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Trends in Otorhinolaryngology- Head and Neck Surgery

RESEARCH ARTICLE ISSN: 2771-6767

Home Sleep Apnea Testing in Pediatric Patients: Parent Preferences

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Abstract

Introduction: Sleep disordered breathing requires in-laboratory attended polysomnography (PSG) for diagnosis, but widespread use of PSG is limited by access to qualified sleep centers and by the burden on caregivers (time, travel, cost). Home sleep apnea testing (HSAT) is not approved for routine use in children, but offers a promising alternative to PSG particularly given further access limitations and burden due to the COVID-19 pandemic. There have not been previous investigations into the level of caregiver interest in HSAT over PSG. We hypothesized that caregivers would be overwhelmingly interested in HSAT and aimed to determine clinical characteristics that may predict caregivers' interest in HSAT over PSG.

Methods: Retrospective chart review was performed for patients that completed baseline PSG from 2018 through 2020 (pre- and post-pandemic) at Rush University Children's Hospital. Statistical analysis evaluated for association of patient characteristics, caregiver reported patient symptoms, and caregiver preference for HSAT.

Results: The majority of caregivers did not prefer HSAT over traditional PSG (65.4%). This trend persisted in the post-pandemic cohort. There was no statistical difference in HSAT preference based on age, gender, ethnicity, or insurance type. Caregivers were more likely to prefer HSAT if they reported that their child had a pause in breathing (OR 2.192, 95% CI = 1.407, 3.414) or gasping/choking events during sleep (OR 1.893, 95% CI = 1.166, 3.072).

Conclusion: Most caregivers are not interested in HSAT. Further studies are needed to identify the reasons behind this and if further education would alleviate caregiver concerns.

Summary

Home sleep apnea testing (HSAT) is not approved for routine use in children, but growing evidence indicates feasibility for use in pediatrics and offers a promising alternative to PSG particularly given access limitations and perceived burden for caregivers. Based on retrospective chart review and the question, "If available and appropriate, would you prefer an at-home sleep test for your child?", we found that the majority of caregivers were not interested in HSAT. These findings introduce a barrier to routine use of HSAT in pediatrics and demonstrate that providers may underestimate the obstacles of implementing HSAT use for pediatric patients as compared to adults.

Keywords: *pediatric; home sleep apnea test; COVID-19*

Abbreviations: *AASM: American Academy of Sleep Medicine, ADHD: Attention Deficit Hyperactivity Disorder, HSAT: Home Sleep Apnea Test, OSA: Obstructive Sleep Apnea, OSAS: Obstructive Sleep Apnea Syndrome, PSG: Polysomnogram, SDB: Sleep Disordered Breathing*

Background

Sleep-disordered breathing (SDB) includes a spectrum of respiratory pathology that can range from primary snoring to severe obstructive sleep apnea (OSA) [1]. Pediatric obstructive sleep apnea syndrome (OSAS) is a common problem that affects 1% to 5% of children and has a peak incidence between 2-8 years of age [1-3]. Consequences of untreated OSA in children can include attention deficit hyperactivity disorder (ADHD) and other behavioral manifestations, failure to thrive, disturbances in cognitive development, and increased utilization of health care services [1]. The gold standard for diagnosing OSA in children is with overnight, in-laboratory polysomongraphy (PSG) that includes direct supervision by a trained sleep technologist. Accordingly, current otolaryngology guidelines recommend PSG for children with complex medical conditions prior to surgical intervention for pediatric OSA [4].

Resources for pediatric patients is limited in the United States, Canada [5], and likely many other places of the world. Sleep centers that are adequately equipped to handle children are less common; based on information from the American Academy of Sleep Medicine (AASM; 2021 unpublished data), 34% of accredited sleep centers have capacity to perform PSGs on children less than 6 years of age and only 3% (n=80) of sleep centers report being pediatric-only. Further, the COVID-19 pandemic has caused an abrupt shift in healthcare access and delivery requiring provider flexibility and judgement for stepping outside traditional patterns of care and has led to greater discussion about use of home sleep apnea testing (HSAT) in children [6,7].

