

Research Article

Factors Associated with Screening for Pediatric Sleep-Disordered Breathing

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Abstract

Objective: Obstructive sleep-disordered breathing (SDB) is the most common indication for tonsillectomy and differences in pediatric tonsillectomy rates among sociodemographic groups have been well documented. However, variations in screening for SDB in the primary care setting have not been well delineated and we aim to study this upstream source in tonsillectomy access.

Study Design: Retrospective chart review

Setting: Tertiary hospital network

Methods: Demographics and SDB screening status were extracted from well-child visits for children ages 2-12 years. Multivariable logistic regression was used to identify factors associated with screening for SDB.

Results: Of 1,001 charts reviewed, a total of 809 children met inclusion criteria (median age 5 IQR [3-8] years, 50.3% female, 49.7% male). Only 45.4% children were screened for SDB, of whom 59 (16.7%) had SDB. Multivariable logistic regression revealed that when controlling for age, sex, race, ethnicity and comorbidity, the odds of being screened for SDB were lower for Black children than their White counterparts (OR 0.59, 95%CI [0.42-0.84], $p=0.003$). However, when controlling for the involvement of a trainee and use of a template, racial differences between White and Black children were no longer significant (OR 0.98, [0.66-1.48], $p=0.53$). However, racial differences persisted for children of other race (OR 0.48, [0.26-0.88], $p=0.009$). The odds of being screened for SDB was higher with use of templated note (OR 3.71 [1.85-7.44]; $p<0.001$) but lower if a medical trainee was involved (OR 0.06, [0.03-0.11], $p<0.001$)

Conclusions: Less than half of children presenting for well-visits were screened for SDB symptoms in this cohort. Some racial differences in screening were mediated by trainee involvement or note template use, which may be avenues to improve equitable access to workup and treatment.

INTRODUCTION

Obstructive sleep-disordered breathing (SDB) is a condition that affects 11-17% of children [1,2]. SDB is caused by narrowing of the upper airway and can lead to decreased oxygen levels, hypercapnia, and disruption of sleep [3]. The most common site of obstruction in otherwise healthy children is at the level of the tonsils and adenoids and adenotonsillar hypertrophy is commonly seen in younger children with SDB. SDB can impact school performance and lead to behavioral problems, exacerbate attention-deficit hyperactivity disorder, and decrease cardiopulmonary function [4-8]. Tonsillectomy is considered the first-line treatment for otherwise healthy children with SDB and tonsillar hypertrophy. Tonsillectomy has shown to improve polysomnography parameters, sleep symptoms, behavior, and quality of life

[3]. Therefore, it is vital that children are properly screened and treated for this condition.

The American Academy of Pediatrics (AAP) clinical practice guidelines recommend that all children are screened for SDB at their yearly well-child visit with their primary care physician (PCP) [4]. Based on this recommendation, all children should be screened for snoring, and children with suspected obstructive symptoms should undergo further evaluation with polysomnography or referral to a specialist. These guidelines state that screening for SDB is essential and should be documented in all well-child visit notes [4-9]. However, recent research suggests that SDB remains underdiagnosed in children [10,11].

Disparities in the diagnosis and treatment of SDB in

children have been well documented and have persisted for decades [12-16]. To complicate this matter, SDB is more common in children who are Black, obese, or from lower resourced families—populations that are most impacted by disparities in treatment [17-21]. Given the known inequities in tonsillectomy rates for children with SDB, it is important to investigate potential drivers of these disparities in the care continuum. Most of the literature to date focuses on differences in receipt of treatment, such as tonsillectomy. However, little is known regarding upstream sources of disparities such as screening for SDB. Therefore, the goal of this study was to evaluate factors that influence screening for SDB per the AAP guidelines in the primary care setting.

METHODS

Setting and Participants

A retrospective chart review was conducted for patients ages 2 to less than 12 years who had a well-child visit in August 2022. This age group was chosen because tonsillar hypertrophy is more commonly seen in younger children and that SDB in older children are likely due to obesity and other comorbidities [22, 23].

The electronic medical record was reviewed for children who presented for their well-child visits at primary care clinics affiliated with our academic institution. This system serves a diverse pediatric population, with patients coming from a range of socioeconomic, racial, and ethnic backgrounds. Clinics from both urban and rural locations were included. Patient charts were excluded if the patient had been seen previously by an otolaryngologist or sleep medicine physician for any reason or if they already had a diagnosis of SDB. Children with serious medical complexity including a syndrome or craniofacial anomaly were also excluded.

