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Prevalence and Predictors of Tonsil Surgery among Adolescents Who Reside in the United Arab Emirates

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Abstract

Background: Although tonsil surgery is performed to improve the quality of life of individuals, it is associated with possible health risks and significant healthcare costs. Research suggests certain factors may predict the need for tonsil surgery.

Aims: The current study assessed the prevalence and predictors of tonsil surgery among Emirati students aged 13 to 20.

Results: By conducting secondary analysis on data collected from a survey administered to 6,363 students in the United Arab Emirates (UAE), results showed that tonsil surgery is associated with nationality, maternal educational level, pesticide/insecticide exposure, indoor humidity, and hay fever symptoms. However, after adjusting for potential confounders, multivariate analysis suggested that nationality is the only predictor of tonsil surgery and that nationals of Gulf Cooperation Council* (GCC) countries other than UAE are more likely to undergo tonsillectomy. Results also suggest that seafood consumption can decrease the rate of tonsil surgery in nationals of GCC countries other than UAE. Furthermore, pesticide/insecticide exposure increases the incidence of the surgery in the group of "other nationalities" including nationals of North Africa, Iran, and western countries.

Conclusion: However, further investigation is required regarding predictors of tonsil surgery in order to understand the disparities in the frequency of tonsil surgery among different populations.

Keywords: Predictors; Tonsil surgery; Adolescents; UAE

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Introduction

Tonsil surgery is one of the most common types of surgeries performed on children around the world. This surgery improves quality of life, mainly by treating tonsillar enlargement and infections [1-3]. However, despite the advantages, tonsil removal is also associated with possible surgery complications and significant healthcare costs [4]. Therefore, it would be advantageous to prevent unnecessary surgeries through identifying and controlling the modifiable predictors of this procedure. According to literature, demographic, socio-economic, and environmental factors, may predict the incidence of tonsil surgery [5]. However, since evidence regarding potential predictors and tonsil surgery is limited or sometimes conflicting, these key factors remain unknown. Therefore, further investigation is needed to examine and explore potential predictors of tonsil surgery.

The United Arab Emirates (UAE) is an Arab country located in the Middle East, consisting of seven Emirates [6]. Given its fast-growing economy, the UAE has accepted a large number of immigrants who generally come from other Asian regions. As a result, the ethnic, cultural, and economic diversity that exists in the UAE makes it an ideal location to assess the roles of various population-level factors that impact diseases such as tonsillitis [7].

Within the UAE, tonsil surgery has been reported as one of the most common inpatient operation among Emirati adolescents [8]. This is consistent with previous literature that demonstrates that majority of tonsil surgeries are performed in the under 20 age group [9,10]. Children and youth are typically the focus of research on tonsillectomies since they are susceptible to several socio-economic and environmental factors and are more likely to have tonsillar enlargement.

Thus, the research objectives of this study were:

1. To assess the prevalence of tonsil surgery among adolescents who reside in the UAE, and
2. To determine the predictors of tonsil surgery among adolescents who reside in the UAE.

Methods

A cross-sectional design was employed to assess the frequency and predictors of tonsil surgery among adolescents who reside in the UAE. Data was examined from the National Study of Population Health in the UAE (2007 to 2009); a research program that was developed in collaboration with the UAE Ministry of Education.

Population and sampling

A cohort of 6,363 high school students, aged 13 to 20 were randomly selected using a stratified sampling strategy. Based on school enrolment data, 147 public and private secondary schools were randomly selected. For the purpose of administering the developed surveys, social workers employed by the UAE Ministry of Education attended training workshops and then collected completed student self-administered surveys [11-13]. All participants' parents were informed of the research study and were asked for consent.

Measurement tools

The survey included a modified version of the International Study of Asthma and Allergies in Childhood Questionnaire [14]. The first component of the survey included information on smoking behaviors, physical activity, diseases, as well as demographic and socio-economic data. The second component of the survey collected data related to the number of previous residences and locations, as well as residential and neighborhood characteristics.

Study variables

The dependent variable examined is a two-level categorical variable that includes main types of tonsil surgery: Tonsillectomy, adenoidectomy, or adenotonsillectomy. The independent variables include 21 potential predictors of tonsil surgery (Table 1).

Data analysis

All analyses were conducted using IBM SPSS 23. The data was analyzed using univariate methods to create descriptive information on each variable. Categorical variables were located in frequency tables to indicate the prevalence of each variable. Continuous variables were examined by descriptive analysis to reveal characteristics such as mean and standard deviation (Table 2).