Home sleep apnea testing (HSAT) is routinely used to diagnose OSA for adults without certain co-morbid conditions [8], but HSAT is not routinely used nor recommended for children of any age or complexity because of differences in scoring criteria and concern about sufficient quality of data for interpretation [9]. There is growing evidence that caregiver-supervised HSAT may be feasible and a reasonable screening tool for use in select pediatric populations [10-15]. It has been assumed by many healthcare providers that parents would prefer HSAT over in-laboratory PSG given concerns regarding unfamiliar sleep environment, cost and time burden on family, and delay in definitive treatment. Parents, as proxy decision makers, balance multiple factors and are ultimately responsible for following through with their child's medical care. Therefore, we are obligated to step back and ask, rather than assume, whether caregivers would prefer HSAT or PSG. To our knowledge, no previous studies have looked at caregiver preference for HSAT versus attended PSG.

Methods

Retrospective chart review included pre-PSG questionnaires, post-PSG questionnaires, and chart review for children and adolescents who completed an attended PSG at Rush University Children's Hospital. Inclusion criteria were children ≥1 year and <18 years of age, those with completed questionnaires, and PSG started as a baseline study. Cases were excluded if the patient had tracheostomy and/or was scheduled for full night titration PSG. Two cohorts included a 2-year pre-pandemic period and a smaller sample of cases after the initial national COVID-19 pandemic shut-down (May through December 2020). This study was approved by the institutional review board at Rush University Medical Center.

Data collection included patient age at the time of the study, type of study (baseline versus split), indication for PSG, co-morbidities, and PSG diagnosis. The pre-PSG questionnaire included sleep characteristics of the child per their caregiver: snoring sometimes, snoring nightly, pause in breathing, gasping/choking, frequent moving, kicking, startle/jump, head banging or body rocking, sleep walking, bed wetting, nightmares, screaming while asleep, and frequency of crying overnight (converted to binary data).

The post-PSG questionnaire was provided to the caregiver in the morning after PSG completion. Data collected included yes/no response to the question, "If available and appropriate, would you prefer an at-home sleep test for your child?". No further details or explanation was provided regarding HSAT.

Initial analysis includes descriptive statistics and Chi-Square test or Mann-Whitney U test, as appropriate. Variables with p-value <0.1 were included in a multivariate logistic regression model. The parameters were then selected by performing a backward elimination procedure. The criteria for the variables to remain in the final model was the Wald test p-value <0.05.

Results

The primary cohort included pre-pandemic cases (n= 410). There was a slight predominance of male gender (58%) and non-Hispanic/Latinx ethnicity (57%). There was also slight majority of cases over 6 years of age (67%) and with private insurance (61%). Indication for PSG were primarily for SDB evaluation (87.8%), less than half for evaluation prior to surgical intervention (40%), and 23% for follow-up evaluation.

Nearly half (47.6%) of the cases were referred from a surgical specialty (otolaryngology, plastic/craniofacial, or general pediatric surgery) and 29% were referred from the child's primary care provider. Of the surgical referrals, 15% (n=29) were based on parent preference, 21% after airway surgery, 25% for symptom-exam mismatch, and 39% were medically complex patients.

The majority of caregivers indicated "no" for HSAT preference (65.4%). There was no statistically significant difference in caregiver preference based on patient gender, age (toddlers, young children, older children, versus adolescents), ethnicity, race, or insurance type. Indication for PSG and previous PSG experience was not associated with differences in caregiver preference for HSAT (Table 1).

In regard to co-morbidities, there was no significant difference in caregiver preference for patients with asthma, ADHD or attention deficit disorder, seizure disorder, neuromuscular disease, or autism (Table 2). However, these findings are limited due to the small number of cases affected with each of these disorders. No differences were found with caregiver HSAT preference and PSG results (apnea hypopnea index, average and nadir oxygen saturation, and peak carbon dioxide values).

