Effect of Applying of Oropharyngeal Exercises on Sleep Problems and Quality of Life in Children with Obstructive Sleep Apnea post-Adenotonsillectomy

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Abstract

Background: Oropharyngeal exercises were non-invasive and cost-effective treatment which acts by increasing the tone of pharyngeal muscles and may bring long-term benefits to the children. **Aim of the study** was to evaluate the effect of applying oropharyngeal exercise on sleep problems and quality of life in children with obstructive sleep apnea post- adenotonsillectomy. **Research design:** Quasi-experimental research design was utilized. **The study** was conducted at the outpatient and inpatient Ear, Nose, and Throat department (ENT) in Benha Health Insurance Hospital. A Purposive sample of 50 children accompanying their mothers was included in this study. **Three tools** were used for data collection 1) Children assessment questionnaire**,** 2) Child's sleep habits questionnaire and 3) OSA-18 quality of life questionnaire. **Results:** The mean age of the children was 9.62 ± 1.84years and 50% of them were male. More than half and more than three quarters (55% &76% respectively) of children reported higher sleep problems and poor quality of life pre-intervention phase. Meanwhile, post-intervention phases, more than two thirds and more than half (70%&54% respectively) of children reported low sleep problems, more than two thirds and two thirds (72%& 66% respectively) of them had good quality of life after 45days and 90days. **Conclusion:** Applying of oropharyngeal exercises daily for 3 months period had a significantly positive effect on decreasing sleep problems and improving quality of life in children with obstructive sleep apnea post-adenotonsillectomy. **Recommendations:** Conducting more continuing oropharyngeal exercises intervention program for mothers having children suffering from OSA to decrease the negative outcomes and improve quality of life with the necessity of follow-up.

Keywords: Oropharyngeal exercises, sleep problems, quality of life, children, obstructive sleep apnea, adenotonsillectomy.

Introduction:

Sleep is necessary for healthy growth, development, emotional well-being and cognitive performance. Furthermore, it is critical for the development of school-based learning skills. According to previous research, the prevalence of sleep problems in children is between 14% and 45%. As a result, sleep problems can have a negative effect on children's wellbeing and health (**Galland etal., 2015; Bathory &Tomopoulos, 2017)**. Sleep problems reported among children commonly include behavioral sleeping problems, problems with falling asleep, waking up during the night, parasomnias, and symptoms related to sleep-disordered breathing. Sleep problems are influenced by a number of factors, including parents' educational levels, living in urban areas, lack of adequate hygiene, socioeconomic status, pharmacological side effects, psychological factors, environmental factors, and the interactions between children and parents **(Iwadare etal., 2013 & Firouzi etal., 2013)**.

Obstructive Sleep Apnea (OSA) had received a significant public attention and medical concern. It is a common childhood condition that affects 1–3% of the general pediatric population. In children, OSA is a sleep breathing disorder characterized by prolonged partial upper airway obstruction or intermittent complete obstruction during sleep, disrupting ventilation and sleep patterns. Loud snoring 3 or more nights per week, abrupt awakening with shortness of breath, chronic

mouth breathing, difficulty staying asleep with multiple nocturnal awakenings, restlessness, waking up feeling unrefreshed, sweeting and finally, frequent morning headaches are all significant symptoms of OSA (**Marcus etal., 2012)**.

The most common cause of nasal obstruction and chronic mouth breathing in children is pharyngeal and palatine tonsillar hyperplasia, which is also the most common cause of sleep-disordered breathing. Various etiological variables, such as craniofacial deformities, neuromuscular weakness, genetic disorders, and obesity, may contribute to pediatric OSA. Adenotonsillar hypertrophy is the most prevalent risk factor for OSA and the preferred therapy is adenotonsillectomy, which accounts for over 500,000 surgeries annually in the United States alone. However, this surgical approach may not be as effective as expected and in some cases residual OSA may exist. A previous study confirmed that adenotonsillectomy cured OSA in only 27.2 % of obese and non-obese children **(Bodenner etal., 2014 & Bhattacharjee etal., 2010)**.

The gold standard for diagnosing pediatric OSA is Polysomnography (PSG). The goal of the PSG is to diagnose, distinguish, and quantify obstructive, mixed, and central apnea, as well as identify hypopneas, high resistance syndromes, and sleep fragmentation. It is done in pediatric age with recordings lasting 11–12 hours in preschool patients and 9–10 hours in school-age subjects. PSG is a costly exam that necessitates specialized equipment, space, and staff **(Berry etal., 2017)** .

In children, every single apnea or hypopnea event detected per hour during PSG must be considered abnormal. Apnea is defined as a detectable airflow reduction of more than 90% that lasts two respiratory circles or longer, whereas hypopnea is defined as a 30% airflow reduction that lasts two respiratory circles or longer. PSG can identify three severity levels of OSA based on the Apnea-Hypopnea Index (AHI): mild OSA (AHI 1–4), moderate OSA (AHI 5–9), and severe OSA (AHI ≥ 10) (**Mitchell etal., 2015)**.

Children with untreated obstructive sleep apnea may exhibit behaviors associated with learning difficulties, such as poor academic performance, aggressive behaviour, developmental delay, nocturnal enuresis, and even growth retardation. Children are at a higher risk of developing respiratory problems, such as respiratory arrest after getting general anaesthesia or sedation **(Kukwa etal., 2015)**. Also, OSA in children is linked to cardiovascular morbidities as high systolic and diastolic blood pressure, dysfunction of autonomic regulation, decreased cerebral blood flow, left ventricular remodeling, and endothelial dysfunction **(Khositseth etal., 2013 & Chan etal., 2015)**.

