations:** Conducting continuous periodical education for nurses in MRI setting about the different methods of calming techniques that can be used for children before and during magnetic resonance imaging.

Keywords: Calming techniques, Children's outcome, Magnetic resonance imaging, Mother's satisfaction

Introduction

Magnetic Resonance Imaging (MRI) is one of the most important imaging techniques that uses radio waves and powerful magnet linked to computer to create detailed pictures of areas inside the body. Magnetic resonance imaging is a safe method used by pediatrician to provide excellent image quality without using ionized radiation therefore well-suited to children (Dong et al., 2019).

The value and accuracy of MRI depend on the absence of any movement by the child during the examination. But, avoiding movement may be difficult because of many factors as, confined space, difficulties lying still in the magnet, intravenous injection, fear of the unknown and noise from the switching gradient. So, pediatricians have to use sedation for children before MRI and expose children to various risks as hypoxemia, myocardial ischemia and arrhythmia, drug interactions and potential for overdose (Horeczko & Mahmoud 2021).

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Nurses play vital role in preparing children for MRI either physically or psychologically to make the actual examination more comfortable and complete the exam accurately. Physical preparation includes maintaining the correct position during imaging, remove metallic objects contacting the patient's skin to prevent burn, injection of contrast material into the bloodstream, and monitoring child. While psychological preparation is achieved through applying different calming techniques **(Daniela & Ciceri 2021)**.

Calming techniques are a variety of behavioral, environmental, and audiovisual techniques that can be applied to children before MRI to cope with situation and overcome children's fear and anxiety. All of calming techniques can be selected according to two factors, patient factor (age) and imaging factor **(Dong et al., 2019)**.

Several calming techniques include the use of illustrative books that include information about MRI. These books are designed in the form of colored, attractive stories that explain the process of MRI and how MRI machines work. Also, an animated video carton that can be viewed prior to the scan is also an important strategy to prepare children for MRI. It is developed to explain the procedure and the steps of the scanning by using different cartoon characters **(Janos et al., 2019)**.

Again, Providing children with the opportunity to explore the magnetic resonance imaging scanner (MRIS) and the examination room prior to the actual scan is promising but time-consuming and complex method to prepare children for magnetic resonance imaging so, play strategy is used to help

children familiarize with the exam **(Harrington et al., 2021)**.

Play strategy can be applied by using a small model of the magnetic resonance imaging unit with audible and visual appearance of the machine. The nurse should provide children and mothers with detailed information regarding the magnetic resonance imaging in easy understandable language before playing with the model of magnetic resonance imaging unit to be familiar with the situation **(Tziraki et al., 2021)**.

Calming children during MRI is better achieved through effective collaboration between mothers and nurses. Nurses usually have special consideration and attention to augment effective children calming and better mother satisfaction through providing sufficient information regarding MRI and enhancing mothers' participation in providing care for their children **(Kada et al., 2019)**.

Significance of the study

Magnetic resonance imaging in children remains relatively difficult because of claustrophobic and noisy environment of magnetic resonance imaging which is reflected through feeling of fear and anxiety. These feeling causing a set of problems as children crying, excessive movements, refusals, premature termination of imaging session, or poor quality imaging **(Ashmore et al., 2019)**.

Various strategies and techniques have been reported to decrease fear, anxiety and ensure comfort as well as cooperation of children during imaging sessions. Even more important, all of these strategies are evaluated alone, combination of more than one of these strategies is not evaluated yet. Thus, the

researcher found urgent to conduct this study hoping that the result may emphasizes on combination of more than one calming technique to achieve better outcomes (Greene et al., 2016).

Aim of the study:

This study aimed to evaluate the effectiveness of calming techniques on children's outcomes regarding magnetic resonance imaging and mothers' satisfaction level.

Research hypothesis:

-Children in the study group1 who receive calming techniques experience lower level of anxiety and fear than those in the control group and study group2.

-Mothers of children in the study group1 who receive calming techniques exhibit lower level of anxiety than those in the control group and study group2.

-Mothers of children in the study group1 who receive calming techniques exhibit higher level of knowledge than those in the control group and study group2.

- Mothers of children in the study group1 who receive calming techniques exhibit higher level of satisfaction

Subjects and Method

Research Design:

A quasi-experimental design was utilized in carrying out this study.

Setting:

The study was conducted at the magnetic resonance imaging unit affiliated to Benha University Hospital. The unit is located in the first floor. It is consisted of 2 rooms and corridor; the first room (scanning room) containing the MRI machine and the second room for the technician while the corridor

contains chairs for children to wait until entering the scanning room.