In regard to reported nocturnal symptoms, HSAT was preferred by caregivers who reported that their child had a pause in breathing or gasping/choking events (OR 2.192, 95% CI = 1.407, 3.414; and OR 1.893, 95% CI = 1.166, 3.072 respectively) (Figure 1).

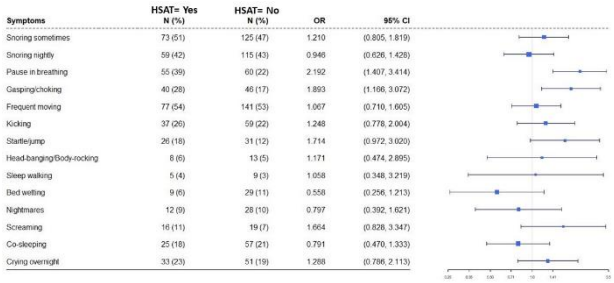

Figure 1: Caregiver HSAT preference: Percentage of cases with positive sleep-related symptoms.

A subsequent analysis based on characteristics of optimal candidates for HSAT (age >12 years, absence of medical complexity, and sleep disordered breathing as indication for PSG; n=73) found that the majority of caregivers (68%) would prefer PSG over HSAT.

Due to the possibility of changes in caregiver preferences due to the COVID-19 pandemic, a second cohort included data from post-pandemic sample (May to December 2020; n=56). There was similar response with majority of caregivers preferring PSG over HSAT (57.1% post-pandemic compared to 65.4% pre-pandemic). Analysis of the post-pandemic cohort included patient age, PSG indication, co-morbidities, and nocturnal symptoms which did not demonstrate statistical significance (data not shown). The distribution of co-morbidities was different as compared to pre-pandemic. The post-pandemic cohort had greater number of patients with seizures and no patients with neuromuscular disease or autism (Table 2). The HSAT preference was significantly higher for children with seizures (p=0.043).

With further review of caregiver response compared to state of Illinois COVID-19 cases by month, there appeared to be an inverse relationship. The only point at which HSAT preference reached >50% was in July 2020 (HSAT preference at 67%) which followed the lowest number of Illinois cases of COVID-19 in June 2020 (Figure 2).

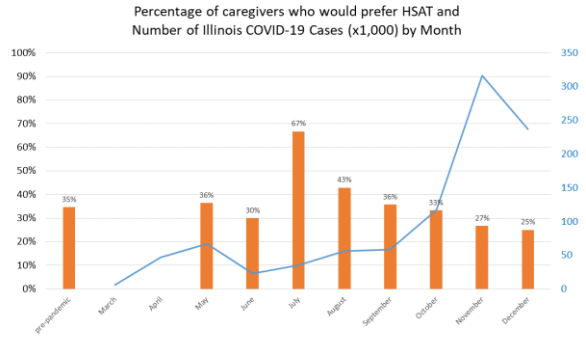

Figure 2: Post-pandemic trend of caregiver preference for home sleep apnea test (HSAT). Percentage of caregivers who report "yes" regarding preference for home sleep apnea testing (HSAT) and the numbers of Illinois COVID-19 cases (x 1,000) each month in 2020. The only time that the preference reached >50% was in July 2020 just after the lowest reported number of COVID-19 cases in June 2020.

Discussion

In the setting of limited resources for pediatric PSG and the era of COVID-19 that has facilitated a shift toward a more accessible and "remote" model of care, HSAT has emerged as an attractive alternative to PSG. Surprisingly, we found that the majority of caregivers would not choose HSAT for their child if clinically indicated and that this preference persisted in the post-pandemic cohort. These findings are in-line with current (2017) AASM recommendations [9], introduces

another barrier to wide-spread use, and emphasizes the different challenges in pediatric versus adult healthcare delivery.

