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ЕЖЕМЕСЯЧНЫЙ НАУЧНЫЙ ЖУРНАЛ

Медицинские новости Грузии

საქართველოს სამედიცინო სიახლენი

GEORGIAN MEDICAL NEWS

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GMN: Georgian Medical News is peer-reviewed, published monthly journal committed to promoting the science and art of medicine and the betterment of public health, published by the GMN Editorial Board since 1994. GMN carries original scientific articles on medicine, biology and pharmacy, which are of experimental, theoretical and practical character; publishes original research, reviews, commentaries, editorials, essays, medical news, and correspondence in English and Russian.

GMN is indexed in MEDLINE, SCOPUS, PubMed and VINITI Russian Academy of Sciences. The full text content is available through EBSCO databases.

GMN: Медицинские новости Грузии - ежемесячный рецензируемый научный журнал, издаётся Редакционной коллегией с 1994 года на русском и английском языках в целях поддержки медицинской науки и улучшения здравоохранения. В журнале публикуются оригинальные научные статьи в области медицины, биологии и фармации, статьи обзорного характера, научные сообщения, новости медицины и здравоохранения. Журнал индексируется в MEDLINE, отражён в базе данных SCOPUS, PubMed и ВИНИТИ РАН. Полнотекстовые статьи журнала доступны через БД EBSCO.

GMN: Georgian Medical News – საქართველოს სამედიცინო სიახლენი – არის ყოველთვიური სამეცნიერო სამედიცინო რეცენზირებადი ჟურნალი, გამოიცემა 1994 წლიდან, წარმოადგენს სარედაქციო კოლეგიისა და აშშ-ის მეცნიერების, განათლების, ინდუსტრიის, ხელოვნებისა და ბუნებისმეტყველების საერთაშორისო აკადემიის ერთობლივ გამოცემას. GMN-ში რუსულ და ინგლისურ ენებზე ქვეყნდება ექსპერიმენტული, თეორიული და პრაქტიკული ხასიათის ორიგინალური სამეცნიერო სტატიები მედიცინის, ბიოლოგიისა და ფარმაციის სფეროში, მიმოხილვითი ხასიათის სტატიები.

ჟურნალი ინდექსირებულია MEDLINE-ის საერთაშორისო სისტემაში, ასახულია SCOPUS-ის, PubMed-ის და ВИНИТИ РАН-ის მონაცემთა ბაზებში. სტატიების სრული ტექსტი ხელმისაწვდომია EBSCO-ს მონაცემთა ბაზებიდან.

WEBSITE

www.geomednews.com

К СВЕДЕНИЮ АВТОРОВ!

При направлении статьи в редакцию необходимо соблюдать следующие правила:

1. Статья должна быть представлена в двух экземплярах, на русском или английском языках, напечатанная через **полтора интервала на одной стороне стандартного листа с шириной левого поля в три сантиметра**. Используемый компьютерный шрифт для текста на русском и английском языках - **Times New Roman** (**Кириллица**), для текста на грузинском языке следует использовать **AcadNusx.** Размер шрифта - **12**. К рукописи, напечатанной на компьютере, должен быть приложен CD со статьей.

2. Размер статьи должен быть не менее десяти и не более двадцати страниц машинописи, включая указатель литературы и резюме на английском, русском и грузинском языках.

3. В статье должны быть освещены актуальность данного материала, методы и результаты исследования и их обсуждение.

При представлении в печать научных экспериментальных работ авторы должны указывать вид и количество экспериментальных животных, применявшиеся методы обезболивания и усыпления (в ходе острых опытов).

4. К статье должны быть приложены краткое (на полстраницы) резюме на английском, русском и грузинском языках (включающее следующие разделы: цель исследования, материал и методы, результаты и заключение) и список ключевых слов (key words).

5. Таблицы необходимо представлять в печатной форме. Фотокопии не принимаются. **Все цифровые, итоговые и процентные данные в таблицах должны соответствовать таковым в тексте статьи**. Таблицы и графики должны быть озаглавлены.

6. Фотографии должны быть контрастными, фотокопии с рентгенограмм - в позитивном изображении. Рисунки, чертежи и диаграммы следует озаглавить, пронумеровать и вставить в соответствующее место текста **в tiff формате**.

В подписях к микрофотографиям следует указывать степень увеличения через окуляр или объектив и метод окраски или импрегнации срезов.