Subjects:

A purposive sample of 159 children accompanied with their mothers. They were divided into three groups (control group, study group1, study group2), each group were consisted of 53 child accompanied with their mothers. They were selected after fulfilled the following inclusion criteria: Children aged between 7-15 years, Children able to understand and communicate, the first time for performing MRI scanning

Exclusion criteria:

-Children with obvious developmental delay, Children with congenital anomalies as down syndrome, Children who have sever life threatening disease

Sample size:

Based on the finding of a previous study conducting by **Munn & Jordan, (2012)**, considering level of significance of 5%, and power of study of 80%, the sample size calculated using the following formula:

$$n = [(Z_{\alpha/2} + Z_{\beta})^2 \times \{2(SD)^2\}] / (\text{mean difference between the two groups})^2$$

Where: n = sample size required in each group, SD = standard deviation, $Z_{\alpha/2}$: This depends on level of significance, for 5% this is 1.96, Z_{β} : This depends on power, for 80% this is 0.84. Therefore, $n = [(1.96 + 0.84)^2 \times \{2(2.75)^2\}] / (1.5)^2 = 52.7$

Based on the above formula, the sample size required per group is 53children accompanied with their mothers.

Tools of Data Collection

Data were collected through the following tools:

Tool (I): Structured interview questionnaire sheet:

This tool was developed by the researcher and translated into Arabic language

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to assess personal data about children and their mothers regarding MRI. It consisted of:

Part1: characteristics of mothers such as: age, level of education, occupation and residence.

Part 2: characteristics of children such as: age, gender, child ranking and child education.

Part 3: Mother's knowledge about magnetic resonance imaging

This tool was designed by the researcher after reviewing scientific and relevant literature as **Rothman et al., (2016) and Thieba et al., (2018)**, to assess mother's knowledge regarding MRI. It includes 5 multiple choice questions about definition of MRI, limitation of procedure, how MRI scanner looked like, risks and preparation for procedure.

Scoring system for mother knowledge:

According to the answers collected from the mothers; a scoring system was applied to interpret mothers' knowledge assessment. The studied mothers' answers were checked and compared with the predesigned model answer that was given a score (2) for correct, complete answer, a score (1) for correct, incomplete answer, and score (0) for wrong answer or don't know.

The mother's total knowledge score:

The total scores level ranged from (0 - 10) grades which classified as the following:
Inadequate knowledge: < (6) grades or less than 60% of total knowledge score. Adequate knowledge: \geq (6) grades or more than or equal 60%.

Tool (II): State Anxiety Scale:

It was developed by **Spielberger, (1970)** to measure transitory anxiety state in children. The scale examines the short-term state anxiety that is commonly specific to

situations. The scale consists of 20 statements that ask children how they feel at particular time.

Scoring system for state anxiety scale: Children respond using three point-Likert scales (1=rarely, 2=sometimes and 3=often. The total scores ranged from 20-60 degree, so, the total level was categorized to Mild > 60% at total score (<36), Moderate 60>75% at total score (36 > 45) and Sever \leq 75% at total score \leq (45).

Tool (III): Children Fear Scale (CFS):

The CFS was developed by **McMurtry et al., (2011)** to measure fear in children. The scale consists of a row of five sex-neutral faces ranging from a no fear face on the far left (0) to a face showing extreme face on the far right (4). Scores on the CFS was converted to numerical scores and the total score is ranged from 0 - 4.

- 0 (no fear), 1 (a little bit more scared) or (mild scared), 2 (a bit more scared) or (moderate scared), 3 (more scared) or (moderate high scared), 4 (extremely fear)

Tool (IV): Hamilton Anxiety Rating Scale (HAM-A):

It was developed by **Shear et al., (2001)** and used to assess of mothers' anxiety level. The scale consists of 14 items, each defined by a series of symptoms, and measures both psychic anxiety (1 to 7 items) and somatic anxiety (8 to 14 items).

Scoring system for Hamilton Anxiety Rating Scale: Each item is scored on a scale of (0 =not present, 1=mild, 2=moderate, 3=sever and 4= very severe), with a total score range of 0–56, where 0 indicate no anxiety, <17 indicates mild severity, 18–24 mild to moderate severity, 25–30 moderate to severe and sever for more than 30.

Tool (V): Mothers' Satisfaction Questionnaire: (for study group (I))

It was designed by the researcher after reviewing scientific literature as **Munn & Jordan, (2012) and Andersson et al., (2016)** to assess level of mothers' satisfaction regarding calming techniques which applied to their children undergoing MRI. It consisted of 10 statements with three point-Likert scale ranged from unsatisfied (1) to satisfied (3).

Scoring system for mothers' satisfaction: The total scores ranged from 10-30. Accordingly, the total level was categorized to Low level of satisfaction > 60% at total score (>18), moderate level of satisfaction 60-75% at total score (18 > 23) and high level of satisfaction \leq 75% at total score (\leq 23).

