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Effect of Educational Intervention about Valsalva Maneuver versus Hot Compresses on Ear Pain for Children Undergoing Hyperbaric Oxygen Therapy

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Abstract
Background: Hyperbaric oxygen therapy has become increasingly popular among children due to its efficacy in the treatment of carbon monoxide poisoning and gas gangrene. The present study was aimed to evaluate the effect of educational intervention about Valsalva maneuver versus hot compresses on ear pain for children undergoing hyperbaric oxygen therapy. **Design: A** quasi-experimental research design was used. **Setting:** Hyperbaric Oxygen Therapy Unit of Tanta International Educational Hospital. **Sample:** A purposive sampling of thirty children aged 6-18 years who were undergoing hyperbaric oxygen therapy and were gathered from the aforementioned areas. Those children were divided into two equal groups; each group consisted of fifteen children. The study group 1of children received valsalva maneuver while the study group 2 was received hot compresses. Three tools were used **Tool I:** Children's knowledge interview schedule consisted of three parts. **Tool II:** Observational Checklist. **Tool III:** Children's Wong-Baker Face Pain Rating Scale. **Results:** Regarding mean total scores of children's ear pain severity, at the beginning, during and after receiving hyperbaric oxygen therapy there were statistically significant differences among Valsalva maneuver group children and among hot compresses group children. **Conclusion:** Both Valsalva maneuver and hot compresses (D-Mid hot packs) were beneficial in alleviating the severity of children's ear pain and equalizing ear pressure at the beginning, during, and after hyperbaric oxygen therapy session. **Recommendations:** Newly admitted children undergoing hyperbaric oxygen therapy should have an educational intervention about knowledge and practices for using Valsalva maneuver and hot compresses to reduce ear pain and equalize ear pressure.

Keywords: Children, ear pain, educational intervention, hot compresses, hyperbaric oxygen therapy & Valsalva maneuver.

Introduction
Hyperbaric Oxygen Therapy denotes the alternating inhalation of 100% oxygen at a pressure higher than 1 atmosphere. Regarding ailments, it is an indispensable adjuvant therapy. Hyperoxia, another name for hyperbaric oxygen therapy treatment, is a therapeutic approach that increases blood and tissue oxygen levels by exposing patients to pure oxygen is more commonly utilized in the juvenile population. A therapeutic effect is achieved by administering therapy in mono place or multi place chambers for 90–120 minutes at pressures varying from 2.0 to 2.8 atmospheres **(Heyboer et al., 2022)**.

Inhaling hyperbaric oxygen involves using a mask, hood, or endotracheal tube; if the chamber is inflated with 100% oxygen, ambient air can also be used. These high oxygen concentrations have significant positive physiological, biological, and biochemical consequences. Depending on the condition, sessions can be given in twenty to sixty therapeutic doses and last anywhere from one to three times a day for an approximate duration of two hours **(Wilkinson & Doolette, 2021).**

Hyperbaric oxygen therapy can be applied as an outpatient treatment for chronic medical conditions or as an emergency treatment in intensive care units for certain acute pathologies. Hyperbaric oxygen therapy is capable of treating all of the following: decompression sickness, gas embolism, necrotizing soft tissue infection, and carbon monoxide toxicity. In certain situations, it serves as the main therapeutic approach, while in others; it supplements traditional therapies **(Brugniaux et al., 2023)**.

A hyperbaric environment containing pure oxygen must be established, this is how hyperbaric oxygenation works therapeutically. Consequently, hyperbaric oxygen therapy has a broad range of effects on the body and can be employed to address chronic hypoxemia, tissue hypoxia, and wound healing. Among other clinical conditions, it can aid in the treatment of reperfusion injuries and necrosis **(Sen, 2021)**.

The highest chamber pressure and the resulting volume changes in closed, gas-filled environments are the most frequent adverse effects observed during hyperbaric treatment. Changes in pressure can often influence the lung, sinuses, and middle ear. The most common injuries, particularly in cases of congestion, are barotraumas to the middle ear and sinuses. When receiving hyperbaric oxygen therapy, ear pain is the

most frequent adverse effect. The symptoms include tinnitus, hearing loss, ear ache, fullness, discomfort and even otorrhagia **(Shupak & Gilbey., 2023).**

Hyperbaric oxygen therapy's most frequent adverse impact is middle ear barotrauma. The majority of middle ear barotrauma happen within the first 10 meters of compression, which is the same as two absolute atmospheres of compression in hyperbaric oxygen therapy. This phenomenon is explained by Boyle's law, which asserts that a body's weight variation ratio rises with surface close proximity. The clinical signs and symptoms of middle ear barotrauma include tympanic retraction, mucosal edema, tiny blood vessel rupture, and serous effusion or bleeding, which leads to an eardrum perforation **(Nasole et al., 2022)**.

Ear pain, which can be in one or both ears, is oddly hard to endure. The ache may be subtle or intense. The most common side effect in children taking Hyperbaric oxygen therapy is ear ache. When fluid clogs the Eustachian tube, an ear tube, it can lead to an ear infection or buildup of pressure behind the eardrum. This may cause ear pain. The most common way to prevent this is to teach the children how to balance middle ear pressure and enhance Eustachian tube function (Valsalva movements, chewing, yawning, and swallowing) **(Karahatay et al., 2023)**.

Making the child feels comfortable and explaining that the pressure feels like being in an airplane is crucial. When children relaxed and ready for the experience, they will feel very at ease in the hyperbaric chamber. Certain children are self-assured enough to receive therapy on their own, while others accompany their parents into the hyperbaric chamber while they sit next to the chamber**(Carlson et al., 2022)** .

The Valsalva maneuver is a breathing technique that can be employed to relieve clogged ears, restore cardiac rhythm, and identify issues with the autonomic nervous system. It entails forcing expiration against a closed glottis. To maintain the intra-oral and intrathoracic pressures equal. By instructing children to close their mouths, pinch their nostrils, and inflate their cheeks through forced expiration through the mouth, the Valsalva maneuver was conducted in a manner akin to inflating a balloon. Until the hearing experienced a sensation of fullness, the mouth was kept closed. This was accomplished by lightly blowing the nostril while holding it **(Liebelt, 2022)**.

The Eustachian tubes, which attach the middle ear to the base of the throat, can be opened using the Valsalva technique, the Valsalva maneuver could assist return it to a normal cardiac rhythm. This is made possible by its capacity to change blood pressure and heart rate **(Wang et al., 2021)**.

Ear pain can be eased with a warm compress by using D-Mid hot pack as special gel formulation in a sealed reusable, used as hot fomentation to relive ear pain, by immerse the pack in warm water 60C for 5-10 minutes, wrap it in towel , and apply it to the affected ear for up to 20-30 minutes. The warmth and moisture can help clear up ear congestion. **(Sadé & Ar, 2023)**.