7. Фамилии отечественных авторов приводятся в оригинальной транскрипции.

8. При оформлении и направлении статей в журнал МНГ просим авторов соблюдать правила, изложенные в «Единых требованиях к рукописям, представляемым в биомедицинские журналы», принятых Международным комитетом редакторов медицинских журналов - http://www.spinesurgery.ru/files/publish.pdf и http://www.nlm.nih.gov/bsd/uniform_requirements.html
В конце каждой оригинальной статьи приводится библиографический список. В список литературы включаются все материалы, на которые имеются ссылки в тексте. Список составляется в алфавитном порядке и нумеруется. Литературный источник приводится на языке оригинала. В списке литературы сначала приводятся работы, написанные знаками грузинского алфавита, затем кириллицей и латиницей. Ссылки на цитируемые работы в тексте статьи даются в квадратных скобках в виде номера, соответствующего номеру данной работы в списке литературы. Большинство цитированных источников должны быть за последние 5-7 лет.

9. Для получения права на публикацию статья должна иметь от руководителя работы или учреждения визу и сопроводительное отношение, написанные или напечатанные на бланке и заверенные подписью и печатью.

10. В конце статьи должны быть подписи всех авторов, полностью приведены их фамилии, имена и отчества, указаны служебный и домашний номера телефонов и адреса или иные координаты. Количество авторов (соавторов) не должно превышать пяти человек.

11. Редакция оставляет за собой право сокращать и исправлять статьи. Корректура авторам не высылается, вся работа и сверка проводится по авторскому оригиналу.

12. Недопустимо направление в редакцию работ, представленных к печати в иных издательствах или опубликованных в других изданиях.

При нарушении указанных правил статьи не рассматриваются.

REQUIREMENTS

Please note, materials submitted to the Editorial Office Staff are supposed to meet the following requirements:

1. Articles must be provided with a double copy, in English or Russian languages and typed or compu-ter-printed on a single side of standard typing paper, with the left margin of **3** centimeters width, and **1.5** spacing between the lines, typeface - **Times New Roman** (**Cyrillic**), print size - **12** (referring to Georgian and Russian materials). With computer-printed texts please enclose a CD carrying the same file titled with Latin symbols.

2. Size of the article, including index and resume in English, Russian and Georgian languages must be at least 10 pages and not exceed the limit of 20 pages of typed or computer-printed text.

3. Submitted material must include a coverage of a topical subject, research methods, results, and review.

Authors of the scientific-research works must indicate the number of experimental biological species drawn in, list the employed methods of anesthetization and soporific means used during acute tests.

4. Articles must have a short (half page) abstract in English, Russian and Georgian (including the following sections: aim of study, material and methods, results and conclusions) and a list of key words.

5. Tables must be presented in an original typed or computer-printed form, instead of a photocopied version. **Numbers, totals, percentile data on the tables must coincide with those in the texts of the articles.** Tables and graphs must be headed.

6. Photographs are required to be contrasted and must be submitted with doubles. Please number each photograph with a pencil on its back, indicate author's name, title of the article (short version), and mark out its top and bottom parts. Drawings must be accurate, drafts and diagrams drawn in Indian ink (or black ink). Photocopies of the X-ray photographs must be presented in a positive image in **tiff format**.

Accurately numbered subtitles for each illustration must be listed on a separate sheet of paper. In the subtitles for the microphotographs please indicate the ocular and objective lens magnification power, method of coloring or impregnation of the microscopic sections (preparations).

7. Please indicate last names, first and middle initials of the native authors, present names and initials of the foreign authors in the transcription of the original language, enclose in parenthesis corresponding number under which the author is listed in the reference materials.

8. Please follow guidance offered to authors by The International Committee of Medical Journal Editors guidance in its Uniform Requirements for Manuscripts Submitted to Biomedical Journals publication available online at: http://www.nlm.nih.gov/bsd/uniform_requirements.html
http://www.icmje.org/urm_full.pdf
In GMN style for each work cited in the text, a bibliographic reference is given, and this is located at the end of the article under the title "References". All references cited in the text must be listed. The list of references should be arranged alphabetically and then numbered. References are numbered in the text [numbers in square brackets] and in the reference list and numbers are repeated throughout the text as needed. The bibliographic description is given in the language of publication (citations in Georgian script are followed by Cyrillic and Latin).

