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Original article

Prospective Evaluation of Post-Operative Weight Changes among Children After (Adeno)-Tonsillectomy

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ABSTRACT

Aims. *This study was aimed at demonstrating the relationship between tonsillectomy and weight change in children.* ***Methods**. This study was conducted in the Department of Otolaryngology at Al-Bayda Medical Center, Libya, between July 2019 to June 2020. A study analyzed the patients who underwent tonsillectomy with or without adenoidectomy, grommet insertion, or adenoidectomy alone by measuring their weight and height before and after the procedure six months postoperatively.* ***Results**. Weight was changed significantly (P=0.001) in children who underwent adenotonsillectomy surgery pre- and post-operatively (at 1, 3, and 6 months). Pre-operative weight was (21.83±10.85) and post-operative weight was (23.06±10.99), (23.75±11.20), and (24.79±11.55) at 1, 3, and 6 months, respectively. In comparison of pre- and post-operative body mass index (BMI). The change in pre-operative BMI was 15.82 2.98 and post-operative BMI was 17.68 ±3.08. The result of the comparison was statistically significant (p=0.001). BMI grade changed in pre- and post-operative settings as follows: underweight pre- (72.5%), post-operative (2.5%), average weight recorded in pre- (25%), post-operative (82.5%), overweight found in pre- (2.5%), post-operative (10%), and obese found in pre- (0%), post-operative (5%) with statistically significant (P=0.001).* ***Conclusion**. There was an increase in weight gain post-tonsillectomy with or without adenoidectomy. The difference was mostly observed six months post-operation, with a positive linear correlation between weight and BMI.*

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INTRODUCTION

Tonsillectomy is one of the most common surgical procedures in the United States, with 289,000 ambulatory procedures performed annually in children <15 years of age based on the most recent published data [1]. Indications for surgery include recurrent throat infections and obstructive sleep-disordered breathing (oSDB), both of which can substantially affect child health status and quality of life (QoL) [2]. Recurrent throat infections are a common reason to see a primary care provider and often result in antibiotic treatment [3]. The cost of outpatient visits and the medications prescribed for sore throats, including antibiotics, are substantial. Indirect costs associated with throat infections and OSDB are significant due to missed school [3, 4]. In children, the term sleep-disordered breathing (SDB) may be used more frequently than obstructive sleep apnea syndrome (OSAS) because the former term recognizes that SDB is a spectrum of sleep-related breathing disorders (SRBDs) that includes primary snoring, upper airway resistance syndrome, obstructive hypoventilation, and OSAS (the most severe aspect of the spectrum). Although the prevalence of OSAS has been reported to range from 0.7% to 3%, the prevalence of snoring and clinical suspicion of SDB in children may approach 11% [1]. OSAS was first described in children by William Osler in1892,

but his study became systematized only after the 70's. OSAS prevalence has 2 peak periods. The first peak occurs in children from 2 to 8 years of age, with the presence of enlarged adenoid and/or tonsils. A second peak arises during adolescence in relation with weight gain. Although gender differences have not been observed in the prevalence of OSAS among prepubertal children, some adolescent boys has been more affected than girls in a few reports [5, 6].

Both obesity and underweight status are associated with childhood OSA. Child obesity increases the risk of OSA, while children with OSA are reported to have delayed growth and impaired weight gain [7]. Diagnosis of OSAS in children is made on the basis of sleep history, physical examination, and polysomnographic findings [7-9]. Polysomnographic (PSG) testing is the gold standard for the diagnosis of OSAS, sleep studies are labor intensive and inconvenient for children and their families [10]. OSA has significant short- and long-term health and QoL concerns. It has been associated with a 5-point decrease in IQ, hypersomnolence, emotional lability, decreased attention, small stature, enuresis, cardiopulmonary morbidity, and missed school [11]. Adenotonsillectomy is the treatment of choice for otherwise healthy children with obstructive sleep apnea with improvement in 90% cases including improvement in their behavior, growth, development. However, some studies examining the efficacy and outcomes of AT in pediatric OSA showed incomplete resolution of OSA after surgery [12,13]. For example, nonobese children with severe OSA and chronic asthma were found to be at higher risk of residual OSA in a recent multicenter retrospective study [12].