Significance of the study:

Hyperbaric oxygen therapy improves antimicrobial activity, enhances oxygen delivery, and mitigates the effects of hypoxia-inducible factors in order to address hypoxic conditions. As a result, this treatment is effective for variety of diseases and clinical conditions. The Valsalva maneuver has some adverse side effects despite the fact that hyperbaric oxygen therapy is generally regarded as a safe therapy **(Joshua et al., 2022).** Middle ear barotrauma, the most severe adverse effect, can occur in 8-68.7% of patients and up to 91% of those who are unable to self-inflate their middle ear because of pressure. The most common type of ear barotrauma can be avoided or decreased by educating children about how to perform the Valsalva maneuver and apply hot compresses. As a result, educating child how to carry out the Valsalva maneuver and applying a hot compress can help relieve ear pain and pressure by opening the Eustachian tubes. Applying hot compress to the affected ear can help equalize pressure and alleviate discomfort **(Alshawi et al., 2023).**

Aim of the study was to evaluate the effect of educational intervention about valsalva maneuver versus hot compresses on ear pain for children undergoing hyperbaric oxygen therapy.

Research Hypotheses:

1-Implementing Valsalva maneuver for children undergoing hyperbaric oxygen therapy is expected to reduce ear pain severity

2- Implementing hot compresses (D-Mid Hot packs) for children undergoing hyperbaric oxygen therapy is expected to reduce ear pain severity

3- Knowledge of children about hyperbaric oxygen therapy, Valsalva maneuver and hot compresses (D-Mid hyperbaric oxygen therapy packs) are expected to enhance after the educational intervention.

Subject and Method:

Research Design:

A quasi-experimental research design was used

Setting:

Hyperbaric Oxygen Unit at Tanta International Educational Hospital which is affiliated to Ministry of Higher Education and Scientific Research

Subjects:

A purposive sampling of 30 children undergoing hyperbaric oxygen therapy was collected from the above mentioned sitting. Those children were divided into two equal groups as the following

Study group (1): Consisted of fifteen children undergoing hyperbaric oxygen therapy who received Valsalva maneuver**.**

Study group (2): Consisted of fifteen children undergoing hyperbaric oxygen therapy who received hot compresses (D-Mid hot packs).

-The total number of children aged 6-18 years who were undergoing hyperbaric oxygen therapy is 70 child / year. The sample size is calculated using Epi-info software statistical package. The calculation is based on type 1 error 0.05 and confidence level 95

Children Inclusion Criteria:

- Both sexes
- Children aged from 6-18 years undergoing hyperbaric oxygen therapy
- Newly admitted children
- Children received educational interventions at any session of the first three ones from starting hyperbaric oxygen therapy
- Children who were cognizant of the time, location and individuals at the period of data collection.

Children Exclusion Criteria:

Children with any psychiatric illness or mental handicap.

Tools of data collection:

The current study utilized three tools for data collection. They were created on the basis of recent literature.

Tool I: Children's knowledge structure interview schedule consisted of three parts: it was developed by the researcher following a review of the literature. It consisted of **three parts**:

Part (1): Demographic characteristics related to the children: such as age, gender, birth order, level of education, residence place

Part (2): Medical history of the children: past and present medical history such as medical diagnosis of disease, side effects at beginning or during and after receiving hyperbaric oxygen therapy

Part (3): Children's knowledge about:

a)Hyperbaric oxygen therapy as: definition, importance, indications, contraindications, types of oxygen chambers, instructions followed by the child before, during and after receiving hyperbaric oxygen therapy, The possible mild side effects, techniques used to decrease ear pain and pressure particularly D-Mid hot packs and Valsalva maneuver.

b) Valsalva maneuver included: definition and uses.

- They were answered by the first group children

c) D- Mid hot packs or compresses such as: instructions for preparing it before applying and precautions of its use.

- They were answered by the second group children

Scoring system: Children's knowledge was scored as follows:

- Complete and correct answer was given (2)
- Correct and incomplete answer was given (1)
- Wrong answer was given (0)

Children's knowledge total scores were divided into the following categories:

- Knowledge at a high level (70–100% of total score)
- Knowledge at a moderate level (60– ↓70% of total score)
- Knowledge at a low level(Less than 60% of total score)

Tool II: Observational Checklist about applying Valsalva maneuver and D-Mid Hot Packs: It was developed by the researcher to assess practices of both study groups children performed this technique by themselves regarding applying Valsalva maneuver (for the first study group) and D-mid hot pack steps (for the second study group)by themselves at beginning, during and after receiving hyperbaric oxygen therapy.

Valsalva maneuver steps: (Wong F, Taylor M, Bailey M, 2004), (Cleveland Clinic, 2022) included: sitting down or lying on back, plugging nose using fingertips Index finger and thumb, taking a deep breath through mouth, closing lips, puffing out cheeks and exhaling gently and slowly for 15-20 seconds while keeping mouth and nose closed as if defecating, opening mouth and nose and exhaling air, repeating the previous steps if it does not make pulse slow, it is preferred to chew gum after the procedure to keep the Eustachian tube open.

Hot Compresses checklist (D-Mid Hot Packs)included**:** washing hands, preparing all needed equipment's, filling the bowl with hot water of about 60 degrees Celsius (testing the temperature of the hot water), immersing the pack in the hot water bowl, leaving the compress in the bowl until it heats up and warms for 5-10 minutes, drying the outside surface of the compress from water residue, wrapping the compress in a towel or piece of gauze before applying it to the affected ear if the compress becomes very hot, making sure that the gel is evenly distributed in the compress by gently pressing it between the palms before applying it to the affected ear, placing the compress longitudinally on the ear for 20-30 minutes (the compress maintains the temperature for up to 30 minutes), repeating of applying hot gel compresses 3-4 times daily as it can help relieve ear congestion and pain.

The children's practices were graded as follows:

- Done was score of (1).
- Not done was score of (0)

The following categories were used to group the total practices scores of children:

- From 80% and more was considered satisfactory
- Less than 80% was considered unsatisfactory

Tool III: Children's Wong-Baker Face Pain Rating Scale/ (2015): The scale, which is used with children ages 3 to 18, has six sketched faces that represent

different levels of pain. It was used to assess severity of ear pain at beginning, during and after receiving hyperbaric oxygen therapy after educational interventions. Consequently, the face that revealed no pain was assigned a score of (0), while the face that revealed a slight amount of pain was assigned a score of (1). The face that revealed a little more pain was assigned a score of (4), the face that revealed even more pain was assigned a score of (6), the face that revealed the most pain was assigned a score of (8), and the face that revealed the worst pain was assigned a score of ten. According to this method, the Wong-Baker facial pain rating scale had the following scoring system: no pain equal to (0), mild pain equal to (1-3), moderate pain equal to (4-6), and severe pain equal to (7-10)

Method:

Administrative process: Director of hospital chosen setting (Hyperbaric Oxygen Therapy Unit at Tanta International Educational Hospital officially granted permission for the study to be conducted on 17/7/2024

Meeting with children: was put into place before the data gathering step started in order to build a good rapport, verify the research's viability, as well as provide a succinct description of the study's purpose.

