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Understanding sociodemographic factors related to health outcomes in pediatric obstructive sleep apnea

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ABSTRACT

Objectives: (1) To examine relationships between socioeconomic status (SES) and successful treatment of pediatric obstructive sleep apnea (OSA) with adenotonsillectomy (T&A).

(2) To explore sociodemographic factors and medical comorbidities that separate OSA and refractory OSA populations in children.

Methods: We retrospectively reviewed pediatric OSA patients (ages 0–18). Patients evaluated for OSA by pediatric otolaryngology between January 2014 and December 2015 were included. OSA was defined as requiring T&A. Refractory OSA (ROSA) was defined as recurring, polysomnography-proven, OSA after T&A, ultimately requiring another intervention, such as a multi-level airway operation. Clinical data were complemented with sociodemographic data. ZIP codes were used to approximate median household income.

Results: Our cohort included 105 ROSA and 53 OSA patients. These patients came from similar rates of single parent households and coverage by public insurance. Median household income for OSA patients was $47,086 (IQR $36,395-$60,196), compared to $45,696 (IQR $37,669-$56,203) for ROSA patients. Over 60% of all patients fell below the national household income average. Nearly half of the cohort resided in the three largest metro counties closest to our institution. These patients represented higher rates of single-parent households ($p = 0.045$) and public insurance ($p = 0.002$), and trends towards lower rates of ROSA ($p = 0.138$).

Conclusion: Our results identified sociodemographic factors that may influence healthcare compliance and subsequently overall health outcomes. We identified no statistically significant difference in measures of SES between patients with refractory vs non-refractory OSA. Patients living closest to our medical center had lowest rates of ROSA, suggesting that access to care may affect outcomes of pediatric OSA.

1. Introduction

Socioeconomic status (SES) is a social determinant of health that has been linked with a large number of healthcare issues and outcomes, including rates of chronic disease such as diabetes and obesity, prevalence of trisomy 21 and other chromosomal abnormalities, surgical outcomes, and treatment efficacy [1–6]. The relationship between SES and obstructive sleep apnea (OSA) has been previously studied; however, no clear link in pathogenesis has been identified. Family SES, parental occupations and insurance status have all been associated with the incidence of OSA and success of non-surgical treatment [7–11]. If SES affects outcome in the surgical management of pediatric OSA, then an argument exists for the combination of providers and social work/case management professionals into multidisciplinary teams that focus on treatments and their expected efficacy in the patient's specific socioeconomic context.

Two factors that have been independently characterized as risk factors for OSA are obesity and SES [11,12]. The link between obesity and OSA in both children and adults has been related to anatomy and airway collapse during sleep [13]. There have been multiple proposed explanations relating SES to the pathogenesis of OSA: reverse causality (ie, OSA leads to lower SES in adults), lower SES interferes with access to care, or environmental factors associated with lower SES contributing to OSA [12]. To our knowledge, fewer studies have examined how these SES factors may affect the post-surgical outcomes of OSA treatment. Refractory OSA (ROSA) was defined as recurring,

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polysomnography-proven, OSA after T&A, ultimately requiring another intervention—in this case, a multi-level airway operation. The primary aim of this study is to examine any relationships between SES and the successful treatment of pediatric OSA with adenotonsillectomy (T&A). The secondary aim is to explore the socioeconomic ramifications of demographic factors and comorbidities that separate OSA and refractory OSA (ROSA) populations in children.

2. Methods

This study was a retrospective review of pediatric patients (ages 0–18) approved by the Vanderbilt University Medical Center Institutional Review Board (IRB # 170372). Inclusion criteria for this database were patients seen by otolaryngologists at our tertiary care center between 2014 and 2015 have been diagnosed with OSA and surgically treated with T&A. Additionally, all patients received a post-operative polysomnogram. Six patients from the original database with incomplete polysomnographic data were excluded. Treatment success (i.e. non-refractory) was defined as resolution of OSA symptoms after operation. Refractory OSA was defined as polysomnography-proven OSA residual or recurring after T&A and requiring subsequent multi-level operation. Clinical, demographic and payer information were extracted from the electronic health record for all patients in the study period identified as having undergone T&A for OSA. Comorbid risk factors for OSA were listed as Down syndrome, cerebral palsy, hypotonia, craniofacial diagnoses, neuromuscular disease, or laryngotracheomalacia.

Socioeconomic status was defined in our study as patient's zip code (as a proxy for household income), insurance status, and number of parents involved in childcare. Median household income based on zip code was extracted from the 2006–2010 American Community Survey [14]. Zip code was also used to determine distance to our hospital system.