The preface of the primary question about HSAT preference, "if available and appropriate," highlights the importance of caregiver judgement despite provider recommendations. In considering the existing variability with evaluation and management of pediatric SDB [16,17] and importance of caregiver perspectives, the shared decision-making model comes to the forefront for guiding care. This model actively engages caregivers in decision-making for their children, which can be a powerful tool that uses qualitative factors (family concerns and priorities) as a step toward improving satisfaction and measurable outcomes in children with SDB [18,19]. Therefore, the absence of discussion about HSAT could, in itself, be a deterrent for caregiver interest in HSAT for their child and a limitation of the study.

Our findings also demonstrate that caregivers who report that their child has a pause in breathing or gasping/choking events have greater interest in HSAT over PSG suggesting that parental concern about their child's breathing may influence urgency for completing diagnostic testing. Also, since the dependence of the quality of the at-home testing is based on caregiver attention for ensuring monitoring equipment remains in place on their child overnight, it may be that caregivers who recognize breathing changes are already more vigilant with watching their child overnight (no change in their burden of attention).

Other disadvantages for caregivers regarding use of HSAT for their child include the possibility of needing attended PSG if the data from HSAT has significant amount of artifact and the additional time and travel during business hours that would be needed to return the HSAT device (depending on the facility, this may be difficult to navigate).

For the post-pandemic cohort, the caregivers may have had a greater sense of safety with bringing their child to the medical facility for testing (again, self-selecting those who would prefer PSG over HSAT). Further, the distribution of co-morbidities varied compared to the pre-pandemic cohort reflecting that the more urgent or complex cases were scheduled for PSG. Specifically, the frequency of cases with seizure disorder were much higher and more of these caregivers' indicated preference for HSAT (33% reported "yes" for HSAT preference versus 10% who reported "no" for HSAT preference). This may reflect caregiver experience with at-home epilepsy monitoring (this data was not consistently available upon chart review).

The major limitations for our study is the absence of HSAT education and absence of follow-up questions. Since the caregivers are presented with the question about HSAT preference after the overnight PSG, this may be affected by selection bias (families who would prefer PSG are actually showing up for PSG testing) and potential misunderstanding that HSAT is as complex as the attended PSG (the caregiver may feel overwhelmed with the amount of monitoring needed). As a retrospective study, these limitations are partly inherent, and is excellent fodder for future prospective studies.

Given that the AASM does not recommend use of HSAT [9] for pediatric patients and other disadvantages for use in children noted earlier, HSAT may not become routinely used despite the abrupt leap in remote clinical care due to the pandemic. It is unclear if caregiver hesitation and other barriers would be sufficiently overcome with more information about the HSAT device and testing process or if the question was posed during clinic visit, rather than at time of PSG.

Further studies are necessary to more fully investigate caregiver preferences regarding HSAT, especially due to the potential change in burden, barriers, and judgement that influence decision-making in a post-pandemic world.

	n (%)	**HSAT = Yes n (%)**	**HSAT= No n (%)**	**p-value**
Total	**410**	**142 (35%)**	**268 (65%)**	
Patient Gender				
-Female	170 (42%)	62 (44%)	108 (40%)	0.517
-Male	240 (58%)	80 (56%)	160 (60%)	
Age				
-Toddler (1-3 years)	48 (11.7%)	18 (13%)	30 (11%)	
-Child (3-6 years)	89 (21.7%)	35 (25%)	54 (20%)	0.641
-Older Child (6-12 years)	167 (40.7%)	53 (37%)	114 (43%)	
-Adolescent (12-18 years)	106 (25.9%)	36 (25%)	70 (26%)	
Race				
-Asian	13 (3%)	4 (3%)	9 (3%)	
-Black	138 (34%)	48 (34%)	90 (34%)	0.225
-Other	163 (40%)	49 (35%)	114 (43%)	
-White	96 (23%)	41 (29%)	55 (21%)	
Ethnicity				
-Hispanic/Latino	175 (43%)	54 (38%)	121 (45%)	0.165
-Not Hispanic/Latino	235 (57%)	88 (62%)	147 (55%)	
Insurance				
-Public	250 (61%)	82 (58%)	168 (63%)	0.306
-Private	159 (39%)	60 (42%)	99 (37%)	
PSG indication: SDB				
-Yes	360 (88%)	123 (87%)	237 (88%)	0.594
-No	50 (12%)	19 (13%)	31 (12%)	
PSG indication: pre-surgical				
-Yes	166 (40%)	56 (39%)	110 (41%)	
-No	244 (60%)	86 (61%)	158 (59%)	0.752
Prior PSG				
-Yes	94 (23%)	123 (87%)	237 (88%)	0.593
-No	315 (77%)	19 (13%)	31 (12%)	
PSG indication per ENT:				
-parent preference	29 (15%)	8 (11%)	21 (17%)	
-symptom/exam mismatch	49 (25%)	17 (24%)	32 (26%)	0.6354
-medically complex	75 (39%)	28 (40%)	47 (38%)	
-after airway surgery	40 (21%)	17 (24%)	23 (19%)	