Ethical and legal considerations:

a. Ethical approval was obtained from the ethical committee of Scientific Research members at Tanta University's Faculty of Nursing before conducting the study with code number 359-12-2023.
b. Nature of the study was not cause any hurt or pain to the children
c. Confidentiality and privacy in relation to the data gathering were taken into account.
d. Consent was taken from the parents of children to participate in the study after explaining the aim of the study and their right to withdraw from the study at any time.

Tools Development: Three different tools were used for data collection; **Tool I:** Children's knowledge interview schedule consisted of three parts. **Tool II:** Observational Checklist about Valsalva maneuver and D-Mid Hot Packs. **Tool III:** Children's Wong-Baker Face Pain Rating Scale for assessing ear pain.

Content validity: to assess the study tools' clarity and content validity, five professionals in the field were gathered to form the panel. The content validity index scored at 98 percent.

Reliability: The relevant statistical test was employed to evaluate the questionnaire's reliability. The instruments that were generated were assessed for reliability using internal consistency. 0.90 is the Cronbach's alpha coefficient.

A pilot study: Prior to initiating data collection, the tools utilized were subjected to a pre-test in the aforementioned location. To measure the clarity, applicability, and reliability of the tools, 10% of the sample who undergoing hyperbaric oxygen therapy was included in the study. In order to implement the required modifications, the questions were rearranged and specific items were restated. Those children were not incorporated into the study's total sample.

Phases of the study:

Assessment, planning, implementation and evaluation comprised the educational intervention's four phases of the present study.

Assessment phase:

In an effort to accrue baseline data and investigate children who met the inclusion and exclusion criteria, the researchers conducted an evaluation of all study subjects. The children involved in the study were met by the researcher to elucidate the research objectives and evaluate the knowledge and practices of both groups prior to conducting the educational intervention on the Valsalva maneuver and D-Mid hot packs, following their verbal assent. (**Tool I and II**).

Planning phase:

Following the results of a requirements analysis and a review of relevant literature, the following was included in the development of the educational intervention for children: a) Determining explicit objectives for the educational intervention. b) Formulating the educational intervention's content. c) Interactive lectures, PowerPoint presentations, booklets, images, demonstrations, and re-demonstrations were among the instructional techniques and resources that were implemented.

Study group (1): consisted of fifteen children undergoing hyperbaric oxygen therapy who received Valsalva maneuver .

Study group (2): consisted of fifteen children undergoing hyperbaric oxygen therapy who received hot compresses (D- Mid hot packs).

Implementation phase:

- The researchers worked the morning shift three days a week from 9:00 am to 1:00 pm at Hyperbaric Oxygen Therapy Unit at Tanta University International Educational Hospital to collect the data for the pretest, educational intervention conduction, and immediate posttest.
- The children were interviewed individually one by one in order to get the data.
- Before conducting the educational intervention, the researchers performed a pretest by interviewing each child who met the inclusion criteria one at a time and getting their oral consent. This was down to collect baseline data and assesses the children's knowledge and practices regarding hyperbaric oxygen therapy and the utilization of a variety of non-pharmacological ear pain management modalities, including the Valsalva maneuver as well

as hot compresses (D-Mid hot packs). There were two steps in this phase. The first was that the researchers gave each child a questionnaire form, explained its contents to them, and let them fill it out on their own. Children's demographic data, data about their present medical history, and closed-ended (multiple-choice) questions about hyperbaric oxygen therapy (for both study groups), the Valsalva maneuver (for the first study group only), and D-Mid hot packs or compresses (for the second study group only) were all included in the questionnaire sheet. This was done to evaluate the children's basic knowledge and information for the first time to cover (**tool I**). Children required ten to fifteen minutes to respond to this step. The second step involved asking each child to perform steps of procedures including Valsalva maneuver (for the first study group only) and D- Mid hot packs or compresses (for the second study group only). This was done to evaluate the children's level of practice for the first time using a checklist for each procedure, and the researchers assigned a score for each step or task to complete (Tool II). Each child needed roughly ten minutes to complete this step.

- Then, the researchers provided the educational intervention individually for each child at any session of the first three ones before receiving hyperbaric oxygen therapy on two sessions.

The first session lasted about 15-20 minutes and centered on:

Knowledge about hyperbaric oxygen therapy such as: definition, importance, indications, contraindications, types of oxygen chambers, instructions before, during and after receiving hyperbaric oxygen therapy, and side effects, health education to children about non-pharmacological ear pain management modalities as D-Mid hot packs and Valsalva maneuver.

Knowledge about Valsalva maneuver as: definition, uses for the first group

Knowledge about D- Mid hot packs or compresses as: instructions for preparing it before applying and precautions of its use for the second group children only).

The second session lasted about 10 minutes and focused on: demonstration and re-demonstration of standard steps of Valsalva maneuver(for the first group children only) and D- Mid hot packs or compresses (for the second group children only) when the child feels ear pain resulting from high pressure at the beginning, during and after receiving hyperbaric oxygen therapy.

- Several methods of educational were used as lectures, interactive discussion, demonstration and re-demonstration. The researchers explained this information to the children using educational booklets with colored pictures which were assigned to them.

Evaluation phase:

- On Immediate post- test: The same assessment methods were used to reassess children's knowledge and practices immediately after conducting the educational intervention, and the findings were compared to the pre-test levels using tools (I, II).
- Also, the study groups children were observed and evaluated for severity of ear pain resulting from high pressure of by the researchers using Wong – Baker Faces Pain Rating Scale 3 times including:
  - The first time: Before conducting educational intervention (Valsalva maneuver or D-Mid hot packs) when the child experiencing ear pain andat the beginning of hyperbaric oxygen therapy session.
  - The second time: After conducting educational intervention (Valsalva maneuver or D-Mid hot packs) when the child experiencing ear pain at the beginning or during hyperbaric oxygen therapy session.
  - The third time: After conducting educational intervention (Valsalva maneuver or D-Mid hot packs) when the child experiencing ear pain after hyperbaric oxygen therapy session.
  - Then, the comparison between the 2 groups was done, to determine effectiveness of the two interventions used.
  - Data was gathered by the researchers throughout the course of three months, from the end of July 2024 to the end of October 2024.

Statistical analysis of the data:

A computer was used to input and analyze data using the IBM SPSS software package version 20.0. Qualitative data was described using percentages and numbers. A test for distribution normalcy, the Shapiro-Wilk test, was utilized. The range, mean, and standard deviation were used to describe the quantitative data. We used a 5% level of significance to evaluate the results. We utilized seven tests: Using a chi-square test to compare groups based on categorical factors Fisher Resolving chi-square errors when 20% or more of cells have predicted counts below 5 requires an exact test. The relevance between the various stages can be examined using the Mc Nemar and marginal homogeneity tests. In order to compare the two groups that were analyzed, the researchers used a Student t-test for normally distributed quantitative data. To compare the two periods, we utilized a paired t-test for quantitative variables that regularly distributed. For quantitative variables that follow a normal distribution, we can use ANOVA with repeated measures to compare over many time periods. For quantitative variables that follow an abnormal distribution, we can use the Friedman test **(White, 2019)**.

