Professional Behavior: A National Survey

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OMS Residents' Obstructive Sleep Apnea-related Education, Knowledge, and Professional Behavior: A National Survey

Abstract

Objectives: Oral and maxillofacial surgeons (OMS) treat adult and pediatric patients with obstructive sleep apnea (OSA). Objective 1 assessed sleep apnea related education, knowledge, and professional behavior of OMS residents in the United States. Objective 2 was to compare the responses of junior vs. senior residents and residents in single vs. dual degree programs.

Methods: OMS residents in the United States received a recruitment email with a link to an anonymous online survey; 81 residents responded. The survey included 20 questions to assess respondents' OSA-related education, knowledge, attitudes, and professional behavior.

Results: Respondents generally agreed that they had received OSA-related didactic-based education (5-point scale with "5" = agree strongly: Mean=3.62) and clinical training (Mean = 3.75). Clinical and classroom educational gaps are identified in relation to treatment with oral appliances and hypoglossal nerve stimulation. The residents scored on average 10.38 out of 18 (58%) possible points for the knowledge questions. Findings about pediatric OSA suggest that only 43.8% of residents understand diagnostic criteria for pediatric OSA, with only 26.6% screening pediatric patients for OSA. A case analysis shows that only 1.5% of residents correctly identified an AHI of 17 as moderate sleep apnea.

Conclusion(s): This survey found knowledge gaps in several areas that can be improved upon. It identifies deficiency in objective knowledge about OSA amongst OMS residents and a specific lack of clinical training and confidence with hypoglossal nerve stimulation and management of pediatric patients with OSA. Junior and senior residents and single and dual degree residents showed no statistically significant differences in any

category except senior residents in regard to surgical management of OSA, particularly with maxillomandibular advancement.

Key Words:

Education, Professional

Professional Behavior

Professional Attitudes

Sleep apnea, Obstructive

Surgery, Oral

Residency, Dental

OMFS residents

INTRODUCTION

Obstructive sleep apnea (OSA) is a chronic medical condition characterized by repeated episodes of complete or partial upper airway obstruction that can be associated with oxygen desaturations, cortical arousals, daytime sleepiness and cardiometabolic disease. OSA remains undiagnosed in 80-90% of cases[1-4] with a prevalence of 9-38% in the adult population.[5-7] This multifactorial condition is associated with several hereditary, physiological and anatomic risk factors.[8-14] OSA is associated with cardiovascular morbidity, increased inflammatory burden and increased incidence of motor vehicle accidents.[8,10,15,16] Positive airway pressure (PAP) is considered the gold-standard treatment for obstructive sleep apnea in adults, with other non-surgical and surgical options available for appropriately selected individuals.[2,4,17] Excellent information about risk factors for, and diagnosis and treatment of OSA is widely available.[18-21]

As the prevalence of OSA increases, adequately training future clinicians in OSA diagnosis and treatment can result in a significant decrease in medical and societal costs and

an improvement in patients' quality of life.[1-2] In addition to diagnosis with polysomnography or a home sleep apnea test, screening for symptoms of OSA is essential. For example, screening patients for OSA prior to ambulatory anesthesia can minimize perioperative and postoperative complications.[22] Singh et al. found that 58% of surgeons failed to identify symptomatic OSA patients pre-operatively when pre-operative polysomnograms (PSG) were collected, and clinicians were blinded to the PSG results.[23] Several programmatic factors may yield heterogeneity in the extent of OSA-related surgical training and education that exists in OMS residency programs. Based on current accreditation standards set by the Commission on Dental Accreditation (CODA) for OMS, specific procedures for OSA are within the realm of orthognathic surgery, but no specific requirements exist to demonstrate competency in specifically managing patients with OSA.[24]