Data Collection and Analysis

Demographic information including age, race, ethnicity, sex, height, weight, insurance status and type, zip code, concomitant disorders, and sleep-related medications were extracted from patients' charts. Provider type, clinic location, otolaryngology or sleep medicine referrals and polysomnography referrals were recorded. Concomitant disorders such as attention-deficit hyperactivity disorder and learning disorders were identified through ICD-10 codes. The provider notes for each visit were read to identify whether screening for a sleep disorder occurred at each well-child visit. Screening was determined by whether the provider documented snoring or any other obstructive sleep symptoms in the chart. Clinical features

of SDB, defined as any sign or symptom outlined in the clinical practice guidelines [24], were also extracted. These signs and symptoms included labored breathing, gasping or snoring during sleep, enuresis, cyanosis, headaches on awakening, daytime somnolence, attention-deficit hyperactivity disorder, and learning problems. These data were collected and stored using REDCap. This review was approved by the IRB at the Medical University of South Carolina.

Definition of Variables

Race was categorized into White, Black, and other. Other was defined as Asian, American Indian, Alaska Native, Pacific Islander, unknown race or multiracial. The categories for Ethnicity included Non-Hispanic or Hispanic. The categories for insurance included public, private and self-pay. Public insurance was defined as any insurance type that was provided by the government (Medicaid, Tricare, etc.). Private insurance was defined as any insurance that was provided by a separate organization. Self-pay insurance included patients who paid for their own insurance. For the multivariable regression model, age was categorized into 3 groups: 2 to less than 5 years, 5 to less than 8 years, and 8 to less than 12 years. Comorbidity in this analysis was defined as asthma, attention-deficit hyperactivity disorder, allergic rhinitis, obesity, enuresis, learning difficulties, overweight or underweight, tonsillar hypertrophy, and hypertension. A templated note was defined as a note that was preformatted, with standardized sections for each component of the well-child checks. In this study, not all templated notes had screening questions for SDB.

Statistical Analysis

A power analysis was conducted to ensure that an appropriate number of charts were included. The results of our power analysis suggested that at least 800 charts needed to be included to detect a 10% difference in screening between groups. The overall study population was characterized using descriptive statistics. Normality was assessed using the Kolmogorov-Smirnov test and visually using a histogram. A chi-squared test was used for categorical variables. The only continuous variable was age, which was not normally distributed. Therefore, median, and interquartile range were used to describe age. Multivariable logistic regression models were utilized to determine which factors were associated with the dependent variable (SDB screening). Odds ratios (ORs) and 95% confidence intervals (CIs) were employed to describe these relationships. Since we were interested in whether certain system level factors might be associated

with attenuation of any racial/ethnic disparities, we constructed 3 separate multivariable logistic models. Model 1 included demographics and comorbidity indicator. Model 2 was identical to Model 1, with the exception of the addition of "Medical Trainee" present during exam. Model 3 was identical to Model 2, with the exception that "Template Use" was added as a covariate. P values <0.05 were considered statistically significant. All analyses were performed using SPSS version 27 (IBM Corp. Released 2020. IBM SPSS Statistics for Windows, Version 27.0. Armonk, NY: IBM Corp).

RESULTS

A total of 1,001 charts for children undergoing well-child checks during the month of August 2022 were screened. Of those, 809 met inclusion criteria. There were 402 (49.7%) male patients, and the median age was 5 years IQR [3-8]. Patient characteristics and their association with the assessment and identification of snoring in their charts are outlined in Table 1. This cohort was made up of 26.3% White, 42.9% Black, and 30.8% of other children. With respect to ethnicity, 72.5% of the population was non-Hispanic and 24.7% were Hispanic.

Children with public insurance made up 74.5% of the cohort, while 15.1% of children had private insurance and 10.4% of children were self-pay. There were no significant differences in screening for SDB based on insurance type ($p=0.07$). A medical trainee was involved in 19.5% of clinic visits, and there was a statistically significant decrease in likelihood of screening if a medical trainee was involved ($p<0.001$). There was a significant increase in likelihood of screening for SDB if a templated note that screened for snoring or obstructive sleep symptoms was used during the well-child checks ($p=0.006$). There was an increase in SDB screening rates for children with SDB-related comorbidities ($p=0.05$).