Results

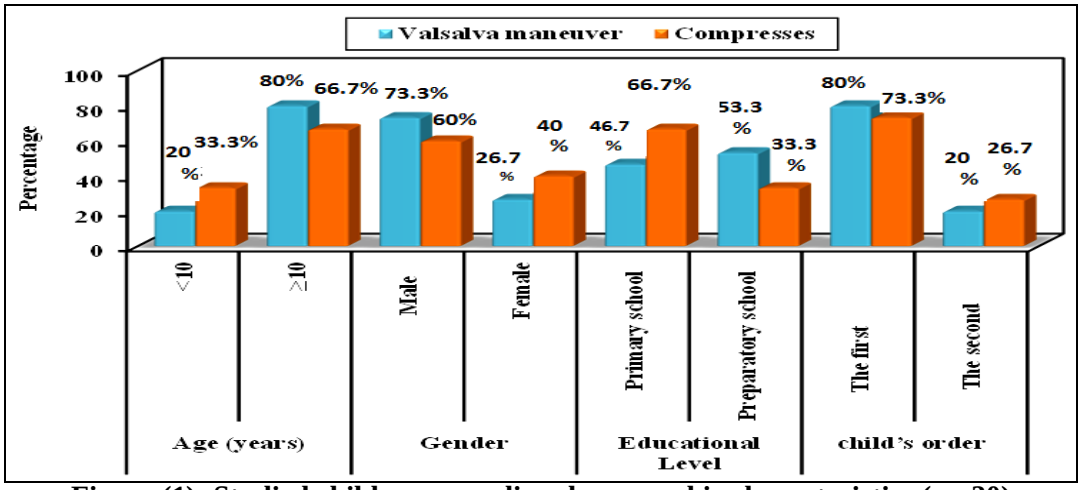

Figure (1): Studied children regarding demographic characteristics (n= 30)

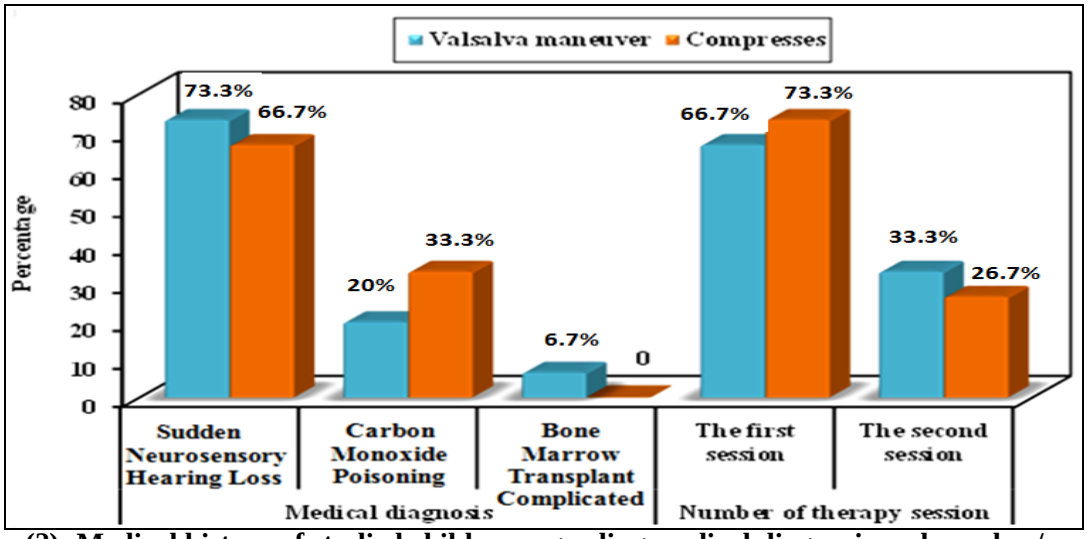

Figure (2): Medical history of studied children regarding medical diagnosis and number/ order of the present hyperbaric oxygen therapy session(n=30)

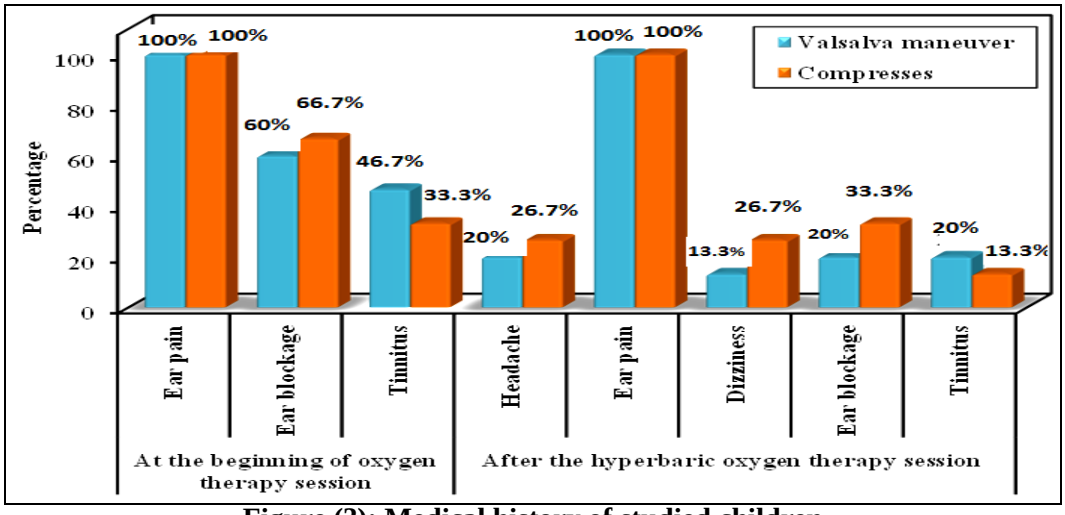

Figure (3): Medical history of studied children

Table (1): Mean total scores of the studied children's knowledge before and after implementation (n=30)

Mean total scores of children Knowledge	Valsalva Maneuver (n = 15)		D-Mid Hot Compresses (n = 15)		$t(p_1)$	$t(p_2)$
	Before educational intervention	After educational intervention	Before educational intervention	After educational intervention		
Knowledge of children about hyperbaric oxygen therapy:						
Total score (0 – 20)						
Min. – Max.	0.0 – 11.0	13.0 – 20.0	3.0 – 14.0	12.0 – 20.0	1.661 (0.108)	0.146 (0.885)
Mean ± SD.	4.93 ± 3.28	17.93 ± 2.52	7.0 ± 3.53	18.07 ± 2.49		
Average score (0–2) (Mean ± SD.)	0.49 ± 0.33	1.79 ± 0.25	0.70 ± 0.35	1.81 ± 0.25		
% score (Mean ± SD.)	24.67 ± 16.42	89.67 ± 12.60	35.0 ± 17.63	90.33 ± 12.46		
t_0 (p_0)	**15.382* (<0.001*)**		**13.606* (<0.001*)**			
Children's knowledge about: - **Valsalva Maneuver Or** - **D-Mid hot compresses**						
Total score (0 –4)						
Min. – Max.	0.0 – 0.0	1.0 – 4.0	0.0 – 2.0	2.0 – 4.0	4.675* (<0.001*)	0.638 (0.529)
Mean ± SD.	0.0 ± 0.0	3.27 ± 0.96	1.07 ± 0.88	3.47 ± 0.74		
Average score (0–2) (Mean ± SD.)	0.0 ± 0.0	1.63 ± 0.48	0.53 ± 0.44	1.73 ± 0.37		
(Mean ± SD.)	0.0 ± 0.0	81.67 ± 24.03	26.67 ± 22.09	86.67 ± 18.58		
t_0 (p_0)	**13.163* (<0.001*)**		**14.697* (<0.001*)**			
Children's knowledge:						
Total score (0 – 24)						
Min. – Max.	0.0 – 11.0	15.0 – 24.0	3.0 – 16.0	14.0 – 24.0	2.243* (0.033*)	t=0.282 (0.780)
Mean ± SD.	4.93±3.28	21.20± 3.32	8.07±4.30	21.53± 3.16		
Average score (0–2) (Mean ± SD.)	0.41±0.27	1.77 ± 0.28	0.67±0.36	1.79 ± 0.26		
% score (Mean ± SD.)	20.56±13.68	88.33± 13.84	33.61±17.92	89.72± 13.16		
t_0 (p_0)	**16.630* (<0.001*)**		**14.638* (<0.001*)**			