9. To obtain the rights of publication articles must be accompanied by a visa from the project instructor or the establishment, where the work has been performed, and a reference letter, both written or typed on a special signed form, certified by a stamp or a seal.

10. Articles must be signed by all of the authors at the end, and they must be provided with a list of full names, office and home phone numbers and addresses or other non-office locations where the authors could be reached. The number of the authors (co-authors) must not exceed the limit of 5 people.

11. Editorial Staff reserves the rights to cut down in size and correct the articles. Proof-sheets are not sent out to the authors. The entire editorial and collation work is performed according to the author's original text.

12. Sending in the works that have already been assigned to the press by other Editorial Staffs or have been printed by other publishers is not permissible.

Articles that Fail to Meet the Aforementioned Requirements are not Assigned to be Reviewed.

ავტორთა საყურადღებოდ!

რედაქციაში სტატიის წარმოდგენისას საჭიროა დავიცვათ შემდეგი წესები:

1. სტატია უნდა წარმოადგინოთ 2 ცალად, რუსულ ან ინგლისურ ენებზე,დაბეჭდილი სტანდარტული ფურცლის 1 გვერდზე, 3 სმ სიგანის მარცხენა ველისა და სტრიქონებს შორის 1,5 ინტერვალის დაცვით. გამოყენებული კომპიუტერული შრიფტი რუსულ და ინგლისურენოვან ტექსტებში - **Times New Roman (Кириллица)**, ხოლო ქართულენოვან ტექსტში საჭიროა გამოვიყენოთ **AcadNusx.** შრიფტის ზომა – 12. სტატიას თან უნდა ახლდეს CD სტატიით.

2. სტატიის მოცულობა არ უნდა შეადგენდეს 10 გვერდზე ნაკლებს და 20 გვერდზე მეტს ლიტერატურის სიის და რეზიუმეების (ინგლისურ, რუსულ და ქართულ ენებზე) ჩათვლით.

3. სტატიაში საჭიროა გაშუქდეს: საკითხის აქტუალობა; კვლევის მიზანი; საკვლევი მასალა და გამოყენებული მეთოდები; მიღებული შედეგები და მათი განსჯა. ექსპერიმენტული ხასიათის სტატიების წარმოდგენისას ავტორებმა უნდა მიუთითონ საექსპერიმენტო ცხოველების სახეობა და რაოდენობა; გაუტკივარებისა და დაძინების მეთოდები (მწვავე ცდების პირობებში).

4. სტატიას თან უნდა ახლდეს რეზიუმე ინგლისურ, რუსულ და ქართულ ენებზე არანაკლებ ნახევარი გვერდის მოცულობისა (სათაურის, ავტორების, დაწესებულების მითითებით და უნდა შეიცავდეს შემდეგ განყოფილებებს: მიზანი, მასალა და მეთოდები, შედეგები და დასკვნები; ტექსტუალური ნაწილი არ უნდა იყოს 15 სტრიქონზე ნაკლები) და საკვანძო სიტყვების ჩამონათვალი (key words).

5. ცხრილები საჭიროა წარმოადგინოთ ნაბეჭდი სახით. ყველა ციფრული, შემაჯამებელი და პროცენტული მონაცემები უნდა შეესაბამებოდეს ტექსტში მოყვანილს.

6. ფოტოსურათები უნდა იყოს კონტრასტული; სურათები, ნახაზები, დიაგრამები - დასათაურებული, დანომრილი და სათანადო ადგილას ჩასმული. რენტგენოგრამების ფოტოასლები წარმოადგინეთ პოზიტიური გამოსახულებით **tiff** ფორმატში. მიკროფოტოსურათების წარწერებში საჭიროა მიუთითოთ ოკულარის ან ობიექტივის საშუალებით გადიდების ხარისხი, ანათალების შეღებვის ან იმპრეგნაციის მეთოდი და აღნიშნოთ სურათის ზედა და ქვედა ნაწილები.

7. სამამულო ავტორების გვარები სტატიაში აღინიშნება ინიციალების თანდართვით, უცხოურისა – უცხოური ტრანსკრიპციით.