Tools validity and reliability:

The content validity of the study tools was assessed and reviewed by a panel of three experts in the field of pediatric nursing (professors of pediatric nursing) specialty from faculty of nursing Benha University who are selected to test content validity of the tools and to judge its clarity, relevance, comprehensiveness, understanding and applicability. Reliability of the tools was applied by the researcher for determining the extent to which the items in the questioner were related to each other and for testing the internal consistency of the tools by administration of the same tools to same subjects under same condition. It was done by using Cronbach alpha coefficient test. The reliability of knowledge questionnaire was 0.910, reliability of satisfaction questionnaire was 0.897, the reliability of state anxiety scale is 0.881 and reliability of children fear scale is 0.873.

Ethical consideration:

An approval is obtained from Research Ethics Committee of Faculty of Nursing Benha University. A brief

explanation about the study aim, nature, and expected outcome was be given to assure the participants that information obtained will confidential and used only for the purpose of the study. Oral consent was taken from participants and assures them that they have the right to withdraw from the study at any time. The study should not have any physical, social or psychological risks on the participants.

Pilot study:

A pilot study was carried out on 10% (16) children and their mothers, to test the clarity and applicability of the tools and to estimate the required time to fulfill the study tools. Because there is no radical modifications were carried out on the study tools as revealed from results of pilot study therefore, the subjects were included in the study sample.

Field work

Data collection extended over a period of three months from first of September 2020 to the end of November 2020. Through this period, the researcher attended the study setting three days every week from 9 Am to 1Pm. The researcher started by introducing herself to the participants and giving them a brief idea about the aim and nature of the study prior data collection. The framework of the study was carried out according to 4 phases as the following:

- **Assessment phase:**

Assessment phase involved interviews with children and their mothers to collect baseline data. The researcher visited MRI unit affiliated to Benha University Hospital 3 days/week on (Sunday, Tuesday, Thursday) from 10Am to 1Pm, number of children and mothers taken every day was ranged from (4-5) . At

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the beginning of interview; the researcher welcomed children accompanied with their mothers, explained the purpose, duration, activity of the study and take their oral approval to participate in the study prior to data collection. Then the researcher gave the studied children anxiety and fear scale (**tool II and III**) (pre-test) for filling it and it took about 20 minute. After that the researcher gave the studied mothers questionnaire to assess their level of knowledge regarding MRI and level of anxiety (**tool I part (3) and tool IV**) for filling it, it took about 25 minute. This period of pretest took 4 weeks (from the beginning of September 2020 to the beginning of October 2020).

- **Planning phase:**

Based on baseline data obtained from assessment phase and relevant review of literature, the MRI calming techniques session was designed by the researcher for children and their mothers according to the children and mother's needs. Different calming technique methods (**MRI animation Video, MRI storybook and booklet and MRI model**) were designed to decrease children's level of fear and anxiety, decrease mother's anxiety and increase mother's level of knowledge and satisfaction regarding MRI. Different methods of teaching were used as brain storming and demonstration. Suitable teaching media included PowerPoint presentation using portable data show. This phase took about 1 month (from the beginning of October to the beginning of November)

- **Implementation phase:**

The researcher began with control group then study group 1 and study group2 to avoid sample bias and contamination. This

phase took 3 months from the beginning of November 2020 to the end of February 2021.

For (control group): routine care according to hospital policy was applied which include ask the child to remove any metal objects with him as (coins, hair pins, accessories, mobile) and put I.V cannula if contrast material will be used. Data collection for control group lasted for 1 month.

For (study group I):

Different pediatric calming techniques (MRI animation video, MRI model and MRI storybook or booklet) were applied for each child and his mother in one session before applying MRI. The session is applied for each child and his mother individually. Each session took from 30 -45minutes to discuss its items, taking into consideration attention span of children and mothers. During the session, children had watch MRI animation video, play with MRI model and read MRI storybook or booklet with the assistance of the mother or the researcher. Each child and his mother had the chance to ask any questions and the researcher replied clearly. Total number of session for all children in study group1 was 53 session over a period of one month.

For (study group II): Different entertainment calming techniques that not include information about MRI (Tom& Jerry carton, Mickey Mouse story and puzzle play) were applied for each child and his mother individually in one session before applying MRI scanning. The session is applied for each child and his mother individually. Each session took from 30 - 45minutes. Total number of session for all children in study group2 was 53 session over a period of 1 month.

- **Evaluation phase:**

Post-test has been done for the children in study groups 30 minute after intervention and one hour after performing MRI by using tools (**II and III**). Also, mother's level of anxiety was evaluated after 30 minute after intervention and one hour after performing MRI by using tools (**IV**) and knowledge level is evaluated after one hour by using (**tool I part 3**). Additionally mother's satisfaction level in study group I has been evaluated one hour after performing MRI by using (**tool V**).