Studies about OSA-related education and knowledge suggested that inadequate time was dedicated to teaching about sleep disorders in medicine and dentistry.[25-29] Education about sleep disorders in U.S. dental schools was limited to didactic-based teaching and only engaged students at an introductory level.[30] Being part of a dental surgical subspecialty, OMS should be educated about a variety of procedures and treatments. Having education about oral appliances, hypoglossal nerve stimulation or adenotonsillectomy would allow clinicians to weigh the pros and cons of different treatment modalities and refer to the appropriate provider for treatment that they do not perform. Moreover, if surgical interventions are indicated, OMS providers should be familiar with the different types of surgical procedures available.[31] OSA may result from upper airway collapsibility at multiple levels. However, data from otolaryngology residency programs showed a predominance of oropharyngeal procedures were being taught and performed.[32] The lack of hypopharyngeal procedures may lead to inadequate OSA treatment. Surgical interventions for OSA should be performed by

experienced surgeons who also understand the indications for and limitations of upper airway surgery.[33] It should be considered that the number and type of surgical procedures performed during residency, including nonsurgical modalities, is likely to shape the graduates' professional behavior after graduation.

Based on these considerations, the first objective was to assess the sleep apnea related education, knowledge, and professional behavior of OMS residents in the United States (U.S.). The second objective was to compare the differences between the responses of junior vs. senior residents and of residents in single vs. dual degree programs.

METHODS

This research was determined to be exempt from Institutional Review Board (IRB) oversight by the Health Sciences and Behavioral Sciences IRB at the University of Michigan on October 19, 2019 (HUM #00170454). The design was a cross-sectional survey design with group comparisons.

Respondents: An a priori power analysis with the program package G*Power 3.1.2 (http://www.psycho.uni-duesseldorf.de/abteilungen/aap/ gpower3) was conducted to determine the sample size needed to have the power to test hypotheses about relationships between the constructs of interest. It was assumed that alpha = 0.05, power = 0.80, medium effect size of |rho| = 0.30, when using one-sided tests to test for the significance of correlations. The results showed that 62 respondents were required to have the power to test for the significance of such correlations.

At total of 81 residents responded to this survey. Two surveys were excluded from data analysis because they lacked responsiveness to the majority of the questionnaire. For the 2020-2021 residency year, 1207 OMS residents attended residency programs (personal communication from AAMOS administrative office). However, a response rate cannot be

determined because it is unknown how many program directors and American Association of Craniomaxillofacial Surgery (AACMFS) members forwarded the recruitment email for this survey to their residents.

Procedure: During the year 2020, 99 OMS program directors and 215 members of the AACMFS received an email that informed them about the purpose of this project and asked them to forward an attached recruitment email to their residents. The program directors were identified through the American Association of Oral and Maxillofacial Surgeons (AAOMS) webpage, which included program directors of all CODA-accredited OMS residency programs at the time of inception of this study. The program directors received one follow-up reminder email.

Materials: The email sent to the OMS program directors explained the purpose of the study and asked them to forward an attached recruitment email to their residents. The residents were also informed of the purpose of the study and were asked to respond to an anonymous Qualtrics survey that they could access with a web-link provided in the email. One follow-up email to the program directors and the members of the AACMFS explained that more responses were needed. It asked them to forward an attached recruitment email to their residents.

A pilot study was conducted with a first draft of the survey. A recruitment email was sent to 18 OMS residents at the University of Michigan. It informed them about the purpose of the research and asked them to provide pilot feedback about the survey. Five residents returned the survey with feedback. The responses showed that the average time of completion was acceptable (6 minutes and 33 seconds). In addition, the feedback was used to make minor revisions and to finalize the survey.