8. სტატიას თან უნდა ახლდეს ავტორის მიერ გამოყენებული სამამულო და უცხოური შრომების ბიბლიოგრაფიული სია (ბოლო 5-8 წლის სიღრმით). ანბანური წყობით წარმოდგენილ ბიბლიოგრაფიულ სიაში მიუთითეთ ჯერ სამამულო, შემდეგ უცხოელი ავტორები (გვარი, ინიციალები, სტატიის სათაური, ჟურნალის დასახელება, გამოცემის ადგილი, წელი, ჟურნალის №, პირველი და ბოლო გვერდები). მონოგრაფიის შემთხვევაში მიუთითეთ გამოცემის წელი, ადგილი და გვერდების საერთო რაოდენობა. ტექსტში კვადრატულ ფჩხილებში უნდა მიუთითოთ ავტორის შესაბამისი N ლიტერატურის სიის მიხედვით. მიზანშეწონილია, რომ ციტირებული წყაროების უმეტესი ნაწილი იყოს 5-6 წლის სიღრმის.

9. სტატიას თან უნდა ახლდეს: ა) დაწესებულების ან სამეცნიერო ხელმძღვანელის წარდგინება, დამოწმებული ხელმოწერითა და ბეჭდით; ბ) დარგის სპეციალისტის დამოწმებული რეცენზია, რომელშიც მითითებული იქნება საკითხის აქტუალობა, მასალის საკმაობა, მეთოდის სანდოობა, შედეგების სამეცნიერო-პრაქტიკული მნიშვნელობა.

10. სტატიის ბოლოს საჭიროა ყველა ავტორის ხელმოწერა, რომელთა რაოდენობა არ უნდა აღემატებოდეს 5-ს.

11. რედაქცია იტოვებს უფლებას შეასწოროს სტატია. ტექსტზე მუშაობა და შეჯერება ხდება საავტორო ორიგინალის მიხედვით.

12. დაუშვებელია რედაქციაში ისეთი სტატიის წარდგენა, რომელიც დასაბეჭდად წარდგენილი იყო სხვა რედაქციაში ან გამოქვეყნებული იყო სხვა გამოცემებში.

აღნიშნული წესების დარღვევის შემთხვევაში სტატიები არ განიხილება.

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EFFECT OF ENLARGED ADENOIDS AND TONSILS ON BLOOD OXYGEN SATURATION IN AL BAHA, SAUDI ARABIA

Rajab A. Alzahrani, Soliman shreed Soliman, Saadi Rabea Saadi AlGhamdi, Mohammed Abdullah S Alzahrani, Abdullah Mohammed B Alghamdi, Ibrahim Abdulaziz A Alghamdi, Essam Mohammed S Alghamdi, Musab Mohammed B Alzahrani, Yahya Ahmed Salem Alzahrani, Mujtaba Alrayah Fadlalla, Mohammed A. Alghamdi.

Faculty of Medicine, Al Baha University, Saudi Arabia.

Abstract.

Introduction: The adenoids and palatine tonsils, part of the lymphoid tissue, act as a first line of defense protecting the lower airways and gastrointestinal tract. Adenotonsillar hypertrophy in children may lead to airway obstruction. This study aims to demonstrate the association between adenotonsillar hypertrophy and decreased blood oxygen saturation.

Methods: A retrospective cohort study was conducted among children aged 7-12 years with adenotonsillar hypertrophy and obstructive symptoms, admitted to King Fahad Hospital and Prince Mishari Hospital, Saudi Arabia, for tonsillectomy between July 2023 and January 2024. Exclusion criteria included respiratory diseases, cardiac disease, nasal polyps, nasal septum deviation, chest wall abnormality, and lower airway diseases. The control group included 56 healthy children. An otolaryngologist determined the severity of airway obstruction using the tonsil size. Oxygen saturation was measured using pulse oximetry. The determinants of oxygen saturation were assessed using multiple linear regression, with significance set at $p < 0.05$.

Results: The study included 357 participants, with an even age distribution between 7-9 years (49.6%) and 10-12 years (50.4%), and 52% males. Diagnoses included adenoid hypertrophy (30%), tonsil hypertrophy (35%), both conditions (19%), and the control group (16%). Tonsil sizes ranged from Grade 1 (48%) to Grade 4 (8.4%), with 17% normal. The median oxygen saturation was 96.0% for the adenotonsillar hypertrophy group and 99.0% for the control. Oxygen saturation levels differed significantly across groups ($p < 0.0001$), with lower median saturation in hypertrophy groups than controls. Males had a lower oxygen than females (estimate: -0.338, 95% CI [--0.640, -0.036], $p = 0.028$). Adenoid hypertrophy (estimate: -3.863, 95% CI [-5.241, -2.484], $p < 0.001$), tonsil hypertrophy (estimate: -3.631, 95% CI [-5.053, -2.208], $p < 0.001$) and having both conditions (estimate: -3.777, 95% CI [-5.3.7, -2.247], $p < 0.001$) was associated with lower oxygen saturation. Grade 1 tonsil size was associated with an increase in oxygen saturation (estimate = 2.905, 95% CI [1.616, 4.194], $p < 0.001$). In contrast, Grade 4 tonsil size was linked to lower oxygen saturation (estimate= -4.848, 95% CI [-6.367, -3.329], $p < 0.001$). Grades 2 and 3 were not significantly associated with changes in oxygen saturation.