For the bivariate analysis, chi-square tests were used to examine the association between the independent categorical variables and tonsil surgery. An independent t-test was conducted to compare continuous variables such as seafood consumption. Additionally, the p Levene's test was used to indicate whether the variances were equal across the two groups. A significant association is defined as an association with a p-value of less than 0.05 for chi-square or

Table 1: List of 21 potential predictors of tonsil surgery examined in survey.

Type of Predictor	Variables
Demographic	1. Sex
	2. Nationality, which includes categories of:
	i. UAE
	ii. Gulf Corporation Council (GCC) countries other than UAE (Kuwait, Kingdom of Saudi Arabia, Oman, Qatar, Bahrain, and Yemen)
	iii. Middle East Arab countries other than GCC (Lebanon, Syria, Jordan, Palestine, and Iraq)
	iv. South East Asia (India, Pakistan, Bangladesh, Sri Lanka, Philippines, and Indonesia)
	v. Other countries (including North Africa [Egypt, Tunisia, Morocco, Algeria, Libya, Sudan, Somalia, and Mauritania], Iran and Western countries)
Lifestyle	3. Eating good food
	4. Having good eating and drinking habits
	5. Physical exercise
	6. Frequency of eating sea food (continuous variable)
Socioeconomic	7. Father's educational level
	8. Mother's educational level
	*both of these variables are binary variables with categories of: 'completed high school' and 'not completed high school.
	9. Household income, which is a 2 to level categorical variable with those who report a monthly family income at or below AED (United Arab Emirates Dirham) 15,000 in one category versus those who report a family income greater than AED 15,000.
	10. The index of residential crowding, which is a ratio (numerical) variable, was calculated by dividing the number of individuals who reside in the household over the number of bedrooms in the house.
Environmental	11. Environmental to bacco smoke (ETS),
	12. Outdoor air pollution
	13. Exposure to insecticides/pesticides,
	14. Exposure to chemicals used in arts, crafts, ceramics, stained glass work or similar hobbies on a regular basis
	15. to o humid homes
	16. Peeling and flaking paint (related to humidity)
Comorbidities	17. Allergic rhinitis (hay fever) symp to ms
	18. Allergic rhinitis diagnosis
	19. Asthma symp to ms
	20. Asthma diagnosis'
	21. Hearing loss

Table 2: Descriptive sociodemographic and health outcomes for a sample of adolescents who reside in the UAE (n=6,363).

Variable	Valid Number	Values	Frequency n (%)
Tonsil surgery	6,363		
		Negative	6,159 (96.8)
		Positive	204 (3.2)
Sex	6,257		
		Male	2,797 (44.7)
		Female	3,460 (55.3)
Nationality	6,223		
		UAE	3,069 (49.3)
		GCC countries other than UAE	356 (5.7)
		Middle East Arab Countries other than GCC	978 (15.7)
		South East Asia	1,041 (16.7)
		Other Nationalities	779 (12.5)
Household Income	3,882		
		Less than 15,000AED	2,884 (74.3)
		Equal or above 15,000AED	998 (25.7)
Crowding Index	5,065	2.39/1.38 (mean, SD)	
Paternal Education	5,098		
		Not completed HS	2,151 (42.2)
		Completed HS	2,947 (57.8)
Maternal Education	5,130		
		Not completed HS	2,616 (51)
		Completed HS	2,514 (49)
Seafood Consumption	5,532	7.58/7.20 (mean, SD)	
Good Eating Habits	6,192		
		No	1,697 (27.4)
		Yes	4,495 (72.6)
Eating Good Food	6,213		
		No	3,877 (62.4)
		Yes	2,336 (37.6)
Physical Exercise	6,220		
		No	2,687 (43.2)
		Yes	3,533 (56.8)
ETS	5,443		
		No	3,293 (60.5)
		Yes	2,150 (39.5)
Outdoor Air Pollution	5,247		
		No	4,428 (84.4)
		Yes	819 (15.6)
Pesticide/ Insecticide	5,114		
		No	1,422 (27.8)
		Yes	3,692 (72.2)
Art/Craft	5,190		
		No	4,240 (80.7)
		Yes	950 (19.3)
Indoor Humidity	4,849		
		No	3,962 (81.7)
		Yes	887 (18.3)
Peeling Paint	5,097		
		No	3,053 (59.9)
		Yes	2,044 (40.1)
Hearing Loss	5,643		
		No HL	4,977 (88.2)
		Mild to Moderate HL	463 (8.2)
		Moderate to severe HL	203 (3.6)
Hay Fever Diagnosis	6,214		
		No	5,885 (94.7)
		Yes	329 (5.3)
Hay Fever Symp to ms	6,140		
		No	4,028 (65.6)
		Yes	2,112 (34.4)
Asthma Diagnosis	6,121		
		No	5,356 (87.5)
		Yes	765 (12.5)
Asthma Symp to ms	6,121		
		No	5,166 (84.4)
		Yes	955 (15.6)

independent t-tests.