According to the World Health Organization, Quality of Life (QOL) is the personal judgment of one's health and diseases, including a multidimensional assessment of a person's satisfaction with life and the perceptions of his or her position in life in different contexts **(The World Health Organization, 1995)**. The extent to which pediatric OSA has an impact on QOL is still unknown. Furthermore, the importance of considering health-related QOL in the assessment of clinical outcomes in children with OSA cannot be overemphasized. After adenotonsillectomy validated disease-specific QOL surveys can be used to assess changes in a child's sleep disturbance and daytime symptoms. The OSA-18 is the most extensively used QOL survey for children with OSA, and it has been validated as an evaluative and discriminative tool (**Lee etal., 2014)**.

Nurses assist in the diagnosis of pediatric OSA by asking the right questions, assessing the situation, and observing the child. These inquiries allow nurses to look into other factors that may be contributing to the development of pediatric OSA. The nurse's assessment and early detection are the initial steps in implementing appropriate interventions to reduce the risk of poor health outcomes for children with OSA. On the basis of screening criteria, nurses report their findings to physicians. This helps nurses make assumptions and improves clinical findings about a child's ability to respond well to a treatment plan **(Wolfson etal., 2013)**.

Orthodontic treatment, mandibular advancement, and weight loss are all options for treating OSA. These treatments correct the

oropharyngeal structure but may have no effect on either functionality or neuromuscular disorders. Oral breathing and lip hypotonia, which are common in children with OSA, seldom improve following surgery or medication, and may be the cause of persistent OSA. They may genuinely change pharyngeal nasal tone (tongue and cartilage hypotonia), causing a collapse on inspiration and increasing nasal resistance. As a result, it's critical to investigate the efficacy of various treatment options for OSA (**Villa etal., 2011)**.

Significance of the problem:

Approximately 12% to 15 % of children are affected by sleep breathing disordered, with the highest prevalence in preschool-aged children between the ages of 3 and 5 years. The sleep problem normally arises between the ages of 2 and 7 years in 2% of children and 2.5 percent to 6% of adolescents who have been diagnosed with OSA and both sexes are affected equally. However, after puberty, OSA seems to be more prevalent in boys (**Biggs et al., 2015)**.

Oropharyngeal exercises consisted of isometric and isotonic exercises involving the tongue, soft palate, and lateral pharyngeal wall in order to ameliorate functions of suction, swallowing, chewing, breathing, and speech. As a result, oropharyngeal exercises may be used to support medical and surgical treatment in order to reestablish nasal breathing, normal lip position, and restore the proper swallowing pattern. There is less awareness about the use of this intervention among the health care providers, so not commonly used. In Egypt, there are fewer researches evaluating the impact of oropharyngeal exercises on clinical outcomes in children with OSA. Therefore, the researchers conducted the present study to evaluate the effectiveness of oropharyngeal exercises as a mean of reducing OSA symptoms in children after adenotonsillectomy and improve their quality of life.

Aim of the study

The aim of this study was to evaluate the effect of applying oropharyngeal exercise on sleep problems and quality of life in children with obstructive sleep apnea post-adenotonsillectomy.

Hypotheses:

H_1- Applying of oropharyngeal exercises will decrease sleep problems mean score in children at 45 day and 90 day post-intervention compared to the pre-intervention phase.

H_2- Applying of oropharyngeal exercises will improve quality of life mean score in children at 45 day and 90 day post-intervention compared to the pre-intervention phase.

Subjects and Methods

Research design:

A quasi- experimental design was utilized to achieve the aim of the study.

Settings:

This study was conducted at the outpatient and inpatient Ear, Nose, and Throat department (ENT) in Benha Health Insurance Hospital affiliated to the Egyptian Ministry of Health. This hospital was chosen because this hospital has the highest capacity of children with ENT problems.

Subjects:

Sample size: Epi Info program was used to estimate the sample size using the following parameters.
1- Population size: 110 children
2- Expected frequency: 50%
3- Acceptable error: 10 %
4- Confidence coefficient: 95%
The minimal Sample size: 50 children

Sample type: A Purposive sample consisted of 50 male and female children accompanying their mothers chosen from the previously mentioned hospital after fulfilling the inclusion criteria.

Inclusion criteria:

- Age: 7 - 11 years

- Children who are recently diagnosed with mild residual OSA post- adenotonsillectomy.

- Children not take sleep medication.

-Mothers willing to participate in the study.

Exclusion criteria:

- Children with nasal obstruction due to other causes like septal deviation, allergic rhinitis, asthma and congenital nasal deformities.
- Children with mental retardation or epilepsy.

Tools of Data Collection:

Data collection was done through the following tools:

Tool (I): Children assessment Questionnaire sheet:

It was designed by the researchers to collect date about children and their mothers, it includes two parts:

Part (1): Characteristics of the studied mothers: age, educational level, occupation, residence, monthly income and attending training courses about oropharyngeal exercises.

Part (2): Characteristics of the studied children: age, gender, educational grade and rank.

Part (3): Medical data: duration of illness, weight, height and present complains. These data were taken from the children medical records.

Tool (II): Child's Sleep Habits Questionnaire (CSHQ):

It considers a retrospective questionnaire that was developed and adapted by researchers from **Owens et al., (2000)** to identify sleep problems and habits in children according to their mothers report during the previous recent week. It includes 33 items reflecting the major presenting clinical sleep complaints and grouped under 8 domains that encompass: bedtime behavior (6items), sleep onset delay (1item), sleep duration (3items), anxiety around sleep (2items), night waking (3items), sleep-disordered breathing (3items), parasomnias (7 items), and daytime sleepiness (8items).