Conclusion: Adenotonsillar hypertrophy is significantly associated with decreased blood oxygen saturation and related cardiopulmonary complications in children. Early adenotonsillectomy may be of benefit in preventing these complications and improving oxygen saturation levels.

Key words. Adenotonsillar hypertrophy, blood oxygen saturation, adenotonsillectomy, airway obstruction, pediatric otolaryngology, sleep apnea, cardiopulmonary complications.

Introduction.

The adenoids and palatine tonsils are lymphoid structures in the nasopharynx and oropharynx, respectively, and are part of Waldeyer's ring. They belong to the body's mucosa-associated lymphoid tissue and are located at the entrance of the upper aerodigestive tract. These structures serve as part of the body's first line of defense, protecting the lower airways and gastrointestinal tract and aiding in the development of antigenic memory by the host [1].

Several factors, such as chronic bacterial or viral infections and passive cigarette smoke, can cause adenotonsillar hypertrophy in children [2]. The size of the adenoids and tonsils varies among children but generally reaches its maximum between 3 and 6 years, after which they begin to atrophy [3]. This age range coincides with the period when infections of the adenoids and tonsils are most frequent [4].

Repeated infections of the adenoids and tonsils occur in children who have not yet developed immunity. Even after infections resolve, residual enlargement of the lymphoid tissues may persist, narrowing the nasopharyngeal and oropharyngeal tracts. The combined effect of muscular hypotonia during sleep and adenotonsillar enlargement due to infections and antigenic stimulation can synergistically narrow the airway, leading to decreased pulmonary oxygenation or obstructive sleep apnea (OSA) [4].

Large tonsils are associated with symptoms of airway obstruction, including mouth breathing, snoring, sleep apnea, nighttime coughing, hyponasal speech, sinusitis, and recurrent otitis media [5]. In severe cases, patients may develop cor pulmonale, pulmonary artery hypertension, or reduced alveolar ventilation, which can recur after adenotonsillectomy [6]. Severe upper airway obstruction can lead to cor pulmonale, ventilation disorders, reduced alveolar ventilation, chronic hypercapnia, hypoxia, respiratory acidosis, pulmonary artery stenosis, right ventricular dilatation, and heart failure [7-9]. Removal of airway obstruction by adenotonsillectomy reverses these conditions [10]. One study found that children with adenoid and/or tonsillar hypertrophy had significantly ($P < 0.001$) lower basal SpO2 levels than healthy controls [11]. Another study found that children without adenotonsillar enlargement had better oxygen saturation profiles than those with enlargement [12].

This study aims to demonstrate the association between tonsillar or adenoidal hypertrophy and decreased blood oxygen saturation, along with subsequent cardiopulmonary

complications. Early recommendations for adenoidectomy and tonsillectomy may be beneficial in preventing these complications.

Materials and Methods.

Study design, population and settings:

A retrospective cohort study was conducted among children aged 7-12 years presented with adenoid and/or palatine tonsils hypertrophy with obstructive symptoms admitted to King Fahad Hospital and Prince Mishari Hospital, AlBaha, Saudi Arabia, for tonsillectomy. Children with respiratory diseases, cardiac disease, nasal polyps, nasal septum deviation, chest wall abnormality and lower airway diseases were excluded from the study.