Hypertrophy of adenotonsillar tissue is primarily responsible for the development of OSA in otherwise healthy children. Impingement of the upper airway by enlarged adenotonsillar tissues exponentially increases pharyngeal resistance that leads to episodic airway narrowing and collapse characteristic of OSA [14]. However, not all children with adenotonsillar hypertrophy uniformly suffer from OSA [15]. A common complication of tonsillectomy is bleeding during or after the surgery. In published reports, the rate of primary bleeding (within 24 hours of surgery) has ranged from 0.2% to 2.2% and the rate of secondary bleeding (>24 hours after surgery), from 0.1% to 3% [16]. Primary bleeding is generally considered to be related to surgical technique whereas environmental factors that influence oropharyngeal healing contribute to delayed (secondary) hemorrhage [16-18]. Several authors have reported that the risk of post-tonsillectomy bleeding depends on the skill level of the surgeon, with the risk of bleeding increasing when procedures are performed by trainees. However, a surgeon's inexperience and dissection in the wrong plane results in more post-tonsillectomy bleeding [19]. Furthermore, the operation time is increased, leading to a greater loss of blood. Reported risk factors for hemorrhage include the following: older patient age, male sex, history of recurrent acute tonsillitis or peritonsillar abscess, hot surgical techniques, such as monopolar electrocautery, and perioperative use of aspirin and ketorolac [20]. Another study argued that the risk of post-tonsillectomy bleeding was increased by 2.3 times in obese children [21]. There is limited empirical evidence regarding the association between BMI and post-tonsillectomy bleeding. Childhood obesity is linked with a longer duration of anesthesia, prolonged operative time, and a greater rate of readmission after adenotonsillectomy [22]. Growth is divided in many phases as described to Bjork. The modifications of the general body end in the sexual maturation phase. Growth is related to many factors such as alimentation, hormones, physical activity and psycho-affective disorders. All of these factors have negative effects on growth hormone secretion [23].

There is increasing interest in respiratory disorders in children with growth alterations. Respiratory stimulus is one of the most important stimuli in both cranial and body growth. Much research has shown that adenotonsillar hypertrophy may be associated with a slowing or stopping of growth during pediatric age [24-26]. There are three theories to explain the occurrence of low weight index in many children with OSAS: first: decreased production of growth hormone, second: decreased caloric intake due to anorexia/dysphagia in children with adenoid tonsil hypertrophy, and third: increased energetic spending due to nocturnal respiratory effort [27].

Adenotonsillar hypertrophy is often associated with growth retardation, maybe due to reduced appetite and caloric intake, nocturnal hypoxemia and respiratory acidosis, with probably the involvement of impaired growth hormone secretion and action, even though the exact mechanisms of how adenotonsillar hypertrophy leads to growth retardation remain still little understood [28]. Chronic tonsillitis, might also have an impact in the patient's weight and height, where the retardation varies about 10% compared to children with normal development [29,30]. Its effect on the patients' immune system is not clear. While most authors report no significant reductions of serum levels of immunoglobulins (IgM, IgA and IgG), others have reported that such changes are able to influence immune status [31]. Some of the local clinical manifestations of chronic tonsillitis include the tonsillogenic, odour (bad smell) from the mouth, difficulty in breathing, continuous coughing, sense of presence of other bodies/entities in the pharynx [32]. Therefore, this study was assessed effect of (adeno) tonsillectomy on growth of children from 2 to 14 years, considering percentiles of BMI, which makes comparing children of different ages and sex possible.

METHODS

Study design and setting

A prospective clinical trial study was conducted at Otolaryngology Department in Al-Bayda Medical Center, Libya. After taking approval from local ethical committee, study was conducted and patients between July 2019 and June 2020. A total of 40 cases aged from 2 to 4 years who underwent tonsillectomy. Patients were followed up to monitor their growth (BMI) by measuring their height and weight for o month,1 month, 3 months, and 6 months' post (adeno) tonsillectomy, and who underwent adenoidectomy and myringotomy with tonsillectomy also included among cases. The indications of tonsillectomy were chronic adenotonsillitis, recurrent attack of tonsillitis, obstructive sleep apnea, peritonsillar abscesses (quinsy), snoring, febrile convulsion and decrease of hearing. Data on weight (Kg) and height (cm) and covariates (gender, age ,birth weight, maturity at birth , mode of delivery, maternal education, number of family , season of surgery , type of procedure , indication of procedure , type of homeostasis , onset of oral feeding post-operative dysphagia or bleeding or other complication) were obtained from questionnaires completed by the parents.