Scoring system: The total questionnaire is calculated by summing all item scores and items are rated on a three-point Likert scale ranged from one to three. A score of one for usually (if sleep problem occurred five to seven times/week); 2, sometimes (if occurs two to four times/week) and 3, rarely for (zero to one time during a week). The total scores were ranged from 33 to 99. In this study, higher CSHQ scores indicate low sleep problems. So, levels were categorized as high sleep problems (< 50%) were ranged from 1< 49.5point, moderate sleep problems (50% to < 75%) were ranged from 49.5 < 74 point and low sleep problems (75-100%) were ranged from 74-99 point.

Tool (III): Obstructive Sleep Apnea Quality of Life Survey (OSA-18) Questionnaire: The questionnaire was designed and adapted from **Franco etal., (2000)** to measure quality of life specific for children with obstructive sleep apnea. It consists of 18 items categorized under 5 domains; sleep disturbances (4 items), physical suffering (4 items), emotional distress (3 items), daytime problems (3 items), and caregiver concerns (4 items).

Scoring system: Items are scored in seven-point classification (1- none of the time, 2- hardly any of the time, 3- a little of the time, 4- some of the time, 5- a good bit of the time, 6- most of the time, 7- all of the time). The total OSA-18 score ranged between 18 and 126. Higher scores indicate worse quality of life. Accordingly, The impact of OSA on QOL was classified in three levels as follows, minor impact that indicates good QOL (< 50%) was ranged from 1< 63point, moderate impact that indicates fair QOL (50% to < 75%) was ranged from 63 < 94.5 point and major impact that indicates poor QOL (75-100%) was ranged from 95-126 point.

Validity and reliability of tools:

Tools of data collection were translated into Arabic and investigated for their content validity through distribution to 3 experts (two in the field of pediatric nursing from faculty of nursing, Benha University and one in the field of ENT specialty from faculty of medicine, Benha University) to test the content validity of the instruments and to judge its clarity, comprehensiveness, relevance, consistency, simplicity and accuracy. Minor modifications were made based on experts' suggestions in formulating some items. From the experts' perspective, the tools were considered valid.

The reliability of tools was assessed by the researchers using Cronbach's alpha coefficients. Internal consistency for children assessment questionnaire sheet was 0.90, and internal consistency was 0.79 for CSHQ and 0.83for OSA-18.

Phases of Study Application:

Preparatory phase:

A review of the past, current local and international literature covering all study aspects through using journal, books and magazines were done to be suitable with research problem and guide the researchers in preparation of study tools.

Ethical consideration:

The researchers obtained permission from the Ethics Committee at the faculty of nursing, Benha University before beginning the data collection process. Verbal explanation of the aim, benefits, and activities of the study were given to the mothers and their children to gain confidence and trust. After that, each mother was asked to sign a consent form. All data gathered would be kept strictly confidential and used for research purposes. Children autonomy and freedom from harm were guaranteed. Each mother was informed that participating in the study was completely voluntary, and withdrawal at any time would not impact the care provided. The subjects were coded to protect their confidentiality.

Pilot Study:

A pilot study was carried out on 10% of the study sample (5 children accompanied their mothers) to examine the applicability, clarity, relevance, objectivity, feasibility of tools and to estimate the time needed for each tool. Minor modifications were done (in tool I) in form of adding or omission of some questions according to the results of pilot study. The pilot study subjects were excluded from the study to avoid sample bias and contamination. This phase took one month from (the beginning of October 2017 to the end of October 2017).

Procedures:

Data collection took a period of eight months starting from the beginning of November 2017 to the end of June 2018. The researchers visited the outpatient ENT clinic two days a week, Sunday and Tuesday in the morning shift (over a period of three month) until predetermined sample size was completed. The numbers of children taking / week were ranged from 4 to 5 children. At the beginning of the interview the researchers introduced themselves to each participant included in the study, explained all information about the study purpose, duration, and exercises technique. Mother's written consent was taken to participate in the study prior to data collection. Then, the researchers start to collect baseline data (use Tool I, II &III). The time used for finishing each participant interview ranged between 20-30 minutes, according to mother's physical and mental readiness.

Implementation phase:

Children with residual OSA post-adenotonsillectomy were referral to the inpatient ENT department for closed observation (at least 24 hours) where the oropharyngeal exercises training sessions were held. The exercises were carried out by researcher's staff that was previously trained for each child separately in the presence of his mother. Each session comprised of a set of exercises that required 45 minutes to complete. Each exercise included in each session had to be repeated 10 times, at least 3 sets / per day. Then, the researchers instruct children to perform the exercises daily after discharge over a period of three months at home, 7days/week. Teaching methods was demonstration, re-demonstration. Children were given instructions sheet which explained the proper way to do these exercises. In addition, children and their mothers were followed up telephonically to provide guidance regarding the oropharyngeal exercises and to ensure that the home exercises were being performed correctly.

The oropharyngeal exercises consisted of 10 exercises involving orofacial and pharyngeal area which developed and adapted by researchers from Cheng etal., (2017) to correct the improper function of the tongue and facial muscles. The 10 exercises were the following:

1. **Push up the Tongue**: Place the tip of the tongue against the hard palate on the roof of the mouth, just behind the top teeth, and push upwards and hold for 5 seconds. Repeat 10 times.
2. **Touch Nose:** Stick out your tongue and try to touch the tip of your nose and hold for 10 seconds, and then relax. Repeat 10 times.
3. **Touch Chin:** Stick out your tongue and try to lick the bottom of your chin and hold for 10 seconds, and then relax. Repeat 10 times.
4. **Push Tongue Left**: Stick out your tongue and move it as far as you can to the left and hold for 10 seconds, then relax. Repeat 10 times.
5. **Push Tongue Right**: Stick out your tongue and move it as far as you can to the right and holds for 10 seconds, then relax. Repeat 10 times.
6. **Roll Tongue**: Roll your tongue by folding the edges toward the middle lengthwise, so it looks like the end of a taco shell. Stick it out as far as you can while keeping it folded and hold for 10 seconds, then relax. Repeat 10 times.
7. **Click the Tongue:** Make a loud clicking sound with the tongue against the roof of the mouth. Click the tongue for 15 seconds and then repeat 10 times.
8. **Push the Tongue against a Spoon**: Push the tip of your tongue firmly against a spoon held in front of your lips for 10 seconds. Keep the tongue straight and don't let it point downwards. Repeat 10 times.
9. **Hold a Spoon:** Place the handle of a metal spoon between your lips and hold it in place with only your lips for 10 seconds. Do not place the handle between your teeth. Try to keep it parallel to the floor. As your strength improves, you can place other small objects on the spoon for added weight (i.e., sugar cube). Repeat 10 times.
10. **Hold a Button with lips**: For children, who are not at risk of swallowing a button, tie one to a piece of string at least 10 cm in length. Place the button between the teeth and lips. Purse your lips tightly and pull out on the string, not letting it slip out. Pull for 10 seconds, and then relax. Repeat 10 times. For added difficulty, place the button flat between the lips.

Evaluation Phase:

The children were evaluated by using same of pretest tools that conducted after 45 days and 90 days post- intervention by comparing the change in children sleep problems and quality of life.

Administrative Design:

For conducting the study, an official letter was issued from the Dean of faculty of nursing, Benha University to the administrators of the study setting to carry out the study. A clear explanation was given about the nature, importance and expected outcomes. Then, it was possible to carry out the study with minimal resistance.

Statistical Design:

The collected data were organized, categorized, tabulated and analyzed using SPSS advanced statistics version 20. Data were presented using descriptive statistics in the form of numbers and percentages for qualitative variables, and mean and standard deviation for quantitative variables. Quantitative continuous data were compared using paired t-test. Reliability of the interviewing questionnaire was done using Cronbach's Alpha. Pearson correlation analysis were done for assessment of inter relationship among quantitative variables. Statistical significance differences was as at P-value < 0.05 and highly statistically significant differences was considered at P-value <0.001, while no statistical significant differences was considered at P-value >0.05.

Limitations of the study:

- Caregivers who involved in the study may have more concerns about their children health status and this may recall a selection-bias.

Results:

Table (1): Shows the studied mothers according to their characteristics, it was observed that two fifth (40%) of the mothers were in the age group of (25: < 30) with a mean age 28.34 ± 9.23years. Regarding the

level of education, more than half (52%) of them were illiterate and more than three quarters (76%) of them were housewife. As regards residence, nearly three quarters (74%) of the studied mothers coming from the rural area. Majority of the studied mothers had insufficient monthly income and all (100%) of them did not attend any training courses about oropharyngeal exercises.

Table (2): Clarified that, equal numbers of studied children (50% & 50% respectively) were male and female. More than half (58%) of them were in the age group of (7: < 9) with a mean age 9.62 ± 1.84years. Also, two fifth (40%) of them were ranked as the first child in the family, majority (88%) of them had primary stage level. Concerning to duration of illness, two thirds (66%) of children had duration< 2years.

Figure (1): Revealed that more than three quarters (78%) of the studied children were overweight.

Figure (2): Demonstrated that the majority (80%) of the studied children had inappropriate height.

Figure (3): Clarified that, (95%, 93%, 78%, 67%, & 57% respectively) of the studied children complain from loud snoring, mouth breathing, restless sleep, morning headache and choking.

Table (3): Showed that there was a highly statistical significant improvement in the total sleep problems mean score and the mean scores for all domains after 45days and 90days post-intervention phases (P<0.000).

Figure (4): Illustrated that more than half of children (55%) reported high sleep problems in the pre-intervention phase. While, more than two thirds and more than half (70% & 54% respectively) of them reported low sleep problems after 45 days and 90 days post-intervention phases.

Table (4): Showed that the total OSA quality of life mean score was higher (84.2±3.21) pre-intervention phase and the higher mean scores were evident in the domains of caregiver concerns (24.0±2.17), sleep disturbance (21.90±2.49) and physical symptoms (20.22±1.62). While the lower mean scores were related to the domains of daytime problems (9.80±1.57) and emotional distress (8.10±2.21). Meanwhile, post-intervention phases, there was a highly statistical significant improvement in the total OSA quality of life mean score and the mean scores for all domains after 45days and 90days (P<0.000).

Figure (5): Presented that more than three quarters (76%) of children reported poor OSA quality of life in the pre-intervention phase. On the other hand, more than two thirds and two thirds (72% & 66% respectively) of them reported good OSA quality of life after 45 days and 90 days post- intervention phases.

Table (5): Displayed that there was a highly statistical significant negative correlation between the children sleep problems and OSA quality of life scores in the pre, after 45days and 90days post-intervention phases (P<0.000).

Table (1): Frequency distribution of the studied mothers according to their characteristics (n=50)

Mothers' characteristics	No.	%
Age		
- 25:<30 years	20	40.0
- 30:<35 years	12	24.0
- 35:<40 years	14	28.0
- ≥ 40 years	4	8.0
Mean ± SD	**28.34 ± 9.23**	
Range	20-43	
Mothers' educational level		
- Illiterate	26	52.0
- Read and write	6	12.0
- Primary education	6	12.0
- Preparatory education	12	24.0
Occupation		
- Housewife	38	76.0
- Working	12	24.0
Place of residence		
- Rural	37	74.0
- Urban	13	26.0
Monthly income		
- Sufficient	5	10.0
- Insufficient	45	90.0
Attending training courses about oropharyngeal exercises		
- Yes	0	0.0
- No	50	100.0

Table (2): Frequency distribution of the studied children according to their characteristics (n=50).