We employed a total coverage of all children presented to the selected hospitals between July 2023 and January 2024 who met the inclusion/exclusion criteria. Data were retrieved from electronic medical records and paper files. The children were examined by an otolaryngologist who determined the size of the tonsils according to the following criteria: the size ranged between +1 and +4 based on oropharyngeal obstruction of 25%, 50%, 75%, and >75%, respectively. Documented factors such as breathing through the mouth instead of the nose, constantly running nose, Nasal speech, Snoring, Sleep apnea, and Restlessness during sleep were retrieved from the medical files. We included 56 healthy children from primary school students with matched age and sex without adenoids and/or palatine tonsils hypertrophy as a control group who were also examined by the same otolaryngologist. Patients and control groups were subjected to Pulse oximeters to measure their O2 saturation.

Ethical consideration.

The Research Ethical approval was obtained from the Research Ethical Committee at the University (IRB.No: REC/PHA/BU-FM/2023/38). Written informed consent was obtained from the children's parents, and they will not participate until they give full approval. The children's anonymity, privacy, security, and confidentiality were maintained, and their information was used for scientific purposes only.

Analytical plan.

The data was collected, checked for completeness and coded in an Excel sheet. The data was analyzed using SPSS software version 27 (Statistical Product and Service Solutions, SPSS Inc, Chicago, IL, USA). Continuous variables were presented as a median and interquartile range, while categorical variables were expressed as numbers and percentages. Data normality was assessed using histograms and the Shapiro-Wilks test. The Kruskal-Wallis rank sum test was employed to identify the association between adenoids and/or palatine tonsils hypertrophy and oxygen saturation. Multiple linear regression was used to assess the determinants of oxygen saturation. The significance level is set at $p < 0.05$.

Results.

The study comprised 357 participants. The age was nearly equally distributed between 7-9 years (49.6%) and 10-12 years (50.4%), with more than half (52%) being males. Regarding diagnoses, 30% had adenoid hypertrophy, 35% had tonsil hypertrophy, 19% had both adenoid and tonsil hypertrophy, and 16% were in the control group.

Table 1. *Demographic and clinical characteristics of study participants.*

Characteristic	**n (%)**
Age	
7-9 years	177 (49.6%)
10-12 years	180 (50.4%)
Gender	
Female	172 (48%)
Male	185 (52%)
Diagnosis	
Adenoid hypertrophy	108 (30%)
Tonsil hypertrophy	125 (35%)
Both	68 (19%)
Neither (control group)	56 (16%)
Tonsil Size	
Grade 1	173 (48%)
Grade 2	57 (16%)
Grade 3	36 (10%)
Grade 4	30 (8.4%)
Normal	61 (17%)
Oxygen saturation of adenotonsillar hypertrophy group*	96.0 (93.0, 98.0)
Oxygen saturation of control group*	99.0 (97.0, 100.0)
*Median (IQR)	

Table 2. *Prevalence of Respiratory and Sleep-Related Symptoms in adenotonsillar hypertrophy participants.*

Characteristic	**N = 301**[1]
Breathing through the mouth instead of the nose	
No	52 (17%)
Yes	249 (83%)
Constantly running nose	
No	79 (26%)
Yes	222 (74%)
Nasal speech	
No	148 (49%)
Yes	153 (51%)
Snoring	
No	205 (68%)
Yes	96 (32%)
Sleep apnea	
No	240 (80%)
Yes	61 (20%)
Restlessness during sleep	
No	252 (84%)
Yes	49 (16%)
[1]n (%)	

Regarding Tonsil size, 48% had Grade 1, 16% had Grade 2, 10% had Grade 3, 8.4% had Grade 4 and 17% had normal tonsil size. The median oxygen saturation was 96.0% for the adenotonsillar hypertrophy group and 99.0% for the control group. Table 1 Among adenotonsillar hypertrophy children, 83% reported breathing through the mouth instead of the nose, while 74% had a constantly running nose. Nasal speech was present in 51%, whereas Snoring was reported by 32%. Sleep apnea