Table 1: Caregiver HSAT Preference: Patient Demographics and Indication for Polysomnography Referral.
*Significance based on p-value ≤ 0.05.
SDB: Sleep disordered breathing, ENT: Otolaryngology, PSG: Polysomngraphy

	Total N (%)	HSAT = Yes N (%)	HSAT= No N (%)	p-value
Pre-pandemic Cohort		**142 (35%)**	**268 (65%)**	
History of adenotonsillectomy	94 (23%)	38 (27%)	56 (21%)	0.179
Enlarged tonsils	167 (41%)	49 (35%)	118 (44%)	0.062
Obesity (BMI Z-score ≥ 1.645)	166 (40%)	51 (36%)	115 (43%)	0.170
Asthma	74 (18%)	23 (16%)	51 (19%)	0.478
ADHD or ADD	39 (10%)	15 (11%)	24 (9%)	0.597
Seizure	29 (7%)	11 (8%)	18 (7%)	0.685
NMD	15 (4%)	5 (4%)	10 (4%)	0.914
Autism	7 (2%)	0 (0%)	7 (3%)	0.101
Post-pandemic Cohort		**24 (43%)**	**32 (57%)**	
History of adenotonsillectomy	9 (16%)	3 (13%)	6 (19%)	0.716
Enlarged tonsils	22 (40%)	9 (38%)	12 (42%)	0.739
Asthma	12 (22%)	3 (13%)	9 (29%)	0.141
ADHD or ADD	8 (15%)	5 (21%)	3 (10%)	0.276
Seizure	11 (20%)	8 (33%)	3 (10%)	0.043
NMD	0	NA	NA	NA
Autism	0	NA	NA	NA

Table 2: Caregiver HSAT Preference: Cohort co-morbidities.
*Significance based on p-value ≤ 0.05.
ADHD: Attention Deficit Hyperactivity Disorder, ADD: Attention Deficit Disorder

Conclusion

The majority of caregivers would prefer in-laboratory attended polysomnogram (PSG) over portable at-home sleep apnea test (HSAT) for their child, even if deemed appropriate. The multiple factors influencing caregivers' thoughts regarding use of HST for their child warrant further investigation and may pose an additional barrier to widespread use.

Acknowledgements

All work completed at Rush University Children's Hospital at Rush University Medical Center in Chicago.

All authors have approved this manuscript.

No conflict of interest for any of the authors: Dr. Jeffe, Mr. Spellman, Ms. Zhang, Ms. Presta, Ms. Koliboski, Dr. LoSavio, and Dr. Patwari

This manuscript is not part of a clinical trial.

have no conflict of interest.

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Received: 28 Jan 2022; **Accepted:** 22 Feb 2022; **Published:** 25 Feb 2022

Citation: Jeffe J, Spellman A, Zhang Y, Presta N, Koliboski C, et al. Home Sleep Apnea Testing in Pediatric Patients: Parent Preferences. *Trends Otorhinolaryngol Head Neck Surg.* 2022; 2: 108.