Children' Characteristics	No.	%
Age		
- 7 : < 9 years	21	42.0
- 9: ≤ 11 years	29	58.0
Mean ± SD 9.62 ± 1.84		
Gender		
Female	25	50.0
Male	25	50.0
Rank of the Children		
The 1st	20	40.0
The 2nd	8	16.0
The 3rd	14	28.0
Above the 3rd	8	16.0
Educational level		
Primary Stage	44	88.0
Drop out	6	12.0
Duration of illness		
< 2years	33	66.0
>2years	17	34.0

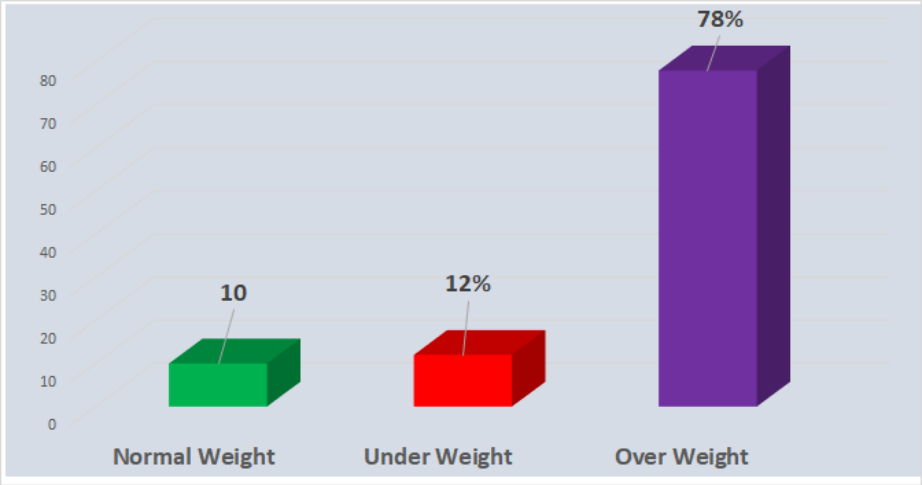

Figure (1): Frequency distribution of the studied children according to their weight

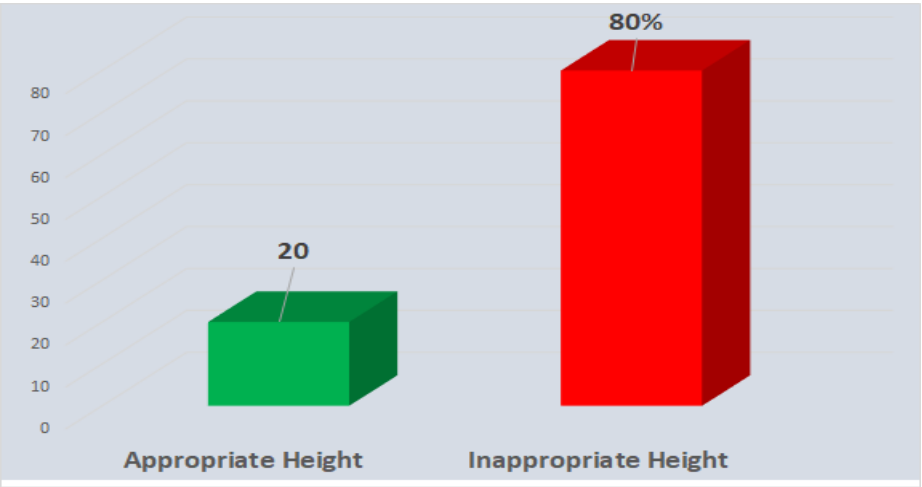

Figure (2): Frequency distribution of the studied children according to their height

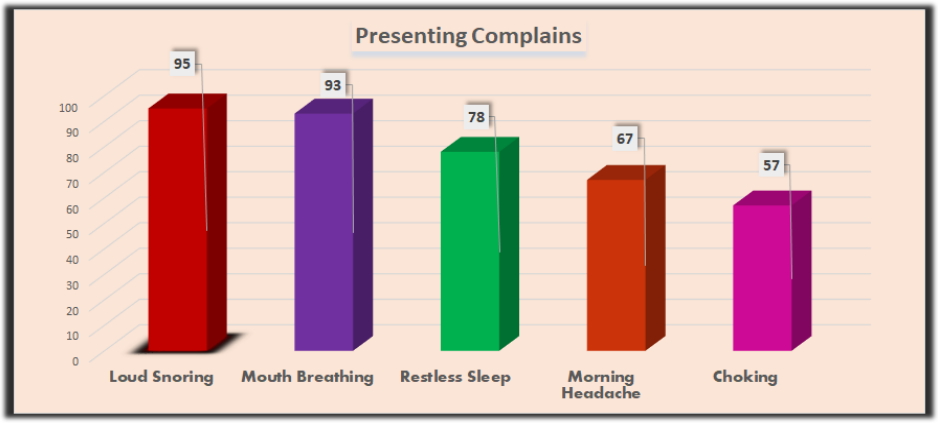

Figure (3): Frequency distribution of the studied children according to their presenting complains.