was observed in 20% and Restlessness during sleep affected 16%. Table 2 The Kruskal-Wallis test indicates a significant difference in oxygen saturation levels across the groups (χ^2 = 152.20, p < 0.0001). Participants with adenoid hypertrophy had a median oxygen saturation of approximately 97, Participants with tonsil hypertrophy had a median oxygen saturation of 96, Those with both adenoid and tonsil hypertrophy showed a median oxygen saturation of 92 and the control group exhibited a higher median oxygen saturation of 99. Figure 1 Gender was a significant predictor of oxygen saturation levels, with males showing a decrease in oxygen saturation compared to females (estimate: -0.338, 95% CI [--0.640, -0.036], p = 0.028). Regarding diagnoses, adenoid hypertrophy (estimate: -3.863, 95% confidence interval (CI) [-5.241, -2.484], p < 0.001), tonsil hypertrophy (estimate: -3.631, 95% CI [-5.053, -2.208], p < 0.001) and having both conditions (estimate: - 3.777, 95% CI [-5.3.7, -2.247], p < 0.001) was associated with a decrease in oxygen saturation levels. Tonsil size also significantly impacted oxygen saturation. Grade 1 tonsil size was associated with an increase in oxygen saturation (estimate = 2.905, 95% CI [1.616, 4.194], p < 0.001). In contrast, Grade 4 tonsil size was linked to a decrease in oxygen saturation (estimate= - 4.848, 95% CI [-6.367, -3.329], p < 0.001). Grades 2 (p = 0.819) and 3 (p = 0.965) were not significantly associated with changes in oxygen saturation. Snoring was associated with decreased oxygen saturation (estimate = -0.608, 95% CI [-1.082, -0.135], p = 0.012). Sleep apnea (p = 0.093) and Breathing through the mouth instead of the nose (p = 0.125) did not significantly associate with oxygen saturation levels Table 3.

Table 3. *Predictors of oxygen saturation.*

Variable	Category	Estimate	Standard Error	Confidence interval	P value
Intercept		98.532	0.202	98.134, 98.930	**<0.001**
Gender	Male	-0.338	0.154	-0.640, -0.036	**0.028**
Diagnosis					
	Adenoid hypertrophy	-3.863	0.701	-5.241, -2.484	**<0.001**
	Tonsil hypertrophy	-3.631	0.723	-5.053, -2.208	**<0.001**
	Both	-3.777	0.778	-5.3.7, -2.247	**<0.001**
Tonsil Size					
	Grade 1	2.905	0.655	1.616, 4.194	**<0.001**
	Grade 2	0.156	0.682	-1.185, 1.498	0.819
	Grade 3	-0.031	0.718	-1.443, 1.380	0.965
	Grade 4	-4.848	0.772	-6.367, -3.329	**<0.001**
Breathing through the mouth instead of the nose	Yes	-0.35	0.227	-0.796, 0.097	0.125
Snoring	Yes	-0.608	0.241	-1.082, -0.135	**0.012**
Sleep apnea	Yes	-0.393	0.234	-0.853, 0.066	0.093