Logistic regression analysis was conducted to examine the predictors of tonsil surgery. Variables with p-value of less than 0.1 were included. The conditional logistic regression test was conducted in three methods: Enter; forward stepwise; and backward stepwise. To assess how a predictor can change the effects of other predictors, interaction terms were added to the original logistic regression models. In order to ascertain how well the data fits the models, a Hosmer-Lemeshow test was conducted. Furthermore, to determine how much variation in the study outcome was explained by each model, a McFadden's pseudo-R2 test was held (likelihood ratio index. Based on the results of the Hosmer-Lemeshow and McFadden tests, and the number of significant variables for each model, backward stepwise method with interactions was selected. All variables with significant p-value (less than 0.05) were examined in a new logistic regression test (enter method). Those variables and interactions with p-value of less than 0.05 were considered to be significant.

Results

Results of the analyses determined any associations between the predictors and tonsil surgery. Overall, 3.2% of the students had undergone at least one type of tonsil surgery: Adenoidectomy, tonsillectomy, or adenotonsillectomy.

Findings from bivariate analysis

Based on the analysis (Table 3), there were no associations between a history of tonsil surgery and each of sex or having UAE nationality. However, when participants were categorized into five groups of nationalities (the UAE, other GCC, other Middle East Arab, South East Asia, other nationalities), the Pearson chi-square suggested

Table 3: Association between tonsil surgery and potential predictors among adolescents who reside in the UAE (results of bivariate analysis).

Variables	Valid Number	T	t to Test p to value	X^2	Chi to Square p to value
Sex	6,257			0.111	0.739
Nationality	6,223			**34.55**	**P<0.001**
Household Income	3,882				0.631
Crowding Index	5,065	0.48	0.631		
Father's Educational Level	5,098			0.85	0.357
Mother's Educational Level	5,130			**5.449**	**0.02**
Seafood Consumption	5,532	1.87	0.063		
Good Eating Habits	6,192			0.054	0.816
Eating Good Food	6,213			1.398	0.237
Physical Exercise	6,220			0.054	0.816
ETS	5,443			1.47	0.225
Outdoor Air Pollution	5,247			0.498	0.48
Pesticide/Insecticide	5,114			**4.589**	**0.032**
Art/Craft	5,190			0.254	0.614
Indoor Humidity	4,849			**5.348**	**0.021**
Peeling Paint	5,097			2.027	0.155
Hearing loss	5,643			0.444	0.801
Hay Fever Diagnosis	6,214			0.536	0.464
Hay Fever Symp to ms	6,140			**10.69**	**0.001**
Asthma Diagnosis	6,121			3.546	0.06
Asthma Symp to ms	6,121			1.776	0.183

Significant results are shown in bold.

an association between participants' nationality and history of tonsil surgery ($X^2 \geq 46.861$, p<0.001). In regards to the variables related to lifestyle, results showed that tonsil surgery was not associated with eating good food, eating habits, physical exercise, and frequency of seafood intake.

When examining the socio-economic variables, an association was found between maternal educational level and tonsil surgery ($X^2 \geq 5.449$, p=0.020). Statistical tests did not suggest associations between tonsil surgery and either paternal educational level or household income. Similarly, the crowding index showed no significant difference between participants who had undergone tonsil surgery and those who had not (t=0.481, p=0.631). Additionally, results revealed significant associations between tonsil surgery and each of exposure to pesticides/insecticides ($X^2 \geq 4.589$, p=0.032) and indoor humidity ($X^2 \geq 5.348$, p=0.021). However, no associations were shown between tonsil surgery and each of ETS, outdoor air pollution, chemicals used in arts or crafts, and peeling or flaking paint at home.

In relation to health-related variables, a significant association was found between symptoms of hay fever and tonsil surgery ($X^2 \geq 10.687$, p=0.001). Associations between tonsil surgery and each of hearing loss, hay fever diagnosis, asthma symptoms, and asthma diagnosis were not significant.

Findings from multivariate analysis

Overall, six models of the binary logistic regression test were created using the following variables: Nationality, maternal educational level, indoor humidity, exposure to pesticide/insecticide, symptoms of allergy, and diagnosis of asthma (Table 4). The results

Table 4: Results of the goodness of fit tests for the conditional logistic regression models (the UAE data).