*Data is presented as Mean ± SD, SD: Standard deviation, t: Student t-test, t_0: Paired t-test, p_0: p value for comparing between pre and post in each group, p_1: p value for comparing between the studied groups Before Program, p_2: p value for comparing between the studied groups Post Program *: Statistically significant at $p \leq 0.05$.*

Table (1): Percentage distribution of studied children's regarding total knowledge scores before and after educational intervention (n=30)

Total knowledge scores	Valsalva Maneuver (n = 15)				D-Mid Hot Compresses (n = 15)				Test of sig. (p_1)	Test of sig. (p_2)
	Before educational intervention		After educational intervention		Before educational intervention		After educational intervention			
	No.	%	No.	%	No.	%	No.	%		
Knowledge of children about hyperbaric oxygen therapy:										
Low (<60%)	15	100.0	0	0.0	13	86.7	0	0.0	FET= 2.009 (0.489)	χ^2= 0.370 (^{FE}p=1.000
Moderate (60 – <70%)	0	0.0	2	13.3	1	6.7	1	6.7		
High (≥70%)	0	0.0	13	86.7	1	6.7	14	93.3		
MH (p_0)	**29.000*(<0.001*)**				**28.000*(<0.001*)**					
Children's knowledge about:										
-Valsalva Maneuver or -D-Mid hot Compresses										
Low (<60%)	15	100.0	3	20.0	15	100.0	2	13.3	–	χ^2= 0.240 (^{FE}p=1.000
Moderate (60 – <70%)	0	0.0	0	0.0	0	0.0	0	0.0		
High (≥70%)	0	0.0	12	80.0	0	0.0	13	86.7		
^{McN}p$_0$	**<0.001***				**<0.001***					
Total score of children's knowledge:										
Low (<60%)	15	100.0	0	0.0	14	93.3	1	6.7	χ^2= 1.034 ^{FE}p=1.000	FET= 1.349 (1.000)
Moderate (60 – <70%)	0	0.0	2	13.3	1	6.7	1	6.7		
High (≥70%)	0	0.0	13	86.7	0	0.0	13	86.7		
MH (p_0)	**29.000*(<0.001*)**				**28.000*(<0.001*)**					

*Data is presented as frequency (%), χ^2: Chi square test, MH: Marginal Homogeneity Test, McN: McNemar test, p_0: p value for comparing between pre and post in each group, p_1: p value for comparing between the studied groups Before Program, p_2: p value for comparing between the studied groups Post Program, *: Statistically significant at $p \leq 0.05$.*

Table (2): Percentage distribution of studied children's practices before and after implementation (intervention) (n=30)

Mean total scores of studied children's practices	Valsalva Maneuver (n = 15)						D-Mid Hot Compresses (n = 15)						Test of sig. (p1)	Test of sig. (p2)	Test of sig. (p3)
	Before educational intervention & Before hyper baric oxygen therapy		After educational intervention& At the Beginning OR during hyper-baric oxygen therapy		After educational intervention & After hyper baric oxygen therapy		Before educational intervention& Before hyper-baric oxygen therapy		After educational intervention&At the beginning OR during hyper baric oxygen therapy		After educational intervention &After hyper-baric oxygen therapy				
	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%			
Unsatisfactory	15	100.0	2	13.3	1	6.7	14	93.3	3	20.0	2	13.3	χ^2=1.034 FE p=1.000	χ2=0.240 FEp=1.000	χ2=0.370 FEp=1.000
Satisfactory	0	0.0	13	86.7	14	93.3	1	6.7	12	80.0	13	86.7			
Q(p_0)	**24.400* (<0.001*)**						**22.167* (<0.001*)**								
Average score (0 – 1)															
Min. – Max.	0.0 – 0.0		0.50 – 1.0		0.75 – 1.0		0.20 – 0.90		0.40 – 1.0		0.80 – 1.0		t= 8.668* (<0.001*)	t=0.798 (0.431)	t=0.666 (0.511)
Mean ± SD.	0.0 ± 0.0		0.93 ± 0.18		0.98 ± 0.06		0.48 ± 0.21		0.88 ± 0.19		0.97 – 0.07				
% Score															
Min. – Max.	0.0 – 0.0		50.0 – 100.0		75.0 – 100.0		20.0 – 90.0		40.0 – 100.0		80.0 – 100.0				
Mean ± SD.	0.0 – 0.0		93.33± 17.59		98.33 ± 6.45		48.0 ± 21.45		88.0 ± 18.97		96.67 ± 7.24				
F (p_0)	**380.180* (<0.001*)**						**71.078* (<0.001*)**								

*Data is presented as Mean ± SD, SD: Standard deviation, t: Student t-test, F: F test (ANOVA) with repeated measures, χ2: Chi square test, Q: Cochran's test, p0: p value for comparing between pre and post in each group, p1: p value for comparing between the studied groups Before HOT Session & Before program, p2: p value for comparing between the studied groups At the Beginning &During HOT Session &After Program, p2: p value for comparing between the studied groups After HOT Session& After Program, *: Statistically significant at p ≤ 0.05.*

Table (3): Percentage distribution of the studied children regarding total scores of ear pain severity of before and after intervention (n=30)