Differences between the pre-defined SES metrics for children with refractory and non-refractory OSA were compared with a *t*-test. Non-parametric tests were used to identify differences for non-normally distributed data as determined by a Shapiro-Wilk test. Chi-square tests were used to evaluate differences of proportions within our patient populations. One-way ANOVA was used to establish differences between patients of different races. Statistical significance was set *a priori* at $p < 0.05$.

3. Results

Data from 158 patients were analyzed. Average age was 10.1 ± 4.9 years. Eighty-nine (56.3%) patients were male. A total of 105 patients (66.5%) were diagnosed with ROSA. The clinical characteristics of our patients are described in Table 1. A higher proportion of patients with ROSA were male compared to those without refractory OSA (61.9% vs 45.3%, p = 0.047). The racial make-up of our patient cohort was similar to the general population of the state in which our care center was located – the only statistical difference was that more people identified as Hawaiian/Pacific Islander in our cohort compared to the state of Tennessee (p = 0.034) [15]. There were no significant differences in BMI or BMI z-score by race (p = 0.168 and p = 0.936, respectively).

Table 1
Patient demographics.

	Non-refractory OSA n = 53	ROSA n = 105	p value
Age	10.7 ± 5.8	9.8 ± 4.4	0.2859
Gender			
Male	24 (45.3%)	65 (61.9%)	0.0467
Female	29 (54.7%)	40 (38.1%)	
BMI	25.7 ± 11.4	23.2 ± 8.9	0.1219
BMI z-score	1.4 ± 1.3	1.3 ± 1.3	0.5633
Race			
White	33 (62.2%)	80 (76.2%)	0.0671
African American	16 (30.2%)	19 (18.1%)	0.0839
Hispanic	2 (3.8%)	4 (3.8%)	0.9911
Asian	2 (3.8%)	1 (1.0%)	0.2199
Hawaiian/Pacific Islander	0 (0%)	1 (1.0%)	0.4760

Table 2
Socioeconomic status of patients with non-refractory versus refractory OSA.

	Non-refractory OSA n = 53	ROSA n = 105	p-value
Median income	$47,086 IQR $36,395-$60,196	$45,696 IQR $37,669-$56,203	0.6739
Single-parent household	15 (28.3%)	29 (27.6%)	0.9280
Public health insurance	34 (64.2%)	64 (61.0%)	0.3478

There was no significant difference in the median household income for OSA patients [$47,086 (IQR $36,395-$60,196)] compared to the median household income for ROSA patients [$45,696 (IQR $37,669-$56,203)] (p = 0.690, Table 2). Considering other factors representative of SES, there were a similar number of children with non-refractory OSA from single parent households compared to those with ROSA from single parent households (28.6% vs 30.6% respectively, p = 0.928). Similarly, there was no difference in the number of children covered by public insurance between the two groups (64.3% vs 62.0%, p = 0.348).

Access and barriers to care is another social determinant of health investigated by our study. Considering the county of residence of our patients, 56 (43.7%) patients reside in the three largest metro counties closest to our institution. These patients represented significantly higher rates of single-parent households (37.5% vs 22.5%, p = 0.045) and higher rates of public insurance (78.6% vs 52.9%, p = 0.002). The observed lower rate of ROSA in the metro counties population (58.9% vs 70.6%) failed to reach statistical significance (p = 0.14).

Obesity is a well-documented co-morbid risk factor for OSA but there are many other medical comorbidities that can predispose a child to developing OSA (Table 3). Between those with refractory and non-refractory OSA, there was a statistically significant difference in the number of children with Down syndrome ($p < 0.001$) and hypotonia (p = 0.002). There were also a significantly higher number of mean risk factors per patient in those with ROSA compared to those with non-refractory OSA (1.29 ± 1.15 vs 0.70 ± 1.03, p = 0.002).

4. Discussion

We have summarized clinical and sociodemographic factors of the pediatric obstructive sleep apnea patient population treated by our tertiary care center. The success rate of T&A is cited to be between 20 and 75% depending on the comorbidities of the patient [16]. Though these factors affecting outcomes of OSA have been studied extensively, there is no comprehensive evaluation of the socioeconomic impact on

Table 3
Medical comorbidities of patients.

	Non-refractory OSA n = 53	ROSA n = 105	p value
Down Syndrome	4 (7.5%)	39 (37.1%)	0.0001
Cerebral Palsy	3 (5.7%)	5 (4.8%)	0.8078
Hypotonia	10 (18.9%)	46 (43.8%)	0.0020
Craniofacial abnormalities	7 (13.2%)	12 (11.4%)	0.7455
Neuromuscular disease	1 (1.9%)	0 (0.0%)	0.1579
Laryngotracheomalacia	12 (22.6%)	33 (31.4%)	0.2479