Model	Hosmer & Lemeshow (p to value)	McFadden's to R^2
Enter (No interactions)	0.543	0.041
Forward Stepwise (No interactions)	0.828	0.037
Backward Stepwise (No interactions)	0.828	0.037
Enter (With interactions)	0.816	0.078
Forward Stepwise (With interactions)	0.593	0.036
Backward Stepwise (With interactions)	0.48	0.063
New Enter (With interactions)	0.826	0.057

of the logistic regression model (Table 5) revealed that tonsil surgery was more common in nationals of GCC countries other than UAE (OR=8.616, 95% CI 1.889 to 39.298, p=0.005). Furthermore, exposure to pesticides or insecticide increased the incidence of tonsil surgery among "other nationalities" category (OR=3.840, 95% CI 1.042 to 14.155, p=0.043). However, seafood consumption reduced the incidence of tonsil surgery among nationals of other GCC countries (OR=0.780, 95% CI 0.629 to 0.967, p=0.024).

Discussion

Findings suggest that 3.2% of adolescents had undergone tonsil surgery in the UAE, a rate that is relatively lower compared to other countries. The lower rates of tonsil surgery in the UAE can be a result of several factors. Firstly, majority of the UAE population are expatriates who generally have a lower socio-economic status compared to UAE nationals and typically have to pay for their healthcare costs and insurance [15]. Therefore, it is possible that many parents of the children who need tonsillectomy are not able to afford the surgery costs. Low tonsil surgery frequency in the UAE may also be an indication of the healthy immigrant effect, which can be seen in countries with high immigrant population [16]. Additionally, the need for tonsil surgery may decline in warm weather due to a reduction in the rates of tonsillar infections [17]. Furthermore, doctors' attitudes to tonsillar diseases and tonsillectomy may influence the rate of the surgery [18]. Finally, other factors, such as physician-to-population ratios for otolaryngologists and the prevalence of underlying diseases, can influence the incidence of the surgery [19].

Results found that five variables are associated with tonsil surgery (p<0.05 in the chi-square test): Nationality, maternal educational level, pesticide/insecticide exposure, indoor humidity, and hay fever symptoms. However, chi-square tests revealed no associations between tonsil surgery and the other 16 variables: Sex, household income, crowding index, paternal educational level, seafood consumption, eating good food, good eating habits, physical exercise, ETS, outdoor air pollution, arts/crafts; peeling paint, hearing loss, hay fever diagnosis, and asthma symptoms.

Nationality

Both bivariate and multivariate analyses suggested that nationality is a predictor of tonsil surgery. Findings also demonstrated that nationals of other GCC countries were more likely to undergo tonsillectomy. Existing evidence shows associations between tonsil surgery and each of race and geographical region of residence, which both are linked with nationality [20]. However, this study could not find a reason for higher frequency of tonsil surgery among "nationals of GCC countries other than UAE" compared to other groups.

Table 5: Results of the Conditional Logistic Regression with Interactions model (the UAE data).

Variables	Reference Category	Categorization	OR	95% CI
Nationality	UAE			
		GCC countries other than UAE	8.616*	1.889 to 39.298
		Middle East Arab countries other than GCC	0.741	0.231 to 2.375
		Southeast Asia	0.441	0.090 to 2.158
		Other Nationalities	0.612	0.159 to 2.353
Maternal education	Not completed high school	Completed high school	1.419	0.776 to 2.593
Indoor humidity	Low	High	1.202	0.468 to 3.089
Pesticide/Insecticide	No	Yes	0.895	0.341 to 2.351
Seafood consumption	Continuous	Increasing	1.023	0.957 to 1.094
Nationality by Pesticide/Insecticide	UAE/No			
GCC countries other than UAE by Pesticide/ Insecticide		GCC countries other than UAE/Yes	0.452	0094 to 2.164
Middle East Arab countries other than GCC by Pesticide/Insecticide		Middle East Arab countries other than GCC/ Yes	1.857	0.616 to 5.601
Southeast Asia by Pesticide/Insecticide		Southeast Asia/Yes	1.369	0.247 to 7.592
Other Nationalities by Pesticide/Insecticide		Other Nationalities/Yes	3.840*	1.042 to 14.155
Seafood by Nationality	Increasing/UAE			
Seafood by GCC countries other than UAE		Increasing/GCC countries other than UAE	0.780*	0.629 to 0.967
Seafood by Middle East Arab countries other than GCC		Increasing/Middle East Arab countries other than GCC	1.015	0.943 to 1.093
Seafood by Southeast Asia		Increasing/Southeast Asia	0.885	0.753 to 1.040
Seafood by Other Nationalities		Increasing/Other nationalities	0.975	0.888 to 1.072
Seafood by Maternal education		Increasing/Completed HS	1.025	0.963 to 1.091
Indoor humidity by Pesticide/Insecticide		High/Yes	1.77	0.623 to 5.030
Seafood by Pesticide/Insecticide		Increasing/Yes	0.958	0.899 to 1.021