Statistical analysis

Data were fed to the computer and analyzed using SPSS software package version 20.0. (Armonk, NY: IBM Corp) Qualitative data were described using number and percent. The Kolmogorov-Smirnov test was used to verify the normality of distribution Quantitative data was described using mean and standard deviation. Significance of the obtained results was judged at the 5% level. Chi-square test was used for categorical variables, to compare between different groups. Fisher's Exact or Monte Carlo correction: Correction for chi-square when more than 20% of the cells have expected count less than 5. Paired t-test: For normally distributed quantitative variables, to compare between two periods. Student t-test: For normally distributed quantitative variables, to compare between two studied groups Mann Whitney test: For abnormally distributed quantitative variables, to compare between two studied groups Friedman test: For abnormally distributed quantitative variables, to compare between more than two periods or stages and Post Hoc Test (Dunn's) for pairwise comparisons and Marginal Homogeneity Test: Used to analyze the significance between the different stages.

RESULTS

The study group included 50 patients, of whom 17 (42.5%) were male and 23 (57.5%) female, to detect the change in mean weight pre- and post-tonsillectomy and body mass index (BMI). Patients from birth to age 14 (6.90 ± 3.41 years) were included in the study. The majority of patients were seen at 2–7 years of life, with 13 patients (32.5%), followed by 11–14 years with 9 patients (11.5%). The mean birth weight was 3.29 ± 0.93 kg, and the mean height was 114.5±22.08 cm. Meanwhile, the mean weight pre-operation at zero months was 21.83±10.85g, as shown in table 1.

Table 1: Demographics of the participated children (n = 40)

Parameters	No. of cases	%
Age (years)		
2 – 4	13	32.5
5 – 7	13	32.5
8 – 10	5	12.5
11–14	9	22.5
Mean of age ± SD.	6.90 ± 3.41	
Sex		
Male	17	42.5
Female	23	57.5
Height (cm)		
Less than 80	3	7.5
81 – 120	23	57.5
121 – 140	8	20.0
More than 141	6	15.0
Mean of high ± SD.	114.5 ± 22.08	
Pre-operative weight (kg)		
≥14	13	32.5
15 – 30	21	52.5
31 – 46	4	10.0

>47	2	5.0
Mean of weight ± SD.	21.83 ± 10.85	
Birth weight (kg)	3.29 ± 0.93	

Table 2 presented demographic data of procedure that include indication of operation: 67.5% of cases was recurrent attack of tonsillectomy and sleep disorder breathing (32.5%). Up on type of procedure: tonsillectomy was found (90%) and adenotonsillectomy (10%). Type of homeostasis was diathermy (90%) and packing (10%). In term of day of hospitalization was one day (95%) and more than 2 days (5%) at mean 1.13±0.56. Complication with post-operative were bleeding (10%), dysphagia (10%), chest infection (2.5%) and fever (2.5%).

Table 2. Demographics data of procedure (n = 40)

Parameters	No. of cases	%
Indication of operation		
Recurrent attack of tonsillectomy	27	67.5
Sleep disorder breathing	13	32.5
Type of procedures		
Tonsillectomy	36	90.0
Adeno-tonsillectomy	4	10.0
Type of hemostasis		
Packing	4	10.0
Diathermy	36	90.0
Hospitalization postoperative (day)		
1	38	95.0
2	0	0.0
>2	2	5.0
Mean ± SD.	1.13 ± 0.56	
Complication		
Bleeding	4	10.0
Dysphagia	4	10.0
Chest infection	1	2.5
Fever	1	2.5

The mean change of weight in children underwent (adeno) tonsillectomy surgery pre- and post-operative at one month, three months and six months' post-operation were 21.83±10.85kg, 23.06±10.99kg, 23.75±11.02kg and 24.79±11.55kg respectively as shown in table 3. Comparison of results shown statistically significant P < 0.001 using Friedman test. Table 4 was shown comparison of change in body mass index (BMI) between pre and post-operative at 6 months that found (15.82 ± 2.98) and (17.68±3.08) respectively. This observation was statistically significant (p<0.001) using Paired t-test.