Statistical analysis:

All statistical analysis were performed using SPSS for windows version 20.0 (SPSS, Chicago, IL). All continuous data were normally distributed and were expressed in mean \pm standard deviation (SD). Categorical data were expressed in number and percentage. The Student's t test was used for comparison between two for variables with continuous data. Correlation co-efficient test was used for determination of correlation between variables with continuous data. Chi-square test was used for comparison of variables with categorical data. Reliability (internal consistency) of the knowledge questionnaire, fear questionnaire, anxiety questionnaire and satisfaction questionnaire were calculated. Statistical significance was set at $p < 0.05$

Results

Table (1): Shows that, nearly one third of mothers in control group and study group1 (34%) are in the age group 30 <40, also, slightly less than half of study group2 (47.25%) are in the same age group with mean ages (34.2 ± 9.8 years, 33.6 ± 9.6 years and 34.5 ± 8.2 years) for the control group, both study groups (1 & 2), respectively. According to level of education, slightly less than half (49.1%) of mothers in control group have university education, also more than one

third (39.6% & 32.1%) of mothers in both study groups (1 & 2) also have university education, respectively.

Regarding the residence, less than two thirds (62.3% of mothers in control group and more than half (56.6%) of mothers in study group 1 are reside in urban area, while more than half of mothers in study group2 are reside in rural area. In reference to mother's work, nearly two thirds (62.3%) of mothers in control group are working. Again, more than half of mothers in both study groups (1&2) (54.7% and 56.6%) are working.

It is apparent from table (2) that, mean ages of studied children are (10.1 ± 3.2 , 9.5 ± 3.0 & 9.7 ± 3.2) for control group, both study groups (1 & 2). More than half (52.8%) of children in control group are males, while more than half (52.8% & 50.9%) of children in both study groups (1 & 2) are females. According to children ranking, more than one third of children in control group are the first (35.8%), again less than half (47.2%) of study group 1 and more than half of study group2 (52.8%) are the first also. It is noticed that, less than two thirds (64.2%) of control group are in primary school. Also, about three quarters (75.5% and 73.6) of both study groups (1 & 2) are in primary school.

Table (3): Shows that, more than three quarters (75.5% & 77.4% & 81.1%) of mothers in control group and both study group (1&2) have inadequate knowledge pre intervention. More than three quarters (79.2%) of mothers in study group1 have adequate knowledge 1hr after MRI while, more than three quarters of mothers in control group and study group2 have inadequate knowledge 1hr after MRI. This difference is highly significant at ($P < 0.001$).

Table (4): Reveals that, the majority of children in control group and both study group (1&2) (86.8% & 88.7% & 94.3) have sever anxiety pre intervention. 30 minutes

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after intervention, the majority of children in study group1 (86.8%) have mild anxiety while the majority of children in control group and study group2 (84.9% & 92.5%) have sever anxiety. 1hr after MRI, the majority of children in study group1 (83%) have mild anxiety while the majority of children (83.0% &90.6%) in control group and study group2 have sever anxiety. This difference is highly significant at ($P < 0.001$).

Table (5): Shows that, more than one third of children in control group and both study group (1&2) (37.7% &41.5% 35.8%) are moderately scared pre intervention. 30 minute after intervention, more than three quarters (79.2%) of children in study group1 have no fear while more than one third (41.5% & 39.6%) of control group and study group2 are moderately scared. 1hr after MRI, the majority of children (84.9%) in study group1 have no fear while slightly more than two fifth (41.5% & 43.3%) of control group and study group2 are moderately scared. This difference is highly significant at ($P < 0.001$).

Table (6): Clarifies that, more than half of mothers in control group and both study group(1&2) (50.9% & 52.8% & 50.9% respectively)have sever anxiety pre intervention. 30 minute after intervention, more than half (56.6%) of mothers in study group1 have mild anxiety while less than two thirds (62.3 % & 39.6% respectively) of mothers in control group and study group2 have moderate to sever anxiety. 1hr after MRI, more than three quarters (75.5%) of mothers in study group1 have no anxiety and more than three quarters and more than half (71.7% & 58.5% respectively) of mothers in control group and study group2 have mild to moderate anxiety. This difference is highly significant at ($P < 0.001$).

Figure (1): Reflects that more than three quarters of mothers in study group 1(79.2%) have high level of satisfaction regarding magnetic resonance imaging 1hr after MRI.