The final survey was developed by the research team. It consisted of five sets of questions. Part 1 evaluated the OSA-related classroom-based and clinical education provided in the residency program. Part 2 consisted of nine knowledge-related closed-ended questions. Six questions were adapted from the Obstructive Sleep Apnea Knowledge and Attitude (OSAKA) questionnaire[34], one question from the Assessment of Sleep Knowledge in Medical Education (ASKME) questionnaire[35], and two new questions were added. Both the OSAKA[34] questionnaire and the ASKME[35] questionnaire are well validated, reliable instruments that have been widely used. In addition to the co-authors on this study who are faculty (1 OMS, 1 ENT and 1 sleep medicine faculty member) involved in teaching and treating OSA, the pilot feedback from the five residents was used to assure the face validity of these two newly developed knowledge questions. One open-ended question asked the respondents how they managed a patient with OSA. Part 3 focused on assessing OSA-related attitudes and assessed the likelihood and confidence of residents in performing surgical treatment for their patients after completing their residency training. Additional questions asked how they would screen adult and pediatric patients for OSA. The screening method alternatives provided included STOP-Bang[36], Epworth Sleepiness Scale for Children and Adolescents (ESS-CHAD),[37] Pediatric Sleep Questionnaire (PSQ)[38], Pittsburgh Sleep Quality Index (PSQI)[39], and some additional questions. Part 4 assessed the residents' professional behavior. Specifically, the questions asked about how many maxillomandibular advancements, genioglossus advancements, hyoid suspensions and palatal or pharyngeal surgeries they had performed. The inclusion of surgical procedures in this manner encompasses the multilevel involvement of OSA.

Part 5 inquired about their educational background such as whether they were in a single or dual degree program, and in which post-graduate year (PGY) of training they were.

Junior residents in single degree programs were considered PGY1/2, while in dual degree programs junior residents were considered as trainees in PGY 1/2/3. Senior residents were in PGY 3/4 for single degree programs and in PGY 4/5/6 for dual degree programs.

Statistical analysis: Data were downloaded from the Qualtrics web site as an SPSS (Version 26) data file. Descriptive statistics such as means and standard deviations were computed to provide an overview of the results. The first set of indices were based on factor analyses (Extraction Method: Principal Component Analysis. Rotation Method: Varimax with Kaiser Normalization) of subsets of Likert-type items. Cronbach alpha inter-item consistency coefficients were computed for the items loading on a given factor with factor loadings >0.40 to determine if there was sufficient inter-item consistency to justify creating indices. Based on the recommendations of DeVellis,[40] Cronbach alphas between 0.7 and 0.8 were considered "acceptable", alphas between 0.8 and 0.9 as "good" and alphas over 0.9 as "excellent". If the Cronbach alphas were >0.70, indices were computed by averaging the responses to the items loading on a given factor. The knowledge index was computed as a sum score of correct response to the knowledge-based questions. Inferential statistics such as independent sample t-tests were used to compare the mean responses of residents in single vs. dual degree programs and of junior vs. senior residents. In addition, inferential statistics were used to test for the significance of correlations. A value of $p<0.05$ was accepted as significant.

RESULTS

Eighty-one responses were received from OMS residents in the United States and seventy-nine responses were analyzed due to the high percentage of missing responses in two surveys. Table 1 shows that 33 respondents attended a single degree program and 46 a dual

degree program. It also provides information about the distribution of the respondents to the different postgraduate years.

Education: The first objective was to assess residents' classroom-based and clinical education pertaining to OSA. In terms of classroom-based education, most respondents agreed/strongly agreed that they had received classroom-based education about the diagnosis (70.1%) and treatment (74.7%) of OSA, about the non-surgical management of OSA (65%), continuous positive airway pressure [CPAP] (67.6%), and surgical management of OSA (76.3%). Fewer respondents agreed /strongly agreed about receiving classroom-based education on oral appliance therapy for OSA (43.8%) and hypoglossal nerve stimulation (56.3%) (see Table 1).

When asked about clinical training concerning the diagnosis, treatment and surgical management of OSA, about two-thirds of the residents agreed/strongly agreed that they had received clinical training related to diagnosis (64.6%), treatment options (65%) and surgical management of OSA (74.3%). However, when asked if they had received clinical training about hypoglossal nerve stimulation as an option for management of OSA, only 23% agreed/strongly agreed that they had received such clinical training (see Table 1).

Knowledge/Attitudes: The second objective was to assess OMS trainees' knowledge and attitudes about OSA and their practice intentions after completing their residency program. Concerning assessing OSA-related knowledge, questions concerning objective knowledge as well as self-perceived subjective knowledge and future behavioral intentions were included in this study (see Table 2).