Severity of Ear Pain	Valsalva maneuver (n = 15)						D-Mid hot Compresses (n = 15)						Test of sig. (p1)	Test of sig. (p2)	Test of sig. (p3)
	Before educational intervention & at the beginning of hyper baric oxygen therapy		After educational intervention & at the beginning OR during hyper-baric oxygen therapy		After educational intervention & after hyper baric oxygen therapy		Before educational intervention& at the beginning of hyper baric oxygen therapy		After educational intervention &at the beginning OR during hyper baric Oxygen therapy		After educational intervention &after hyper-baric oxygen therapy				
	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%			
No pain (0)	0	0.0	5	33.3	11	73.3	0	0.0	3	20.0	8	53.3	χ^2= 0.144 (0.705)	FET= 2.114 (0.449)	χ^2=1.292 (0.256)
Mild pain (1-3)	0	0.0	5	33.3	4	26.7	0	0.0	3	20.0	7	46.7			
Moderate pain (4-6)	6	40.0	5	33.3	0	0.0	5	33.3	9	60.0	0	0.0			
Severe pain (7-10)	9	60.0	0	0.0	0	0.0	10	66.7	0	0.0	0	0.0			
Fr (p_0)	**27.208* (<0.001*)**						**27.745* (<0.001*)**								
Score															
Min. – Max.	4.0 – 10.0		0.0 – 6.0		0.0 – 3.0		4.0 – 10.0		0.0 – 6.0		0.0 – 3.0		t=0.602 (0.552)	t=1.895 (0.068)	t=1.622 (0.117)
Mean ± SD.	6.73 ± 2.02		2.20 ± 2.04		0.47 ± 0.92		7.13 ± 1.60		3.67 ± 2.19		1.13 ± 1.30				
F (p_0)	**110.314* (<0.001*)**						**140.321* (<0.001*)**								

*Data is presented as Mean ± SD, SD: Standard deviation, F: F test (ANOVA) with repeated measures, χ2: Chi square test, Fr: Friedman test, p0: p value for comparing between pre and post in each group, p1: p value for comparing between the studied groups before HOT Session, p2: p value for comparing between the studied groups At the Beginning &During Program, p2: p value for comparing between the studied groups After Program, *: Statistically significant at p ≤ 0.05.*

Table (4): Percentage distribution of the studied children regarding total scores of ear pain severity of before and after intervention (n=30)

Severity of Ear Pain	Valsalva maneuver (n = 15)						D-Mid hot Compresses (n = 15)						Test of sig. (p1)	Test of sig. (p2)	Test of sig. (p3)
	Before educational intervention & at the beginning of hyper baric oxygen therapy		After educational intervention & at the beginning OR during hyper-baric oxygen therapy		After educational intervention & after hyper baric oxygen therapy		Before educational intervention & at the beginning of hyper baric oxygen therapy		After educational intervention & at the beginning OR during hyper baric oxygen therapy		After educational intervention &after hyper-baric oxygen therapy				
	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%			
No pain (0)	0	0.0	5	33.3	11	73.3	0	0.0	3	20.0	8	53.3	χ^2= 0.144 (0.705)	FET=2.114 (0.449)	χ^2=1.292 (0.256)
Mild pain (1-3)	0	0.0	5	33.3	4	26.7	0	0.0	3	20.0	7	46.7			
Moderate pain (4-6)	6	40.0	5	33.3	0	0.0	5	33.3	9	60.0	0	0.0			
Severe pain (7-10)	9	60.0	0	0.0	0	0.0	10	66.7	0	0.0	0	0.0			
Fr (p_0)	**27.208* (<0.001*)**						**27.745* (<0.001*)**								
Score															
Min. – Max.	4.0 – 10.0		0.0 – 6.0		0.0 – 3.0		4.0 – 10.0		0.0 – 6.0		0.0 – 3.0		t=0.602 (0.552)	t=1.895 (0.068)	t=1.62 (0.117)
Mean ± SD.	6.73 ± 2.02		2.20 ± 2.04		0.47 ± 0.92		7.13 ± 1.60		3.67 ± 2.19		1.13 ± 1.30				
F (p_0)	**110.314* (<0.001*)**						**140.321* (<0.001*)**								

*Data is presented as Mean ± SD, SD: Standard deviation, F: F test (ANOVA) with repeated measures, χ^2: Chi square test, Fr: Friedman test, p_0: p value for comparing between pre and post in each group, p_1: p value for comparing between the studied groups before HOT Session, p_2: p value for comparing between the studied groups At the Beginning &During Program, p_2: p value for comparing between the studied groups After Program, *: Statistically significant at $p \leq 0.05$.*

Table (5): Correlation between total scores of knowledge and practices of studied children (n=30)

Total scores of knowledge	Total scores of practices			
	Valsalva Maneuver (n = 15)		D-Mid Hot Compresses (n = 15)	
	R	P	r	p
Before Program	–	–	0.799*	<0.001*
Post Program	0.017	0.953	0.896*	<0.001*

*r: Pearson coefficient, *: Statistically significant at $p \leq 0.05$.*

Figure (1): Illustrates that the majority (80%) of Valsalva maneuver group children and two thirds (66.7%) of hot compresses group children were 10 years old or older. Also, less than three quarters of Valsalva maneuver group children (73.3%) were males. Also, less than two thirds (60%) of hot compresses group children were males. Regarding level of education, 53.3% of Valsalva maneuver group children were at preparatory school. However, two thirds (66.7%) of hot compresses group children were at primary school.

Figure (2): Presents that 73.3% of children of Valsalva maneuver group had sudden neurosensory hearing loss, less than one quarter (20%) of those group children had Carbon Monoxide poisoning and only 6.7 % of them had bone marrow transplant complicated. However, two thirds (66.7%) of hot compresses group children had sudden neurosensory hearing loss and the rest third (33.3%) of them had Carbon monoxide poisoning. Also, two thirds of Valsalva maneuver group children (66.7%) received the educational intervention at the first hyperbaric oxygen therapy session while one third (33.3%) of them received the educational intervention at the second hyperbaric oxygen therapy session. Seventy three point three percentage of children of hot compresses group received the educational intervention at the first hyperbaric oxygen therapy session while more than quarter (26.7%) of them received the second hyperbaric oxygen therapy session.

Figure (3): Reflects that all children (100%) of Valsalva maneuver and hot compresses groups children reported ear pain at the beginning or during hyperbaric oxygen therapy. However, less than half (46.7%) of Valsalva maneuver group children and one third (33.3%) of hot compresses group children suffered from tinnitus at the beginning or during hyperbaric oxygen therapy. Regarding side effects the studied children reported after hyperbaric oxygen therapy session, all children (100%) of Valsalva maneuver and hot compresses groups children suffered from ear pain. However, 13.3% of Valsalva maneuver group children suffered from dizziness and 13.3% of hot compresses group children suffered from tinnitus.

Table (1): Shows that there were statistically significant differences among Valsalva maneuver group children and among hot compresses group children with regards to mean total scores of knowledge about hyperbaric oxygen therapy before and after educational intervention **(p<0.001 for each group)**

Statistically significant differences were observed in the mean total scores of knowledge about Valsalva maneuver among children of Valsalva maneuver group and among children of hot compresses group regards to mean total scores of the knowledge about D-Mid hot compresses before and after the educational intervention (p <0.001 for each group). Additionally, the mean total scores of children's knowledge pre the educational intervention only differed significantly between Valsalva maneuver and hot compresses groups children (**p<0.001)**.

Statistically significant differences were observed among children of Valsalva maneuver group and among children of hot compresses group regarding the mean total scores of knowledge pre and post the educational intervention **(p<0.001)** Furthermore, the Valsalva maneuver and hot compresses groups exhibited a statistically significant difference in the mean total scores of the children's total knowledge before the educational intervention only **(p<0.001)**.