Table (1): Percentage distribution of the studied mothers regarding their characteristics (n= 159)

Mother's general characteristics	Control group n=(53)		Study group 1 n=(53)		Study group 2 n=(53)		Chi square test	
	No	%	No	%	No	%	X ²	P
Age (years)								
<20	3	5.7	3	5.7	0	0.0	X ¹ = 0.251 X ² = 4.639 X ³ = 4.4062	0.969 0.200 0.221
20 <30	14	26.4	16	30.2	14	26.4		
30 <40	18	34.0	18	34.0	25	47.2		
≥ 40	18	34.0	16	30.2	14	26.4		
Mean ±SD	34.2 ±9.8		33.6 ±9.6		34.5 ±8.2			
Level of education								
Illiterate	3	5.7	3	5.7	3	5.7	X ¹ = 1.214 X ² = 3.670 X ³ = 1.439	0.876 0.452 0.837
Read and write	4	7.5	5	9.4	8	15.1		
Preparatory education	8	15.1	8	15.1	5	9.4		
Secondary education	12	22.6	16	30.2	17	32.1		
University education	26	49.1	21	39.6	20	37.7		
Residence								
Rural	20	37.7	23	43.4	30	56.6	X ¹ =0.352 X ² =3.785 X ³ =1.849	0.552 0 0.051 0.174
Urban	33	62.3	30	56.6	23	43.4		
Mothers' work								
Housewife	20	37.7	24	45.3	23	43.4	X ¹ =0.621 X ² 0.352 X ³ 0.038	0.430 0.553 0.845
Working	33	62.3	29	54.7	30	56.6		

X¹: Control vs Study 1, X²: Control vs Study2, X³: Study 1 vs Study 2

Table (2): Percentage distribution of the studied children regarding their characteristics (n= 159)

Children's characteristics	Control group n= (53)		Study group 1 n= (53)		Study group 2 n= (53)		Chi square	P- value
	No	%	No	%	No	%		
Age (years)								
7 <9	17	32.1	19	35.8	19	35.8	X ¹ =1.657 X ² =1.112 X ³ =0.061	0.437 0.573 0.969
9 <12	17	32.1	21	39.6	20	37.7		
12 – 15	19	35.8	13	24.5	14	26.4		
Mean ±SD	10.1 ±3.2		9.5 ±3.0		9.7 ±3.2			
Gender								
Female	25	47.2	28	52.8	27	50.9	X ¹ =0.339 X ² =0.150 X ³ =0.037	0.560 0.698 0.846
Male	28	52.8	25	47.2	26	49.1		
Birth order								
First	19	35.8	25	47.2	28	52.8	X ¹ =1.772 X ² =5.245 X ³ =1.087	0.412 0.072 0.580
Second	18	34.0	17	32.1	18	34.0		
Third	16	30.2	11	20.8	7	13.2		
Child education								
Primary school	34	64.2	40	75.5	39	73.6	X ¹ =1.611 X ² =1.100 X ³ =0.049	0.204 0.294 0.823
Preparatory school	19	35.8	13	24.5	14	26.4		

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Table (3): Total knowledge level for the studied mothers' groups regarding MRI pre-intervention, 30 minutes after intervention and 1hr after MRI. (n= 159)

Mother's total level of knowledge								
Intervention Phases	Control group n= (53)		Study group 1 n= (53)		Study group 2 n= (53)		Chi square	P-value
	No	%	No	%	No	%		
Pre-intervention								
In adequate knowledge	40	75.5	41	77.4	43	81.1	X ¹ = 0.052 X ² = 0.5 X ³ = 0.229	0.819 0.479 0.632
adequate knowledge	13	24.5	12	22.6	10	18.9		
1hr after MRI								
In adequate knowledge	42	79.2	11	20.8	41	77.4	X ¹ =36.264 X ² =0.056 X ³ =33.974	<0.001** 0.812 <0.001**
adequate knowledge	11	20.8	42	79.2	12	22.6		

(**) Highly significant at P < 0.001

Table (4): Percentage distribution of the studied children's groups regarding total children anxiety level pre-intervention, 30 after intervention and 1hr after MRI. (n= 159)

Total children anxiety levels								
Intervention Phases	Control group n= (53)		Study group 1 n= (53)		Study group 2 n= (53)		Chi square	P-value
	No	%	No	%	No	%		
Pre-intervention								
Moderate anxiety	7	13.2	6	11.3	3	5.7	X ¹ =0.088 X ² =1.766 X ³ =1.093	0.767 0.183 0.296
Severe anxiety	46	86.8	47	88.7	50	94.3		
30 minute after intervention								
Mild anxiety	0	0.0	46	86.8	0	0.0	X ¹ =91.067 X ² =1.503 X ³ =95.818	<0.001** 0.220 <0.001**
Moderate anxiety	8	15.1	7	13.2	4	7.5		
Severe anxiety	45	84.9	0	0.0	49	92.5		
1hr after MRI								
Mild anxiety	0	0.0	44	83.0	0	0.0	X ¹ =88.000 X ² =1.317 X ³ =93.143	<0.001** 0.251 <0.001**
Moderate anxiety	9	17.0	9	17.0	5	9.4		
Severe anxiety	44	83.0	0	0.0	48	90.6		