A total of 81.1% of providers were pediatricians, 6.6% were family medicine physicians, and 12.4% were advanced practice providers. There was a significant difference in screening rates between the three groups ($p<0.001$). Snoring was identified in 16.1% of patients. In this subset of children, 6.7% were referred to ENT, 1.7% were referred to sleep medicine, 28.8% were prescribed an intranasal steroid. There were no differences in treatment plan when considering age ($p=0.10$), sex ($p=0.45$), race ($p=0.67$), or ethnicity ($p=0.36$), insurance status ($p=0.64$), medical trainee ($p=0.42$) or use of a note template ($p=0.64$).

Multivariable Analysis

Three multivariable regression models were used to

analyze the relationship between snoring assessment and demographic factors (Table 2). The first model assessed screening rate when adjusting for age, sex, race, ethnicity, and comorbidity. When controlling for sex, race, ethnicity, and comorbidity presence, children ages 5 to less than 8 years and children 8 to less than 12 years had higher odds of being screened for SDB at a well-child visit compared to children 2 to less than 5 years (OR: 1.67 [1.19-2.39]; $p=0.003$ for 5-less than 8-year-old children; OR: 1.75 [1.24-2.48]; $p=0.002$ for 8-less than 12-year-old children). In this same model, Black children and children of another race underwent screening for snoring at lower rates compared to their White counterparts (OR 0.59 [0.42-0.84]; $p=0.003$ for Black children; OR 0.54 [0.30-0.95]; $p=0.034$ for children of other race). There were no differences in screening rates based on ethnicity and presence of a comorbidity when controlling for age, sex, and race.

Another regression model (Model 2) was used to further assess the nuances associated with SDB screening in children. This model, outlined in Table 2, controlled for age, sex, race, ethnicity, comorbidity, and the involvement of a medical trainee in the well-child visit. There was a significant difference in the odds of screening among children from other race compared to White children (OR 0.47 [0.26-0.87]; $p=0.02$), but no difference in screening between Black and White children (OR 0.95 [0.64-1.41]; $p=0.81$). In this same model, children were significantly less likely to be screened if a medical trainee was involved in the clinic visit (OR: 0.07 [0.04-0.12]; $p<0.001$). Significant difference in screening based on age persisted in this model, with older children being more likely to be screened compared to younger children (OR: 2.01 [1.38-2.93]; $p<0.001$ for 5-less than 8-year-old children; OR: 2.21 [1.52-3.23]; $p<0.001$ for 8-less than 12-year-old children).

The final multivariable regression model (Model 3) evaluated in this study included the variables age, sex, race, ethnicity, comorbidity, medical trainee involvement and use of a templated note (Table 2). Differences in screening based on age continued to be significantly higher for older children (OR: 2.21 [1.50-3.26]; $p<0.001$ for 5-less than 8-year-old children; OR: 2.29 [1.55-3.36]; $p<0.001$ for 8-less than 12-year-old children). Children of the other race group were also found to have significantly lower screening rates compared to Black and White children (OR 0.48 [0.26-0.88]; $p=0.009$). Odds of being screened were 94% lower in visits where a medical trainee was involved (OR 0.06 [0.03-0.22]; $p<0.001$). The odds of being screened at a well-child visit was 3.7 times higher in encounters where a templated note was used (OR 3.71 [1.85-7.44]; $p<0.001$).