Additionally, when interaction terms were taken into account, the results suggested that seafood consumption could decrease the rate of the surgery in "nationals GCC countries other than UAE". Literature suggested that seafood consumption can prevent those diseases, such as sleep apnea, that increase the rate of tonsil surgery [21]. However, it is not clear why seafood consumption was not beneficial for other participants. At the same time, due to unrecognized reasons, exposure to pesticides or insecticides increased the risk of tonsil surgery among the group of "other nationalities". Thus, based on findings, nationality may be associated with receiving tonsil surgery and may interact with other environmental factors.

Maternal education level

Results found that participants whose mothers completed high school were more likely to undergo tonsil surgery. This may be attributed to increased maternal awareness and knowledge of health issues [22]. Cahit and Kaan [22] found that incidence of tonsil surgery is higher among children with more educated and wealthier parents. Our study suggests that household income and paternal educational level were not associated with the rate of tonsil surgery. Similarly, Ozkiris et al. [23] reported that students from low-income families and with parents with an educational level lower than a university degree are at risk of having tonsil surgery [23]. Therefore, researches regarding parent education level and tonsil surgery were found to be conflicting and require further investigation.

Pesticide or insecticide exposure

When examining environmental factors, results revealed that participants who had undergone tonsil surgery were more likely to have a history of exposure to pesticide or insecticides. This may be a result of insects being more prevalent in environments with high humidity which requires more chemicals to be applied to eliminate them [24]. Thus, the association between pesticide or insecticide exposure with tonsil surgery may also be related to high humidity, which can be explored in future studies.

Indoor humidity

Findings suggest that living in homes with high humidity was linked with having tonsil surgery. Research has suggested that the incidence of respiratory infections increases among people working or living in environments with high relative humidity levels. At the same time, both mite and fungal populations can increase in high humidity, which in turn can trigger allergic reactions such as allergic rhinitis or asthma [25-27]. High relative humidity also increases the concentration levels of several chemicals present in indoor building materials [25]. Therefore, the association between indoor humidity and tonsil surgery may also be linked to other environmental factors.

Hay fever symptoms

Results suggested that participants with symptoms of hay fever were more likely to receive tonsil surgery. This may be related to the associations between different types of allergies and the enlargement of adenoids and palatine tonsils. Modrzynski and Zawisza [28] proposed that the rate of adenoid enlargement was greater in children with allergic rhinitis than non-allergic children [28]. Additionally, Sadeghi-Shabestari et al. [29] revealed that allergy control may reduce rates of adenotonsillectomy in children with allergies [29]. Furthermore, Olusesi et al. [30] suggested that in addition to allergic

rhinitis, other types of allergy affect tonsil surgery by increasing the rates of early onset enlargement of the adenoids, palatine tonsils, or both [30]. Therefore, symptoms of hay fever may be linked to increasing the frequency of tonsil surgery.

Limitations

Considering that all independent variables could potentially be confounding factors, a binary logistic regression method was selected for control. Other limitations were related to self-reported data, which is subject to low response and recall bias. Many participants did not know or mention their exact type of tonsil surgery which is required to distinguish the predictors of different types of tonsil surgery. Follow-up studies should access medical records. At the same time, some participants did not know the correct and specific diagnosis of their diseases and some of the variables did not have a clear definition. Thus, in order to reduce the effects of inaccurate information, inconsistent and unreliable data was omitted.

Conclusion

Although tonsil surgery is used to improve quality of life among individuals, there are both health and financial complications associated with the procedure. Therefore, it is important to explore and examine the predictors related to tonsil surgery in order to avoid preventable surgeries. This cross-sectional study assessed the frequency and predictors of tonsil surgery among Emirati high school students, examining 21 factors including demographics, lifestyle, environmental factors, and co-morbidities. Results found that five variables are associated with tonsil surgery; nationality, maternal educational level, pesticide/insecticide exposure, indoor humidity, and hay fever symptoms. However, further examination is required to reassess the other potential predictors that provided insufficient evidence in this study. Furthermore, since each type of procedure may have a unique set of predictors, it is important to separately identify the predictors of each type of tonsil surgery. In the end, comparing the predictors of tonsil surgery may help in determining the reasons for disparities in the frequency of tonsil surgery among different populations.

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