Table 3. Comparison of weight pre- and post-operation

Weight (kg)	Pre-operative weight		Post-operative weight (1month)		Post-operative weight (3 months)		Post-operative weight (6 months)		Fr	P. value
	No.	%	No.	%	No.	%	No.	%		
≥14	13	32.5	10	25.0	8	20.0	5	12.5	31.235*	<0.001*
15 – 30	21	52.5	22	55.0	20	50.0	23	57.5		
31 – 46	4	10.0	5	12.5	9	22.5	9	22.5		
>47	2	5.0	3	7.5	3	7.5	3	7.5		
Mean ± SD.	21.83 ± 10.85		23.06 ± 10.99		23.75 ± 11.20		24.79 ± 11.55		89.385	<0.001*
Sig. bet. Periods.	p_1=0.001*,p_2<0.001*,p_3<0.001*,p_4=0.022*,p_5<0.001*,p_6=0.002*									

*Where: SD: **Standard deviation,** IQR: **Inter quartile range. Fr**: **Friedman test**, Sig. bet. periods were done using **Post Hoc Test (Dunn's),** p: p value for comparing between the studied periods, p_1: p value for comparing between **pre** and **1months,** p_2: p value for comparing between **pre** and **3months,** p_3: p value for comparing between **pre** and **6months,** p_4: p value for comparing between **1month** and **3months,** p_5: p value for comparing between **1month** and **6months.** p_6: p value for comparing between **3month** and **6months and** *: Statistically significant at $p \leq 0.05$*

Table 4. Comparison of pre & post-operative BMI change

BMI change (g)	Preoperative BMI	Postoperative BMI (6 months)	T	P
Mean ± SD.	15.82 ± 2.98	17.68 ± 3.08	7.315*	<0.001*

*Where: SD: **Standard deviation,** IQR: **Inter quartile range**, **t: Paired t-test**, p: p value for comparing between the studied periods and *: Statistically significant at p ≤ 0.05*

Table 5 shows the percentage change at BMI grade in pre and post-operative, which found with underweight pre - (72.5%), post-operative (2.5%), an average weight pre- (25%), post-operative (82.5%), overweight per- (2.5%), post-operative (10%) and obese pre- (0%) post-operative (5%). Results of comparison were found statistically significant P <0.001 using Marginal Homogeneity Test. Meanwhile, figure 1 presented percentage of past history in children underwent surgery which found as positive past medical (60%), past surgical (20%) and drug history (20%).
In table 6, there was statistically significance (p value 0.337) relation between indication of procedure and post-operative body mass index (BMI), using Mann Whitney test.

Table 5. Classification of BMI pre and post operation

BMI grade	Preoperative BMI		Postoperative BMI (6 months)		MH	P
	No.	%	No.	%		
Underweight	29	72.5	1	2.5	56.0*	<0.001*
Average	10	25.0	33	82.5		
Overweight	1	2.5	4	10.0		
Obese	0	0.0	2	5.0		

Where: MH: Marginal Homogeneity Test, p: p value for comparing between the studied periods and *: Statistically significant at p ≤ 0.05

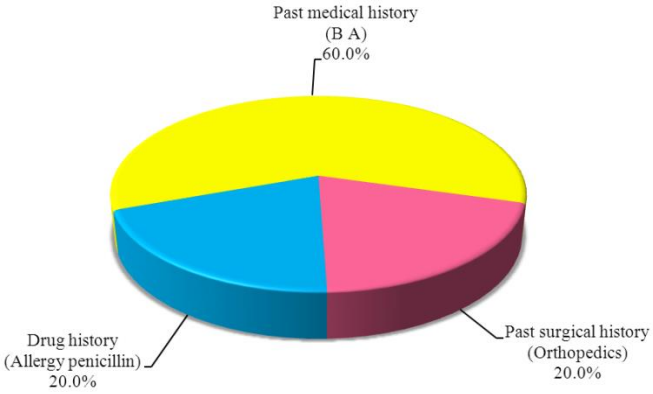

Figure 1. Distribution of the studied cases according to medical history

Table 6. Relation between IOP and BMI

BMI (kg/m^2)	IOP		Test of sig.	P
	RAT (n = 27)	SDB (n = 13)		
Post	17.96 ± 3.43	17.09 ± 2.17	t=0.974	0.337
% of change	14.84 ± 13.19	8.10 ± 8.62	U=119.0	0.106