Table 1: Demographics of the Study Population

Variable	Total patients (%)	Screened for SDB (%)	p-Value ^a	SDB Identified (%)	p-Value ^a
Total Screening Visits	809(100)	367 (45.4)		59 (16.1)	
Age			p<0.001*		p=0.85
2-<5	344 (42.5)	126 (36.6)		19 (32.2)	
5-<8	227 (28.1)	116 (51.1)		18 (30.5)	
8+	238 (29.4)	125 (52.5)		22(37.3)	
Sex			p=0.85		p=0.98
Female	407 (50.3)	186 (45.7)		30 (50.8)	
Male	402 (49.7)	181 (45.0)		29 (49.2)	
Race			p=0.003*		p=0.053
Black	347 (42.9)	139 (40.1)		28 (47.5)	
Other	249 (30.8)	111 (44.6)		20 (33.9)	
White	213 (26.3)	117 (54.9)		11 (18.6)	
Ethnicity			p=0.46		p=0.15
Hispanic	192 (23.7)	90 (46.9)		19 (32.2)	
Non-Hispanic or Latino	598 (73.9)	266 (44.5)		40 (67.8)	
Not Reported	19 (2.3)	11 (57.9)		0 (0)	
Insurance			p=0.07		p=0.029*
Other	84 (10.4)	41 (48.8)		11 (18.6)	
Public	603 (74.5)	260 (43.1)		43 (72.9)	
Private	122 (15.1)	66 (54.1)		5 (8.5)	
Screened at a Previous Visit^c			p=0.95		p=0.82
Yes	212 (26.2)	96 (45.3)		16 (33.3)	
No	450 (55.6)	205 (45.6)		32 (66.7)	
Medical Trainee Involved in Visit			p<0.001*		p<0.001*
Yes	158 (19.5)	14 (8.9)		50 (84.7)	
No	651 (80.5)	353 (54.2)		9 (15.3)	
Provider type			p<0.001*		p=0.88
Pediatrician	656 (81.1)	299 (45.6)		47 (79.7)	
Family Medicine Physician	53 (6.6)	19 (35.8)		4 (6.8)	
Advanced Practice Provider	100 (12.4)	49 (49)		8 (13.6)	
Template Used			p=0.006*		p=0.45
Yes	760 (93.9)	354 (46.6)		56 (94.9)	
No	49 (6.1)	13 (26.5)		3 (5.1)	
Comorbidity			p=0.05*		p=0.006*
Yes	386 (47.7)	189 (51.5)		40 (67.8)	
No	423 (52.3)	178 (48.5)		19 (32.2)	
BMI^c			p=0.03*		p=0.28
Obese (≥95 percentile)	176 (21.8)	99 (56.3)		21 (36.8)	
Overweight (85-<95 percentile)	134 (16.6)	65 (48.5)		9 (15.8)	
Normal weight (5-<85percentile)	428 (52.9)	185 (43.2)		24 (42.1)	
Underweight (≤5 percentile)	36 (4.4)	15 (41.7)		3 (5.3)	

^a P values were calculated using x2 tests for categorical variables.

*Significance of P-values < 0.05 determined for nominal variables by Chi-Square test or Fischer's exact for populations less than 5.

^cMissing data. For screening at a previous visit, data was not available for 147 patients. For BMI, data was not available for 35 patients.

SDB= sleep-disordered breathing

BMI= body mass index

Table 2: Multivariable logistic regression model predicting screening for sleep disordered breathing

	Model 1			Model 2			Model 3		
Variable	Adjusted OR	95% CI	p-value	Adjusted OR	95% CI	p-value	Adjusted OR	95% CI	p-value
Age (years)									
2-<5	Reference			Reference			Reference		
5-<8	1.68	1.19-2.39	0.003*	2.01	1.38-2.93	<0.001*	2.21	1.50-3.26	<0.001*
8+	1.75	1.24-2.48	0.002*	2.21	1.52-3.23	<0.001*	2.29	1.55-3.36	<0.001*
Sex									
Female	1.05	0.78-1.39	0.77	1	0.74-1.37	0.97	1	0.71-1.34	0.98
Male	Reference			Reference			Reference		
Race									
White	Reference			Reference			Reference		
Black	0.59	0.42-0.84	0.003*	0.95	0.64-1.41	0.81	0.98	0.66-1.48	0.533
Other	0.54	0.30 -0.95	0.034*	0.47	0.26-0.87	0.02*	0.48	0.26-0.88	0.009*
Ethnicity									
Non-Hispanic	Reference			Reference			Reference		
Hispanic	1.43	0.79-2.56	0.23	1.37	0.74-2.52	0.31	1.32	0.72-2.45	0.39
Not Reported	1.98	0.72-5.47	0.19	1.94	0.67-5.58	0.22	1.93	0.67-5.52	0.23
Comorbidity									
No	Reference			Reference			Reference		
Yes	1.21	0.90-1.62	0.21	1.15	0.84-1.58	0.4	1.06	0.76-1.45	0.67
Medical Trainee									
No	N/A	N/A	N/A	Reference			Reference		
Yes	N/A	N/A	N/A	0.07	0.04-0.12	<0.001*	0.06	0.03-0.11	<0.001*
Template used									
No	N/A	N/A	N/A	N/A	N/A	N/A	Reference		
Yes	N/A	N/A	N/A	N/A	N/A	N/A	3.71	1.85-7.44	<0.001*

*P values were obtained from logistic regression models. P <0.05 is considered statistically significant.