Nine questions assessed the residents' objective knowledge. These questions were formulated as statements and the respondents indicated how much they disagreed/agreed with each statement. For correct statements, a response of "agree" received one knowledge point

and a response of "strongly agree" received two knowledge points. For an incorrect statement, a response of "disagree" received one point and a response of "disagree strongly" received two knowledge points. The sum of the knowledge points could therefore range from 0 to 18. Overall, more than 90% of the respondents received one or two knowledge points for four objective knowledge statements. Between 70 and 89% received one or two knowledge points for each of three questions, and only slightly more than 50% received any knowledge points for two questions. Overall, the average sum of points for these objective knowledge responses was only 10.38, with a range from 0 to 18 points.

Concerning the subjective self-reported knowledge, Table 2 shows that the majority of respondents (79.9%) agreed/strongly agreed that they understood the diagnostic criteria for OSA in adults. However, only 43.8% of respondents agreed/strongly agreed that they understood the diagnostic criteria for pediatric OSA. In addition, while over half agreed that they were comfortable providing surgical treatment for OSA in adults (53.8%), a lower percentage of respondents (35%) agreed/strongly agreed that they were comfortable providing surgical treatment for OSA in the pediatric population (see Table 2).

When asked how likely they were to provide surgical treatment for OSA in adults and in children after completion of residency training, 75% agreed/strongly agreed that they were likely to provide surgical treatment for adults, while only 35% agreed/strongly agreed that they were likely to do so in children. Most of the respondents (67.5%) agreed/strongly agreed that they would feel confident performing surgical procedures for OSA after training, and 82.6% agreed/strongly agreed that they would feel confident performing maxillomandibular advancement (MMA) (see Table 2).

Group differences in education and knowledge: In addition to analyzing the education and knowledge related responses for all residents, it is also of interest to consider if

the responses of junior vs. senior residents and residents in dual vs. single degree programs differ. Table 3 shows that there were no differences in the average responses related to classroom-based education as a function of time in program or type of program. However, there is one difference in the average responses of junior vs. senior residents in response to the statement if they received clinical training related to the surgical management of OSA. Senior residents agreed more strongly that they had received clinical training about the surgical management of OSA (4.13 vs. 3.62, p= 0.034) than junior residents. In addition, the senior residents agreed more strongly with the statement "I am comfortable providing surgical treatment for OSA in adults" than the junior residents (3.76 vs. 3.02; p=0.006). No significant differences were found between single vs. dual degree programs for classroom or clinical education related responses (see Table 3). No significant differences existed between junior and senior residents' responses concerning their behavioral intentions of how likely they were to provide surgical treatments and how confident they felt after completing their residency program (see Table 3). The data also showed that there were no differences in junior vs. senior residents and in single vs. dual residents' responses concerning their knowledge.

Professional behavior: Table 4 provides an overview of the responses concerning OSA-related professional behavior, specifically when screening, diagnosing, and treating patients with OSA. Regarding patient screening, 73.4% agreed that they screened for OSA in adult patients, while only 26.6% agreed that they screened for OSA in pediatric patients. The most commonly used screening modality was the STOP-Bang questionnaire[36] (59.3%). This survey consists of four questions concerning **s**noring, **t**iredness, **o**bserved apneas and high blood **p**ressure. In addition, it has four questions about demographic information, namely body mass index (**B**MI), **a**ge, **n**eck circumference and **g**ender. This scale has a moderate

sensitivity and high negative predictive value to detect moderate and severe OSA.[36] Fewer respondents selected other screening scales such as the Epworth Sleepiness Scale[37] (40.7%) or informal questions during a patient interview (34.6%). Nearly all residents (96.2%) reported never having performed hyoid suspension surgeries or palatal or pharyngeal surgeries (87.3%). About two thirds (67.1%) had never performed genioglossus advancement surgery and nearly half (46.8%) had never performed maxillomandibular advancement (MMA).

While 85.3% of senior residents versus 64.4% of junior residents screened adult patients for obstructive sleep apnea ($p = 0.033$), no other responses of senior vs. junior residents differed significantly. In addition, significantly more junior residents had never performed MMA than senior residents (67.2% vs. 18.2%; $p<0.001$). No other differences between these two groups and between residents in single vs. dual degree programs were significant (see Table 4).