Where: SD: Standard deviation, t: Student t-test and U: Mann Whitney test

Table 7 shows the relation between post-operative complications and post-operative weight change (at 1, 3, and 6 months post-operative), with no statistically significant P value (0.263, 0.222, 0.359), respectively, using the Mann-Whitney test. Table 8 reported the relation between post-operative complications and post-operative BMI change and found no statistical significance using the Mann-Whitney test. Table 9 shows the relation between post-tonsillectomy bleeding and weight change pre- and post-operatively, which resulted in a statistically insignificant P value of 0.499 using the Mann-Whitney test.

Table 7. Relation between presences of complication with weight

Weight	Presence of Complication		U	P
	No (n = 32)	Yes (n = 8)		
1 month	22.17 ± 10.64	26.59 ± 12.42	94.50	0.263
3 month	22.66 ± 10.54	28.13 ± 13.40	91.50	0.222
6 month	23.89 ± 10.92	28.38 ± 14.02	100.50	0.359
% of change after 6months	16.51 ± 10.50	10.57 ± 13.17	88.50	0.185

Where: SD: Standard deviation and U: Mann Whitney test

Table 8: Relation between complication with weight and BMI

BMI (kg/m)	Presence of complication		Test of sig	P
	No (n = 32)	Yes (n = 8)		
Post	17.31 ± 2.37	19.15 ± 4.98	t=1.016	0.340
% of change	12.71 ± 12.88	12.42 ± 9.77	U=125.0	0.934

Where: SD: Standard deviation, t: Student t-test and U: Mann Whitney test

Table 9: Relation between post tonsillectomy bleeding & weight pre- and post-operative change

Weight (kg)	Presence of Bleeding		U	P
	No (n = 36)	Yes (n = 4)		
1 month	23.09 ± 11.33	22.75 ± 8.54	66.0	0.811
3 month	23.64 ± 11.48	24.75 ± 9.54	60.50	0.617
6 month	24.74 ± 11.80	25.25 ± 10.53	63.0	0.712
% of change after 6 months	15.48 ± 11.36	13.90 ± 10.56	56.0	0.499

Where: SD: Standard deviation and U: Mann Whitney test

DISCUSSION

In current study, data from 40 children whom underwent a tonsillectomy were collected and reviewed with or without adenoidectomy at Al-Bayda Medical Center. Age ranged from 2-14 with mean age (6.90 ± 3.41) years, and number of females more dominant than males. According to the current data, it was clear that children gained weight after tonsillectomy. The mean of the overall weight increased after surgery compared to the weight before surgery; there was a significant difference between the weight at the baseline and after six months of the surgery. Also, there was a significant difference between the weight at baseline, one month, three months and six months after surgery. And these observations were in agreement with previous study that found similar finding [33]. Other studies have shown that tonsillectomy may lead to an increase in weight by decreasing the energy and increased oral intake [34] required in mouth breathing, lower rates of recurrent respiratory tract infections [34-36], increased levels of growth hormone, and decreased levels of systemic catecholamines [36, 37]. The current study showed increase of BMI pre- and post-operative. Previous studies were in agreement with present study found that the BMI% in the study group increased significantly after tonsillectomy [33, 38].

Follow-up was one of the problems faced by us, where patient compliance and data recording were compromised, so that late and long appointments may be missed, especially if the outcome of the procedure was satisfactory, as in our study in Corona, and patients were afraid to come to the hospital.

Limitations of our study included consideration of diet, socioeconomic, and racial factors, as well as high-altitude residency. Error in measurements, a factor that cannot be completely ruled out, was minimized by repeated revision and the exclusion of incomplete or suspicious data.

CONCLUSION

The findings of this study suggest that there is an increase in weight gain post- tonsillectomy with or without adenoidectomy. The difference is mostly observed in six months' post-operation, with a positive linear correlation between weight and BMI.

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Conflict of Interest

There are no financial, personal, or professional conflicts of interest to declare.

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