(**) Highly significant at P < 0.001

Table (5): Percentage distribution of the studied children's groups regarding children fear level pre-intervention, 30 minutes after intervention and 1hr after MRI. (n= 159)

Children Fear level								
Intervention Phases	Control group n= (53)		Study group 1 n= (53)		Study group 2 n= (53)		Chi square	P-value
	No	%	No	%	No	%		
Pre-intervention								
Mild Scared	3	5.7	6	11.3	4	7.5	$X^1=1.680$ $X^2=0.168$ $X^3=1.204$	0.641 0.982 0.752
Moderate Scared	20	37.7	22	41.5	19	35.8		
Moderate-High Scared	19	35.8	17	32.1	19	35.8		
Extremely Fear	11	20.8	8	15.1	11	20.8		
30 minutes after intervention								
No fear	0	0.0	42	79.2	0	0.0	$X^1=94.266$ $X^2=1.175$ $X^3=88.888$	<0.001** 0.882 0.001**
Mild Scared	4	7.5	11	20.8	7	13.2		
Moderate Scared	22	41.5	0	0.0	21	39.6		
Moderate-High Scared	20	37.7	0	0.0	20	37.7		
Extremely Fear	7	13.2	0	0.0	5	9.4		
1hr after MRI								
No fear	0	0.0	45	84.9	0	0.0	$X^1=95.333$ $X^2=8.97$ $X^3=89.059$	<0.001** 0.061 <0.001**
Mild Scared	4	7.5	8	15.1	9	17.0		
Moderate Scared	22	41.5	0	0.0	23	43.4		
Moderate-High Scared	20	37.7	0	0.0	21	39.6		
Extremely Fear	7	13.2	0	0.0	0	0.0		

(**) Highly significant at P < 0.001

Table (6): Total anxiety level for the mothers among studied groups pre-intervention, 30 minutes after intervention and 1hr after MRI. (n= 159)

Total anxiety level for the mothers								
Intervention Phases	Control group n= (53)		Study group 1 n= (53)		Study group 2 n= (53)		Chi-Square	P-value
	No	%	No	%	No	%		
pre-intervention								
Mild to Moderate	5	9.4	4	7.5	6	11.3	$X^1=0.129$ 2 $X^2=0.115$ $X^3=0.442$	0.937 0.944 0.801
Moderate to Severe	27	50.9	28	52.8	27	50.9		
Severe anxiety	21	39.6	21	39.6	20	37.7		
30 minutes after intervention								
No anxiety	0	0.0	23	43.4	0	0.0	$X^1=106.0$ 0 $X^2=8.674$ $X^3=95.09$ 1	<0.001** 0.034 <0.001**
Mild anxiety	0	0.0	30	56.6	3	5.7		
Mild to Moderate	5	9.4	0	0.0	12	22.6		
Moderate to Severe	33	62.3	0	0.0	21	39.6		
Severe anxiety	15	28.3	0	0.0	17	32.1		
1hr after intervention								
No anxiety	0	0.0	40	75.5	0	0.0	$X^1=89.57$ 9 $X^2=7.113$ $X^3=76.53$ 3	<0.001** 0.030* <0.001**
Mild anxiety	6	11.3	13	24.5	17	32.1		
Mild to Moderate	38	71.7	0	0.0	31	58.5		
Moderate to Severe	9	17.0	0	0.0	5	9.4		

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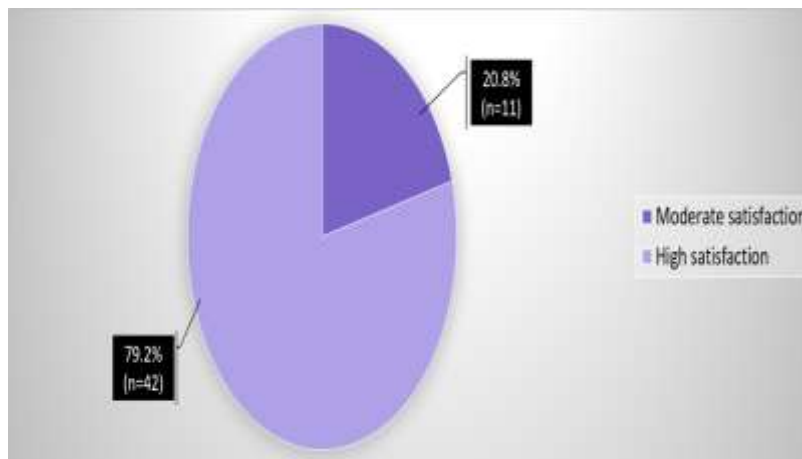


Figure (1): Distribution of total satisfaction for mothers in study group 1 regarding MRI

Discussion

The last three decades have seen a steady rise in the importance of MRI and in the number of MRI studies performed both for clinical purposes and for medical research. However, 10% to 37% of children undergoing MRI suffer from unpleasant effects of the procedure, particularly anxiety of various kinds, including claustrophobia. Children's parents may also experience short-term effects including increases in anxiety, heart rate and blood pressure **Bartik & Toruner (2018)**.