Table (3): Total mean scores of children's sleep problems as reported by their mothers throughout the intervention phases (n=50)

Total children's sleep problems	Max Score	Pre-intervention phase	Post1-intervention After 45 days	Post2-intervention After 90 days	Paired t1-test p-value	Paired t2-test p-value
		X ± SD	X ± SD	X ± SD		
Bedtime resistance	**18**	16.38±1.39	9.32±2.60	8.58±1.92	14.917 0.000**	14.598 0.000**
Sleep onset delay	**3**	2.76±1.89	1.44±0.47	1.31±1.67	5.792 0.000**	4.871 0.000**
Sleep duration	**9**	8.76±0.79	5.74±2.44	4.00±1.21	8.885 0.000**	6.967 0.000**
Sleep anxiety	**6**	4.98±0.49	3.44±0.11	2.96±0.89	8.582 0.000**	8.553 0.000**
Night walking	**9**	8.00±0.40	5.21±0.29	3.51±0.29	8.363 0.000**	6.607 0.000**
Sleep disordered	**9**	7.96±0.89	4.77±1.89	3.88±0.32	7.769 0.000**	6.302 0.000**
Parasomnias	**21**	20.66±0.32	12.41±2.21	10.19±0.56	12.652 0.000**	11.954 0.000**
Daytime sleepiness	**24**	21.84±2.54	12.17±2.51	10.61±0.91	20.792 0.000**	15.105 0.000**
Total sleep problems	**99**	**91.34±2.85**	**54.5 ±3.21**	**45.04±1.92**	36.670 0.000**	30.091 0.000**

T1 paired t-test between pre and post1 **T2 paired t-test between pre and post2**

**** A highly statistical significant difference (P < 0.001).**

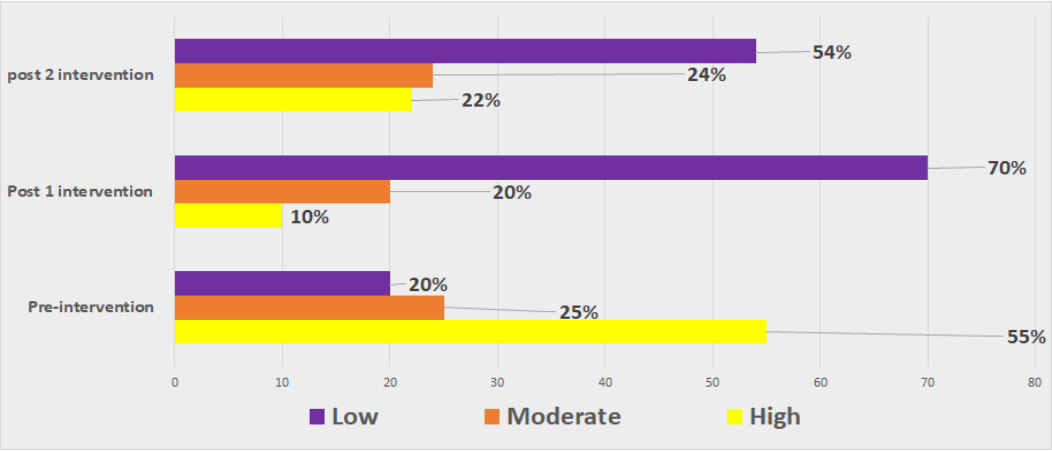

Figure (4): Comparison of sleep problems levels of the studied children as reported by their mothers throughout the intervention Phases (n=50).

Table (4): Total mean score of OSA quality of life among children as reported by their mothers throughout the intervention phases (n= 50).

Quality of life domains	Max score	Pre-intervention	Post1-intervention After 45days	Post 2-intervention After 90days	Paired t1-test p-value	Paired t2-test p-value
		X ± SD	X ± SD	X ± SD		
Sleep disturbance	28	21.90±2.49	12.21±1.97	10.70±2.07	25.928 0.000**	22.985 0.000**
Physical symptoms	28	20.22±1.62	11.62±2.33	9.35±1.99	24.377 0.000**	20.302 0.000**
Daytime problems	21	9.80±1.57	4.15±0.89	3.31±0.49	15.391 0.000**	13.221 0.000**
Emotional distress	21	8.10±2.21	4.75±1.90	3.55±1.85	11.622 0.000**	9.252 0.000**
Caregiver concerns	28	24.0±2.17	12.75±2.99	10.91±2.90	29.350 0.000**	26.681 0.000**
Total quality score	**126**	**84.2±3.21**	**45.48±1.92**	**37.82±2.07**	35.350 0.000**	33.681 0.000**

T1 paired t test between pre and post1 **T2 paired t test between pre and post2**

**** A highly statistical significant difference (P < 0.001)**

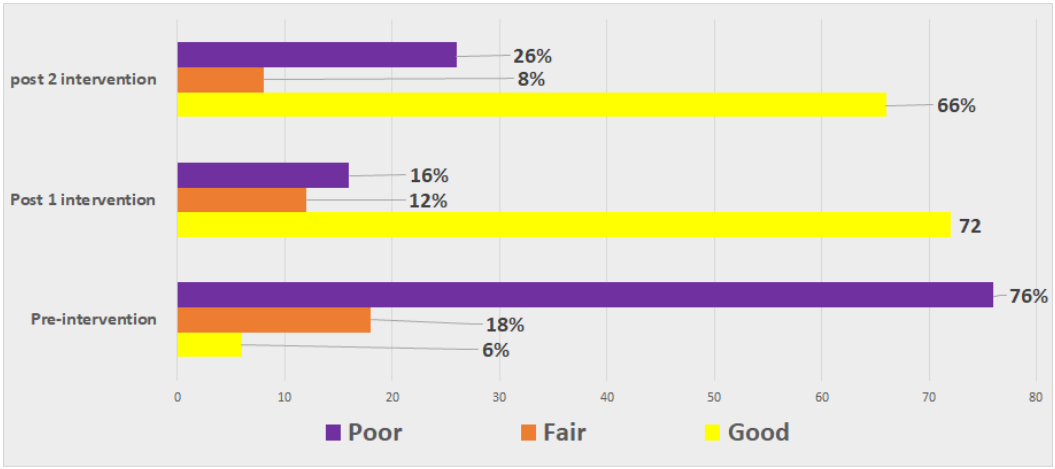

Figure (5): Comparison of OSA quality of life Levels among the studied children as reported by their mothers throughout the intervention Phases (n=50).

Table (5): Correlation matrix between total children' sleep problems and OSA quality of life scores throughout the intervention phases (n=50).