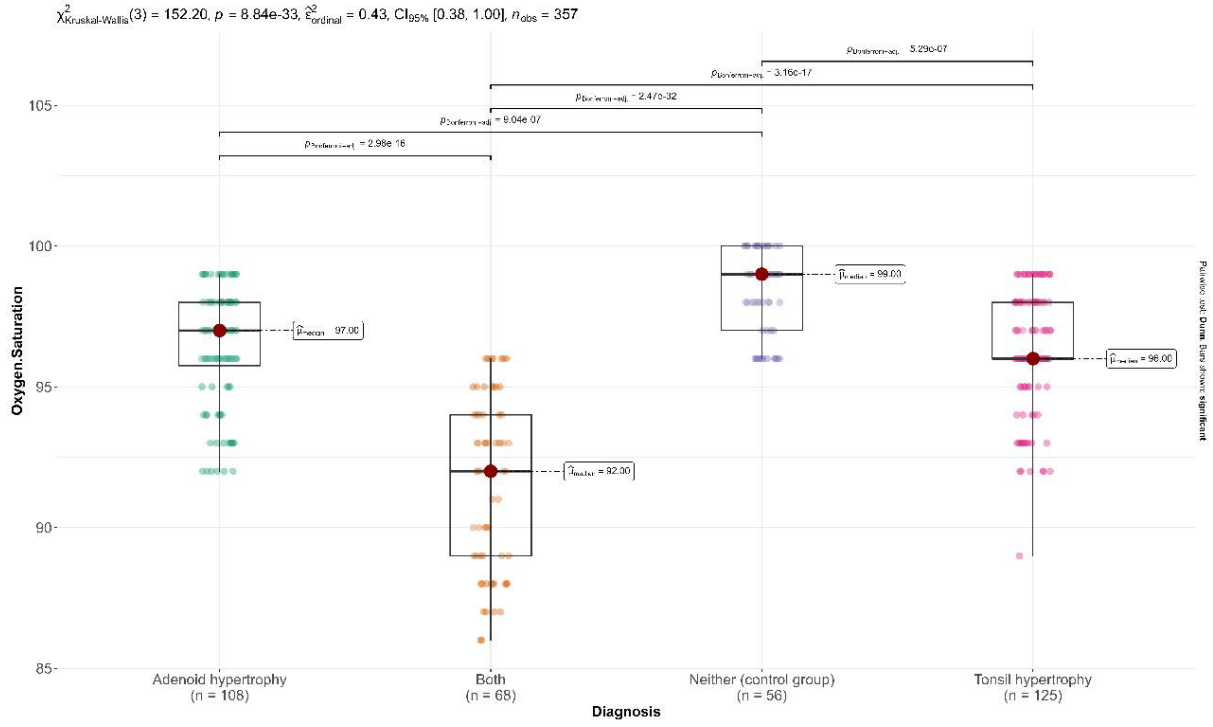

Figure 1. *Impact of Adenoid and Tonsil Hypertrophy on Oxygen Saturation.*

Discussion.

Recurrent infection and allergens exposure in children results in adenoids and tonsils enlargement [13,14]. Adenoid hypertrophy was linked with several conditions, including sleep apnea, chronic serous otitis and sinusitis [15]. Moreover, tonsillar enlargement causes upper airway obstruction, resulting in mouth breathing and limited airflow [16]. In this study, we assessed the effect of enlarged adenoids and tonsils on blood oxygen (O2) saturation in children attending primary schools in the Al Baha area.

We found a significant difference in oxygen saturation across the groups, and all three groups with tonsillar hypertrophy, adenoid hypertrophy and adenotonsillar hypertrophy were associated with significant reduction in oxygen saturation. The control group showed an oxygen saturation level of 99. However, those with adenoid and tonsil hypertrophy showed a median oxygen saturation of 92, the lowest level. A previous study by Yadava et al. showed a lower oxygen saturation level (75.00) among children with adenotonsillar enlargement [17]. Another study by Mbam et al. reported a higher oxygen saturation (96.86) in children with adenotonsillar enlargement [18]. Despite the difference in oxygen levels in these studies, similar to our findings, both demonstrated a significantly lower saturation in the adenotonsillar enlargement group compared to the control group. Participants with tonsil hypertrophy had a median oxygen saturation of 96, and participants with adenoid hypertrophy had a median oxygen saturation of approximately 97. A previous study by Mora et al. on children with tonsillar enlargement and obstructive sleep apnea syndrome reported lower oxygen saturation levels of 79% that rose to 95% after adenotonsillectomy [19]. Moreover, Khalifa et al. showed an oxygen saturation level of 89.4 among children with adenoid enlargement, which improved to 93.5 after adenoidectomy [20]. The later studies included fewer participants starting from the age of 2 and 3 years, which may explain the lower oxygen saturation level. The association between tonsillar size and oxygen saturation was varied, with grade 1 showing a significant increase in oxygen saturation level and grade 2 and 3 tonsillar size showing some degree of reduction in oxygen saturation that was not statistically significant. However, grade 4 tonsillar size was associated with a significant reduction in oxygen saturation. These differences indicate a significant reduction of oxygen saturation with the increase in tonsillar size, which signifies the need for tonsillectomy for grade 4 tonsillar size to improve oxygen saturation and other obstructive symptoms. Similarly, a previous study by Nakata et al. also showed that tonsillar size affects the improvement of the apnoea–hypopnoea index after tonsillectomy, with the most improvement in patients with grade 3 and grade 4 tonsillar size [21]. Breathing from the mouth instead of the nose and sleep apnea showed a slight reduction in oxygen saturation. However, snoring and male gender were associated with a significant reduction in oxygen saturation. As previously shown by Wali et al., the severity of obstructive sleep apnea is significantly associated with the degree of oxygen saturation [9]. Moreover, mouth breathing was associated with an increased incidence of hypoxemia and increased severity of obstructive sleep apnea [22,23].

Limitations: our study provides a comprehensive overview of the effect of enlarged adenoids and tonsils on blood oxygen (O2) saturation in children. However, the small sample size and small number of participants included in the control group limit the generalizability of our results and more studies are needed to validate our findings further.

Conclusion.

The study suggests that surgical intervention may be particularly beneficial for patients with adenoid hypertrophy, significant tonsil hypertrophy (especially Grade 4), and snoring, as they are associated with decreased oxygen saturation.

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