The findings of the current study reveal that mean ages of mothers in study group (1) are 33.6 ± 9.6 . This result is incongruence with **Rothman et al., (2016)** who conducted study in Israel about "preparation of children before MRI reduces the need for anesthesia? Prospective randomized control trial" and stated that mean ages of mothers in study group was 38 ± 6 . The reason for this difference may be due to difference in study sample culture and setting.

According to level of education, more than one third of mothers in study groups are highly educated. This finding is in accordance with **Rothman et al., (2016)** who found that about two quarters of studied mothers have

academic high education. This may be due to their residence in urban area so, interested in education.

The results of this study reveal that, mean ages of children in both study group (1&2) is 9.5 ± 3.0 and 9.7 ± 3.2 respectively. This result is on line with **Waitayawinyu & Wankan (2016)** who conducted study in Thailand about "The success of MRI without sedations in 6-15 years old pediatric patients after watching MRI introductory video" and stated that mean ages of children in study group was 9.8 ± 2 years.

The current study finding is in contrary with what said by **Bartik & Toruner (2018)** who conducted a study in France about "Effectiveness of a preoperative preparation program on children's emotional states and parental anxiety" and found that mean ages of study group was 7 ± 1.7 years .

According to level of education, nearly three quarters of children in study groups have primary education. This finding comes in line with **Olloni et al., (2021)** who conducted study in Denmark about " Pediatric MRI without Anesthesia: The Effect of Application-Supported Communication to Prepare the Child " and reported that most

children in study groups have primary education.

Regarding mothers total level of knowledge pre intervention, it is found that, more than three quarters of mothers in study group (1) have inadequate knowledge pre intervention. This finding is in the same line with **Gårdling & Månsson (2014)** who conducted study in Sweden about "Children's and Parent's Perceptions of a Magnetic Resonance Imaging" and stated that majority of parents, in study group have insufficient knowledge pre intervention regarding MRI Examination

The current study finding clarifies that more than three quarters of mothers in study group (1) have adequate knowledge 1hr after MRI. This result is contrary to **Hartman et al., (2009)** who conducted study in America about "Does a photo diary decrease stress and anxiety in children undergoing magnetic resonance imaging?" and reported that parents in study group have inadequate knowledge post intervention.

The finding of the present study shows that, the majority of children in study groups have sever anxiety pre intervention. This finding is in agreement with **Viggiano et al., (2015)** who conducted a study about "Impact of psychological interventions on reducing anxiety, fear and the need for sedation in children undergoing magnetic resonance imaging" and reported that the majority of children in study and control group have high level of anxiety pre intervention. The researcher attributed this result to their first time performing MRI.

This result is contrary to **Jaite et al., (2019)** who conducted study in China about "A comparison study of anxiety in 57 children undergoing brain MRI s children undergoing an electroencephalogram" and clarified that more than 98% of the children and adolescents stated that they had felt little or

no anxiety before MRI. This difference may be due to older ages of children sample in the previous study where mean age was 12.9 years.

The current study illustrates that majority of children in study group (1) have mild anxiety 30 minute after intervention. This finding comes in the line with **McGlashan et al., (2018)** who conducted study in England about "Evaluation of an internet- based animated preparatory vedio for children undergoing non-sedated MRI" and revealed that, the majority of children who viewed the animation had a good understanding of the MRI procedure and low anxiety levels after intervention (prior to the scan).

Also, this finding is parallel with previous studies conducted in England, Britannia and Canada that reported low anxiety level in children of study group post intervention (**Szeszak et al., 2016; Perez et al., (2019)**). This finding could be attributed to the fact that, children are attracted to topics that presented through different media.

This finding of this study is contradicted with what is found by **Hartman et al., (2009)** in his American study that contains 52 children and reported that, education group children had higher general anxiety after intervention. The researcher owing this difference to single use of illustrative material so, the provided information was unclear and incomplete.

In relation to children's level of fear, it is noticed that, about two quarters of children in control group are moderately scared pre and post intervention. This finding is contrary to **Everts et al., (2021)** who conducted study in Switzerland about " Fear and discomfort of children and adolescents during MRI: ethical consideration on research MRIs in children" and said that the majority of participants in control group experienced no or almost no

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fear after intervention. The researcher suggested that, this difference may be due to fear is perceived as individual feeling differed from child to other.

It was obvious from study findings that, more than one quarter of children in study group (1) are moderately scared pre intervention. These results agreed with Italian study conducted by **Viggiano et al., (2015)** and stated that fear was high for children in study group pre intervention at mean score 1.8 ± 3.0 .