Items		Sleep problems pre	Sleep problems post 1	Sleep problems post 2	Quality of life pre	Quality of life post 1	Quality of life post 2
Sleep problems pre	**R**						
	P-value						
Sleep problems post 1	**R**	.332					
	P-value	.003*					
Sleep problems post 2	**R**	.247	.383				
	P-value	.005*	.000**				
Quality of life pre	**R**	-.510	.131	.144			
	P-value	.000**	.364	.319			
Quality of life post 1	**R**	-.481	-.466	-.577	.376		
	P-value	.000**	.000*	.000**	.001**		
Quality of life post 2	**R**	-.544	-.435	-.562	. 315	. 398	
	P-value	.000**	.000**	.000**	.001**	.001**	

**** Correlation is significant at the 0.01 level (2-tailed)**

**** A highly statistical significant difference (P < 0.001)**

Discussion:

Oropharyngeal exercises were a novel, non-invasive and cost-effective treatment which acts by increasing the tone of pharyngeal muscles. Its goal is to correct the posture adequacy, the tonus and mobility of the orofacial and pharyngeal musculature. Also, oropharyngeal exercises strengthen the oropharyngeal muscles and increase their tone, thereby dilating the upper airways during sleep. It is more physiological and may bring long-term benefits to the children **(De Felicio etal., 2018).** Therefore, the aim of the present study was to evaluate the effect of oropharyngeal exercises on sleep problems and quality of life in children with obstructive sleep apnea post-adenotonsillectomy.

The findings of the present study indicated that the mean age of mothers was twenty eight years, more than half of them were illiterate, more than three quarters were housewife, nearly three quarters reside in the rural area and majority of them had insufficient monthly income. This result may be due to the fact that the data were collected from the health insurance hospital where treatment is for free or covered by medical insurance and it serves usually those from low or middle socioeconomic classes. These findings supported with **Maree et al., (2019)** who assessed prevalence of sleep problems and its relation to sleeping habits in children and found that the mean age of mothers was 29.4±2.5 years, only18.3% had university education and 11.7% were employed.

In addition, this study finding was in accordance with **Lewien et al., (2021)** who found that 58.4% of children belonged to families had middle socioeconomic status. Again, this study finding confirmed by the results of **Beebe etal., (2012)** who studied persistent snoring in preschool children and reported that low socioeconomic status was a strong predictor of sleep-disordered breathing. The possible reasons underlying this correlation included reduced access to health care, differences in health-related behaviors and exposure to environmental toxicants.

Obstructive sleep apnea in children secondary to adenotonsillar hyperplasia was commonly found in the pediatric population. These conditions affect approximately 11% of children which similarly distributed between both sexes **(Lim & Mckean, 2011)**. The finding of the current study showed that the number of females' participant was equal to the number of males. This finding was inconsistent with **Xu etal., (2020)** who studied risk factors of obstructive sleep apnea syndrome in children and found that (69.5%) of them were boys. In addition to that, another study supported by **Spilsbury etal.,**

(2015) who reported a higher incidence of OSA in boys than girls and concluded that the disparity in prevalence between genders could be due to fat distribution, length and collapsibility of the upper airway, and neurochemical control mechanisms. Again, the current study finding found that the mean age of children was 9.62 ± 1.84years.This finding disagreed with **Shindy and El-Ghaiaty, (2014)** who found that the mean age of enrolled children was of 7.6±1.6. Besides, this finding contradicted with **Ahmed et al., (2014)** who reported that the mean age of children was 5.44 years ±3.39. This finding could be because the researchers included older children in their study.

The current study finding showed that more than two thirds of children had a family history of obstructive sleep apnea. This finding was similar with what was reported by **Weinstock etal., (2014)** who evaluated predictors of obstructive sleep apnea severity in adenotonsillectomy candidates and revealed that children with a family history of OSA are at an increased risk for OSA. Again, **Aurora etal., (2011)** stated that sleep apnea can run in families, so a child's risk for obstructive sleep apnea may be increased if another family member has sleep apnea.

Concerning to duration of obstructive sleep apnea, the finding of the present study demonstrated that two thirds of children had obstructive sleep apnea prior to two years. This could be attributed to that more than half of mothers were illiterate and this could be responsible for lower awareness of the disease condition among their children. This finding was in line with **Musa etal., (2017)** who evaluated the impact of adenotonsillectomy on quality of life in children with obstructive adenotonsillar hyperplasia and found that the mean duration of symptoms was 20.67±16.28 months.

The finding of the current study revealed that more than three quarters of the studied children were overweight or obese. This finding was in concordance with **Narang etal., (2012)** who reported that obstructive sleep apnea occurs in 60% of obese children. Similarly, **Katz etal., (2014)** demonstrated that overweight children at greater risk of residual or recurrent OSA after adenotonsillectomy. In this regard, **Bhattacharjee etal., (2011)** stated that obesity related to pediatric obstructive sleep apnea is multifactorial as narrowing of the upper airway may result from fatty deposition of upper airway structures, including deposits in the anterior neck that can lead to pharyngeal collapsibility. Obesity also mass loads the respiratory system secondary to adipose tissue around the thoracic and abdominal walls, reducing overall pulmonary volumes and diaphragm excursion, and leading to substantial reductions in pulmonary reserve, particularly during supine sleep.

Sleep problems among children generally include behavioral sleeping problems, problems with falling asleep, waking up during the night, parasomnias, and symptoms related to sleep-disordered breathing **(Muiz, 2012).** The results of the current study reported that more than half of children had high sleep problems pre-intervention phase. This could be due to parenting practices, television viewing habits, hanging out with friends, and excessive daytime napping among Egyptian children. This findings was corroborated with **Khazaie etal., (2019)** who conducted a study about sleep pattern, common bedtime problems, and related factors among first grade students and revealed that 57% of the first-grade students suffer from sleep problem in the baseline assessment. In contrast, the current study finding was inconsistent with the findings of other studies by **Maree etal., (2019)** who stated that sleep problems were present in 70.8% of the cases and the study in Germany by **Schlarb etal., (2015)** who reported that sleep problems were present in 20–25 %. This difference could be due to cultural and social factors affecting one's sleep.