Table (2): Illustrates that there were statistical significant differences among Valsalva maneuver group children and among hot compresses group children regarding total scores of knowledge about hyperbaric oxygen therapy before and after educational intervention **(p<0.001)**.

There were statistical significant differences among Valsalva maneuver group children in relation to total scores of knowledge about Valsalva Maneuver and among hot compresses group children regarding total scores of knowledge about D-Mid hot compresses before and after the educational intervention **(p<0.001)**. Statistically significant differences were found regarding total scores of total knowledge among children of Valsalva maneuver group and among children of hot compresses group pre and post the educational intervention **(p<0.001)**

Table (3): Represents that there were statistical significant differences among Valsalva maneuver group children and among hot compresses group children regarding mean total scores of total practices before educational intervention (before hyperbaric oxygen therapy),after educational intervention(at the beginning or during hyperbaric oxygen therapy) and after educational intervention (after hyperbaric oxygen therapy) **(p<0.001)**. Additionally, statistically significant differences were found among Valsalva maneuver and hot compresses groups children regarding mean total scores of their total practices before the educational intervention& before receiving hyperbaric oxygen therapy only **(p<0.001).**

Table (4): Demonstrated that there were statistically significant differences in the ear pain severity among children of Valsalva maneuver group and among hot compresses group children before educational intervention(at the beginning of hyperbaric oxygen therapy), after educational intervention(at the beginning or during hyperbaric oxygen therapy) and

after educational intervention(after hyperbaric oxygen therapy) **(p <0.001 for each group)**.

Table (5): Reflects that there was a significant positive correlation between the total knowledge and the total practices among children of the hot compresses group before **(p<0.001)** and after **(p<0.001)** educational intervention as there was an improvement in the knowledge of the children after educational intervention leads to improving in their practices.

On contrast, it was found that there was no correlation between total knowledge and total practices among Valsalva maneuver group children after program **(p= 0.953).**

Discussion:

Hyperbaric Oxygen Therapy remains one of the healthiest treatments available today. Hyperbaric Oxygen Therapy side effects are therefore based on the body's reaction to this high oxygen–high pressure milieu. Among hyperbaric oxygen therapy's most frequent adverse effects is ear pain. Children complained of ear ache, discomfort during compression, pressure, and difficulties equalizing their ears **(Sen, 2021)**.

Based on the age of the children under study, It was determined that the majority of Valsalva maneuver group children and two-thirds of the hot compresses group children were 10 years of age or older. This is appropriate age for understanding for implementation Valsalva maneuver and hot compresses technique. The present results reveled those of other authors who state that **(Peterson et al., 2024)** found that the median ages of the experimental group and the control group were four and five years, respectively, and that the ages of the two groups that obtained hyperbaric oxygen therapy varied from two to seventeen years.

With respect to gender, the hot compresses group consisted of children who were less than two-thirds males. This aligns with **(Chen et al, 2021)** reporting that 18 children, four girls and fourteen boys, were evaluated for participation and enlisted in the study, they utilized warm compresses to alleviate ear pain. The children consisted of four girls and fourteen boys**.**

The educational level of the children in the Valsalva maneuver group was evident, with over half attending preparatory school. Conversely, two-thirds of children of the hot compresses group were attending primary school. These educational levels for children enable their thinking and mental capacity to absorb information and apply the skills they learn related to the Valsalva maneuver or hot compresses. These results agreed with **(Alsayegh et al. 2024)** study who showed that participants during the initial investigation as young as 4 years old this preparatory age.

Regarding number/ order of the present session, two thirds of Valsalva maneuver group children received the educational intervention at the first hyperbaric oxygen therapy session while the third of them received the educational intervention at the second hyperbaric oxygen therapy session. Less than three quarters of hot compresses group children received the educational intervention at the first hyperbaric oxygen therapy session while more than quarter of them received the educational intervention at the second session. The present study focused on starting the educational intervention for study groups children at any hyperbaric oxygen therapy session of the first three ones, because they complain from side effects at the beginning of hyperbaric oxygen therapy and their bodies are not accustomed to this excessive pressure, however after three sessions of therapy, the pain and excessive pressure in ear will decreased or disappear completely as result of the child's body adapting or getting used to it. One of the objectives of the subsequent session was to mitigate the adverse effects of hyperbaric oxygen therapy.

The medical diagnosis of the children under study revealed that less than three-quarters of the Valsalva maneuver group experienced sudden neurosensory hearing loss and less than one-quarter of the group experienced accidental carbon monoxide poisoning. However, two thirds of hot compresses group children had sudden neurosensory hearing loss, and the rest third of them had accidental carbon monoxide poisoning. During the data collection period, a portion of the study children were encountered at the beginning of winter, a time when carbon monoxide poisoning is a prevalent occurrence, particularly in children, as a result of malfunctioning heating systems or water heaters. Consequently, the percentage of children diagnosed with carbon monoxide poisoning was lower in the present study. The current study did not align with **(Moon, 2019)** who reported that more than half of children suffered from acute carbon monoxide poisoning. The malfunctioning of heating systems or water heaters is a common cause of accidental carbon monoxide poisoning in children. It is most prevalent during the winter, particularly among children, due to social, economic, and climatic factors.

There have been few reported adverse effects of hyperbaric oxygen therapy. Barotrauma is a condition that can affect any enclosed air-filled space, including the bowel, lungs, sinuses, teeth, and ears, as a secondary effect of pressure. Ear barotrauma is the most prevalent condition, and it can be prevented or mitigated by implementing hot compresses as well as applying Valsalva maneuver **(Heyboer et al., 2022)**.

According to side effects reported by the studied children at the beginning, during and after hyperbaric oxygen therapy session, it was clear that all children of Valsalva maneuver and hot compresses groups reported ear pain. It is possible that this discovery is linked to issues with pressure equalization and repetitive treatments. The present finding was agreed with (**Joshua et al., 2022)** who presented that middle ear barotrauma is one of the most frequently observed adverse effects of hyperbaric oxygen therapy. The initial phase of hyperbaric oxygen therapy may result in children experiencing distress during compression, ear pain, a sense of pressure, and difficulty with ear equalization. Furthermore, has been documented more frequently than in the investigation **(Hadanny et al., 2023)**.Also, This aligned with **(Ambiru et al., 2021),** who mentioned that adverse effects of hyperbaric oxygen therapy that manifest on the initial day of treatment include pressure equalization issues in the middle ear, cranial sinus, and dentition, as indicated by the report.

Children in the Valsalva maneuver group experience dizziness, while less than half of children in the hot compresses group experience tinnitus. Persistence of tinnitus causes children to experience communication and sleep problems in their daily life and negatively affects their quality of life. In contrast, **(Cannellotto, et al., 2022)** reported that the most common symptom accompanying hyperbaric oxygen therapy was tinnitus.