The current study finding demonstrates that the majority of children in study group (1) have no fear 30 minute after intervention. This finding is similar to a recent study conducted by **Liszio et al., (2020)** about "Virtual Reality MRI: Playful Reduction of Children's Anxiety in MRI Exams" who found that a playful app help majority of children to be examined without fear. The researcher suggested that, this finding might be explained in the light of the fact that, helping children to gain information about certain topic leads to decrease fear from unknown.

The study finding clarifies that, about two quarters of children in study group 2 are moderately scared 30 minute after intervention. This is harmony with **Sparks (2001)**, who conducted study about "Using distraction to decrease pain. MCN "and states that level of fear doesn't decrease in control and study groups with mean 28.97 ± 8.07 for study group and 28.75 ± 9.61 for control group.

The current study finding is contraindicated with **Chad et al., (2018)** who conducted study about "Effect of virtual reality headset for pediatric fear and pain distraction during immunization" and stated that, 94.1% of patient reported that actual fear is improved following intervention.

The finding of the current study has highlighted that; about half of mothers in study group (1) have moderate to sever anxiety pre intervention. This finding is confirmed by **Gårdling et al., (2018)** who conducted study in Sweden about "Impact of Age-appropriate Preparations for Children With Cancer Undergoing Radiotherapy on Parents and Family Functioning, Parents' Anxiety and Hospital Costs—A Feasibility Study" and stated that, parents who don't receive appropriate information showed higher levels of anxiety.

Regarding mothers total level of anxiety 30 minute after intervention, this study clarifies that more than half of mothers in study group (1) reported mild anxiety. This is harmony with **Hartman et al., (2009)** who stated that, parents in the education group have less anxiety regarding their child after education.

This result is contrary to **Morel et al., (2020)** who conducted study about "Impact on child and parent anxiety level of a teddy bear-scale mock magnetic resonance scanner" and stated that anxiety level of mothers still high after intervention. The researcher suggests that parental anxiety was not caused by the technical part of the images acquisition, but mainly by their child's behavior.

As regards mother's total level of satisfaction, our study reveals that, more than three quarters of mothers in study group (1) have high level of satisfaction regarding MRI 1hr after applying MRI. This result is congruent with **Munn et al., (2015)** who conducted study about " Patient anxiety and satisfaction in a magnetic resonance imaging department: initial results from an action research study" and found that there was significant difference concerning general satisfaction among parents who receive information.

Conclusion

The research hypotheses were achieved and calming techniques was effective in reducing anxiety and fear levels among children undergoing MRI in the study group1 than those in control group and study group2. Again, mothers in study group who received MRI calming techniques experience lower level of anxiety and higher level of satisfaction than those in the control group and study group2.

Recommendations:

- Conducting continuous periodical education for nurses in MRI setting about the different methods of calming techniques that can be used for children before and during MRI.
- Dissemination of Arabic and attractive calming technique handouts to all MRI settings at different health system setting are recommended.
- Orientation of newly appointed nurses about the MRI calming techniques and its' benefits.
- Replication of this study at different MRI settings with larger sample size to generalize the findings

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تأثير تقنيات التهدئة على نتائج الأطفال تجاه التصوير بالرنين المغناطيسي ومستوى رضا الأمهات

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يعتبر الرنين المغناطيسي من أهم الاجراءات التشخيصية الحديثة خاصة للأطفال حيث أنه يعطى صورة واضحة لكل تفاصيل الجسم ولكنه عادة ما يسبب الخوف والقلق للأطفال. لذا يمكن تحقيق التحضير النفسي للأطفال الذين يخضعون للتصوير بالرنين المغناطيسي من خلال تطبيق تقنيات تهدئة مختلفة تساعد الأطفال القلقين على التعامل مع الموقف الخطر ، مما يؤدي إلى زيادة احتمالية إتمام المسح بنجاح وزيادة جودة الصورة. لذلك هدفت هذه الرسالة إلى تقييم تأثير تقنيات التهدئة على نتائج الاطفال تجاه التصوير بالرنين المغناطيسي ومدى رضا الأمهات. وقد أجريت هذه الدراسة على ١٥٩ طفل مصابين لأمهاتهم فى وحدة الرنين المغناطيسي بمستشفى بنها الجامعى، حيث كشفت النتائج ن تطبيق تقنيات التهدئة للأطفال الذين يخضعون للتصوير بالرنين المغناطيسي له تأثير إيجابي في تقليل قلق وخوف الأطفال وقلق الأم وزيادة مستوى رضا الأمهات لدى المجموعة التى تلقت الدراسة، كما أوصت الدراسة بأنه يجب إجراء تعليم دوري مستمر للممرضات في مجال التصوير بالرنين المغناطيسي حول الأساليب المختلفة لتقنيات التهدئة التي يمكن استخدامها للأطفال قبل وأثناء التصوير بالرنين المغناطيسي.