N/A= not applicable

DISCUSSION

Inequitable access to tonsillectomy for children has been well documented [25], however little is known about where in the care continuum these disparities may arise. The most common indication for tonsillectomy is obstruction and SDB must therefore be identified during clinic visits. AAP guidelines state that all children should be screened for snoring and those children with symptoms of SDB should be further evaluated with a polysomnogram or evaluation by a specialist. Therefore, identification in the primary care setting is a critical step and bottleneck to evaluation by a sleep specialist or otolaryngologist for treatment. In our study cohort, the overall screening rate for SDB was low as less than half of all children were screened. Of the children who were evaluated, 16.1% were identified to snore regularly, which is consistent with reported prevalence of SDB in the literature [1,2]. We also found racial differences in SDB screening at well-child visits. Black children and children of other race

were less likely to be screened for snoring compared to their White counterparts. This finding is consistent with differences in tonsillectomy rates among Black children who undergo lower rates of surgical intervention, despite being disproportionately affected by obstructive sleep apnea [12-26].

Our aim was also to identify factors that may be influencing the differences in screening seen among different racial and ethnic groups. When accounting for use of a templated note in our regression model, these associations were no longer significant for Black children but persisted for children of another race. Although not completely effective at eliminating racial differences in screening rates, we found that patients were 3.7 times more likely to be evaluated for SDB when a templated note incorporating a question on snoring was used. Prior research has supported improved screening can be achieved with the use of templated notes. A recent multicenter, retrospective study suggests that increased

structured and standardized documentation using note templates is associated with higher quality documentation [27]. For example, a study conducted in 2015 suggested that templated notes for well-child visits significantly improve the documentation of obesity in children [28]. These findings, when taken together with the results of our study, suggest that using a note template can increase the overall screening rate of pediatric SDB and has the potential to reduce screening differences based on demographic characteristics.

Interestingly, we also found that the involvement of a medical trainee was associated with decreased screening rates of SDB during well-child visits. To our knowledge, this is the first study to examine differences in screening practices for pediatric SDB based on level of clinician training. Research in other fields have shown similar findings. For example, patients of internal medicine resident providers were significantly less likely to have received age appropriate cervical, breast, and colorectal cancer screening tests compared to patients of attending physicians [29]. Another study found that attending pediatricians had significantly better identification rates of mothers with depressive symptoms than that of pediatric trainees [30]. Joni et al., found that documentation of pediatric obesity increased with resident-physician training level [31]. Thus, level of education has been shown in multiple settings to impact screening practices, and our results are consistent with these findings. A possible intervention that could increase the overall screening rate among children, which was below 50% in our study, is educating medical trainees on SDB screening recommendations. Additional training on cultural sensitivity and implicit biases is also essential for enhancing patient care.

There are several limitations to this study. Our analysis is based on the documentation of well-child visits. Therefore, verbal screening that was not documented in the chart would not have been captured. This chart review was conducted in primary care and pediatric clinics in a single hospital network and might not be generalizable to other settings. However, the clinics do include outreach clinics in rural parts of the state and include a diverse racial and ethnic population. Additionally, race and ethnicity are self-reported outcomes, making these conclusions prone to reporting bias. Finally, the data were collected in August which coincides with the beginning of resident academic cycle and may have influenced trainee screening practices.

CONCLUSION

This study focused on potential upstream sources of inequities observed in tonsillectomy rates, namely

screening for SDB symptoms in the primary care setting. The results show that use of templated notes can mitigate some of the racial differences in screening for pediatric SDB. These findings pinpoint an actionable change that can be implemented at primary care clinics with relative ease. Our results also suggest that the involvement of a medical trainee greatly lowered SDB screening rates in a primary care setting. Therefore, education for resident physicians may allow for more consistent practices that are congruent with national screening guidelines. The results from this analysis lead to multiple directions for future investigations and potential for actionable items such as implementation of templated notes to improve equitable care pathways for children with SDB.

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