According to obtained results, statistical significant differences were observed among children of Valsalva maneuver group as well as the children of hot compresses group with regard to mean total scores of their general knowledge about hyperbaric oxygen therapy before and after intervention. As children received adequate information about hyperbaric oxygen therapy as indications, benefits, side effects of hyperbaric oxygen therapy and how to manage, so their knowledge is improved after educational intervention. According to the findings of this study and other researches, children did not receive adequate training on how to properly prepare themselves prior to, during, and post hyperbaric oxygen therapy. This is in accordance with **(Azhar, 2022)** discovered that the children undergoing hyperbaric oxygen therapy showed notable increases in their knowledge following obtaining adequate information about hyperbaric oxygen therapy.

Furthermore, statistical significant differences were shown among children of Valsalva maneuver group regarding mean total scores of knowledge about Valsalva maneuver and among hot compresses group children in relation to mean total scores of knowledge about D-Mid hot compresses before and after intervention. Reinforcing practices through child focused education may help children better understand how to manage side effect of hyperbaric oxygen therapy. Results of the present study were in streak with **(Ghods et al., 2022)** found that significant increase post education for participant's knowledge improvement about technique of Valsalva maneuver for relieving pain and vasovagal response when the femoral arterial sheath is removed. Also **(Linhares, et al., 2021)** found that hot compresses improve circulation and sooth inflammation.

The importance of training and educational interventions for children undergoing hyperbaric oxygen therapy on Valsalva maneuver and hot compresses procedures is to reduce ear pain and pressure, and necessity of giving them an educational intervention before use a new device for first time, and informing them of its importance and side effects that may result from it. And how they can deal with these side effects and eliminate them, or at least reduce their severity such as tinnitus, ear pain and increase ear pressure. Its blockage results from exposure to high oxygen pressure through the hyperbaric device

In relation to percentage distribution of studied children's practices before and after intervention, statistically significant differences were discovered among children of Valsalva maneuver group as well as among children of hot compresses group before and after intervention with regards to mean total scores of total practices before educational intervention (before hyperbaric oxygen therapy), after educational intervention (at the beginning or during hyperbaric oxygen therapy) and after educational intervention (after hyperbaric oxygen therapy. As Valsalva maneuver is a distinctive technique that does not necessitate any equipment, it is readily mastered and implemented by children. Additionally, it mitigates the intensity of ear pain in children who are undergoing hyperbaric oxygen therapy. Thus, this corresponds with the findings of **Suren et al., (2022)**, in their study of the Valsalva maneuver and the eutectic mixture of local anesthetics to alleviate vein puncture pain in pediatrics; they documented a statistically significant difference in pain severity between the two groups. The Valslva maneuver can help children to feel less pain by taking their focus away from the unpleasant process.

Based on the results of the present study, there were statistically significant differences between the children in the Valsalva maneuver group and among the children in the hot compresses group before and after the intervention in terms of the mean total scores of ear pain severity at beginning or during, after receiving hyperbaric oxygen therapy as measured by the Wong Baker scale. Children who performed the Valsalva technique reported less pain because

Valsalva maneuver is an easy procedure for children to learn, as its steps are similar to the steps of balloon inflation and it does not need any equipment to do. Also the pain levels was decreased in hot compresses (D-Mid hot compresses) group children but in a degree less than those of Valsalva maneuver group children as hot compresses procedure as a general using pad and hot water is a familiar and known procedure for children, so it was easy for them to learn the total steps of applying D-Mid hot compresses. This result align with **(Elsharkawy, et al., 2022)**, in comparison to the control group, nearly half of the children in the Valsalva group reported feeling comfortable during peripheral cannulation, while only one fifth of the control group reported the same.

One of very useful non-pharmacological method for managing and lowering pain and anxiety symptoms is the Valsalva maneuver. Both hot compresses and Valsalva procedures reduce ear pain, but Valsalva reduced the pain and ear pressure to slightly greater degree than hot compresses. (**Alan & Khorshid, 2022)**. Additionally, children in the Valsalva group focused on using the Valsalva maneuver's stages in a way that would distract them from the unpleasant stimuli. Multimodality non-pharmacological interventions were advised by the American Pain Society for the treatment of ear pain in infants, Valsalva maneuver and hot compresses were employed in the present study in a comparable manner to evaluate their impact on the intensity of ear pain in children who were undergoing hyperbaric oxygen therapy. For the treatment of children's ear discomfort, the American pain Society advised using multimodality non-pharmacological therapies **(Aydin, et al., 2022)**.

In the present study, the effects of hot compresses and the Valsalva technique on the severity of ear pain in children receiving hyperbaric oxygen therapy were compared. Training interventions and regular retraining children on the proper use of hot compresses improve skills and knowledge about appropriate use of the both methods to relive pain.

According to this study, there was no statistically significant difference between total knowledge and overall practices among Valsalva maneuver group children after intervention, As hot compresses group's knowledge after educational intervention had a role in improving their practice, this may be found as the educational intervention for children's knowledge about Valsalva maneuver did not contain outlines about the steps of how to apply Valsalva maneuver but focused on general knowledge about maneuver as definition and uses which are not in close relation with children practices about Valsalva maneuver but rather focused on general knowledge about maneuver, and they taught the steps for performing Valsalva procedure only in the practical part of their practices. This agree with (**Srivastavaet al., 2021)**, found that no correlation between Knowledge about indication of hyperbaric oxygen therapy and practice to relive side effect during and after session. Furthermore, this area may be explored in forthcoming research.

As Hot compresses group's knowledge after educational intervention had a role in improving their practice, because educational intervention for children's knowledge contained some points about how to perform steps of hot compresses, and this is a practical part closely related to applying the steps of hot compresses, this result from their learning knowledge used and applied in their practices. As Valsalva group, there was an improvement in their practices but this improvement was not closely related to children's knowledge about Valsalva maneuver, since educational intervention related Valsalva maneuver knowledge did not contain points about steps of how to perform Valsalva maneuver procedure, but rather focused on general knowledge about maneuver, and they taught the steps for performing Valsalva procedure only in the practical part of their practices.

The present study has provided insight into the use of non-pharmacological pain management techniques, including the Valsalva maneuver and hot compresses, to alleviate ear congestion and pain in children who are undergoing hyperbaric oxygen therapy.

Conclusion:

In accordance to the present study's findings, The Valsalva maneuver and hot compresses (D-Mid hot packs) were both found to be beneficial in alleviating the severity of children's ear pain and equalizing ear pressure at beginning, during, and after hyperbaric oxygen therapy session. Additionally, the study groups children who received the educational intervention regarding Valsalva maneuver and hot compresses had higher levels of knowledge and practices on immediate post-test than pre-test.

Recommendations:

1. Newly admitted children undergoing hyperbaric oxygen therapy should have an educational intervention including knowledge and practices for using Valsalva maneuver and hot compresses (D-Mid hot packs) to reduce ear pain and equalize ear pressure.
2. Hot compresses (D-Mid hot packs) supplies must be available at unit as they are affordable and simple for children to use.
3. Booklets and pamphlets must be available in hyperbaric oxygen unit explaining the steps for

implementing hot compresses and the Valsalva maneuver to both nurses and children.

For future nursing researches: Replicating the study with a larger sample size will allow the results to be more generalized and broadly applicable

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