Results of the current study indicated that that there was a highly significant improvement in the mean scores for all domains of sleep problems after 45days and 90days post-intervention phases and this means that children who practicing oropharyngeal exercise regularly had lower bedtime resistance, better sleep duration, lower episodes of night walking, lower sleep disordered and less daytime sleepiness symptoms. In supporting of this finding, the study of **Ieto et al., (2015)** who applied oropharyngeal exercises for 3 months and at the end of the intervention, the quality of sleep duration had increased. Again the study of **Verma et al., (2016)** who applied

oropharyngeal exercises to twenty mild to moderate OSA patients for 3 months and found a significant improvement in symptoms of daytime sleepiness at the end of the intervention and concluded that oropharyngeal exercise can be considered as an alternative method of treatment in mild to moderate obstructive sleep apnea symptoms. The current results illustrated that one possible reason explained that oropharyngeal exercises could be useful to improve the muscle tone of the tongue, throat, and face which could increase the anatomical space of the orofacial structures and hence, reduce obstruction to the airway resulting in lower sleep disordered **(Varjao, 2012).**

Similarly, this study finding was supported by other research findings by **Huang & Guilleminault, (2013)** who applied an oropharyngeal motor training program for children with OSA in Taiwan and demonstrated the efficacy of oropharyngeal exercises on reducing obstructive sleep apnea and symptoms of sleep disordered breathing in children such as snoring and mouth breathing. Additionally, the study of **Villa etal., (2017)** who evaluated myofunctional therapy in children with sleep-disordered breathing and found that the oropharyngeal exercises have been shown to improve obstructive sleep apnea symptoms and snoring in children.

The present study findings showed that the total OSA quality of life mean score was significantly higher pre-intervention phase due to the major impact of OSA on quality of life and the highest mean score of quality of life domains was related to caregiver concerns, sleep disturbance and physical symptoms. Reason of higher caregiver concerns might be due to most of caregiver were worried about their children health status, miss school, miss activity, behavioral problems, academic performance and occurrence of complications. These findings were in accordance with **Gomes etal., (2012)** who studied quality of life in 59 children with sleep-disordered breathing and found that the total quality of life baseline mean score was higher (83 ± 15.08) and the area most affected were caregiver concerns (21.8 ± 4.25), sleep disturbance (18.8 ± 5.19), physical suffering (17.3 ± 5.0).

Again, the current study finding revealed that the domains of daytime problems and emotional distress had the lowest mean score of quality of life pre-intervention phase and this indicating that OSA has the lowest impact on quality of life in these two domains. This might be due to daytime problems is not usually obvious in young children. Children tend to be more hyperactive/ inattention. This finding was in agreement with **Musa etal., (2017)** who found that the domains of emotional distress and daytime problems had the lowest scores.

Concerning children' OSA quality of life levels, more than three quarters of children with OSA reported poor quality of life in the pre-intervention phase. This could be attributed to the negative impact of OSA on children' quality of life. This finding was in accordance with the finding of other study by **Kang etal., (2014)** who found that children in the OSA group had poorer quality of life in the baseline assessment. Meanwhile, post- intervention phases, the present study revealed that there was a significant improvement in the children' quality of life, where more than two thirds and two thirds of them had good quality of life after 45 days and 90 days. This result might be due to the positive effect of oropharyngeal exercise in reducing the impact of the OSA on the children ability to carry out daily activities efficiently. This study finding was in concordance with **Chuang et al., (2019)** who conducted a comparative cohort study with a passive myofunctional therapy in children with OSA and reported a significant improvement in nasal breathing during sleep and quality of life.

The present study findings indicated that there was a significant negative correlation between the children sleep problems and quality of life scores in the pre, after 45days and 90days post-intervention phases. This mean that children with high sleep problems had poor quality of life while, children with low sleep problems had good quality of life. This study finding was in the same line with **Sundell and Angelhoff (2021)** who tested the associations between children's sleep and health-related quality of life and revealed that there was a significant negative association between sleep onset and maintenance problems and health-related quality of life among younger children.

Conversely, this result disagreed with **Magee et al., (2017)** who reported in an Australian cohort study that minor sleep disturbance in 10 and 11-year-old children correlate positively to poorer QoL, which worsen over time. Again, this finding was inconsistent with **Roeser etal., (2012)** who studied relationship of sleep quality and health-related quality of life in 92 adolescents and found a significant positive correlation between sleep quality and Quality of Life (QoL) and this indicating that better sleep was significantly associated with higher QoL among the group of good sleepers than poor sleepers.

Conclusion:

Based on the results of the study, it can be concluded that applying of oropharyngeal exercises daily for 3 months period had a significantly positive effect on decreasing sleep problems and improving quality of life in children with obstructive sleep apnea post-adenotonsillectomy. Hence, the study aim was achieved and the research hypothesis was supported.

Recommendation:

Based on the study results, the following recommendations are suggested:

1. Conducting more continuing oropharyngeal exercises intervention program for mothers having children suffering from OSA to decrease the negative outcomes and improve quality of life with the necessity of follow-up.
2. Simple Arabic handout about oropharyngeal exercises technique and its benefits should be accessible in all ENT departments of clinical setting.
3. Community-wide education to increase mothers' awareness regarding OSA and its risk factors can be implemented in a variety of clinical settings at different locations to promote healthy sleep habits of children.
4. Further research is needed to clarify the association of sleep insufficiency and problems with academic performance in schoolchildren.

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