In addition to the closed-ended questions, one open-ended question provided the respondents with a case description and asked them to provide their assessment of the severity of OSA and their first step in treating this patient (see Table 5). The case description was about an adult patient with moderate OSA, who presented with an apnea-hypopnea index (AHI) of 17 events per hour. The correct response concerning the severity of the OSA would have been moderate. However, Table 5 shows that the vast majority incorrectly diagnosed it as moderate to severe (77%) or severe (14.8%). In response to the question about their first step in managing this patient, a lack of information provided does not allow a definitive correct answer. Instead, it is informative to realize that the answers ranged widely from diagnostic to lifestyle modifications and included medical, dental, and surgical treatments. For example, only 24.4% mentioned diagnostic steps such as determining the level of

obstruction or using fiberoptic pharyngoscopy and 7.3% would refer for polysomnography. Concerning treatment, 23.1% would recommend lifestyle modifications and 32.9% would recommend medical treatment such as CPAP, reassessment/assessing surgical appropriateness. Only 13.4% recommend dental treatment like an oral appliance. Finally, only 3.7% would recommend surgery treatment with responses consisting of adenotonsillectomy, removal of local obstruction and multilevel surgery.

Pearson correlation coefficients were computed to assess relationships between postgraduate years, OSA-related education, knowledge and professional behavior (see Table 6). The year in the program was only correlated with the frequency of maxillomandibular advancement surgery ($r = 0.39$; $p<0.001$) and genioglossus advancement surgery ($r = 0.28$; $p<0.05$). However, independent of program year, classroom-based and clinical education correlated significantly with objective and with self-reported subjective knowledge as well as with the residents' professional behavioral intentions after their graduation. Only the clinical education and the self-reported knowledge and behavioral intentions correlated with the screening sum score.

DISCUSSION

Several studies have evaluated OSA-related education, knowledge, attitudes, and professional behavior in other health care fields.[25-28] This study is the first research exploring the quantity and quality of OSA related training for residents in oral and maxillofacial surgery graduate programs. It analyzed the education, knowledge, and professional behavior of OMS residents concerning obstructive sleep apnea diagnosis and management in adult and pediatric patients.

Concerning OSA-related classroom education, it was expected that the likelihood of having received this education would increase over the course of the residency education. However, the year in the program did not correlate with the extent of classroom based and clinical education. This raises the question whether all residents will be competent at the time of their graduation from their programs to provide optimal diagnoses, treatment and surgical management of adult and pediatric patients with OSA.

Specifically, interesting is the fact that less than half of the residents had been educated about oral appliance therapy for OSA.[42-45] This relative lack of education about oral appliances and the lack of clinical education about hypoglossal nerve stimulation[46] are concerning. While oral and maxillofacial surgeons may not be involved directly in prescribing these therapies, having knowledge seems to be important to avoid over-diagnosing patients with surgery or underdiagnosing them when surgical management is necessary. It also raises the question whether OMS residency programs focus their attention primarily on training their residents to perform surgery in connection with OSA.

Results from research with dental and dental hygiene students also showed limited and mostly classroom-based education about sleep disorders[26-27] and a potential lack of knowledge among dental school graduates concerning the use of oral appliances for patients with OSA. This situation is unfortunate because oral appliance therapy (OAT) has been used alone or in combination with other measures to improve AHI, oxygen saturation, sleep architecture and reduce blood pressure. Research showed that the effectiveness of OAT was comparable to CPAP. It also showed that the use of OAT resulted in a subjective improvement in STOP-Bang scores.[42- 45]

Concerning the benefits of hypoglossal nerve stimulation, outcome data showed the effectiveness of this approach. A 68% reduction in AHI was found within 12 months of

implantation.[46] Utilization of a hypoglossal nerve stimulator (HNS) appears to represent an alternative treatment to MMA surgery for patients with severe OSA and should thus be included when providing patients with treatment options. Furthermore, combined treatment with hypoglossal nerve stimulation and oral appliance has shown nearly 96% reduction in AHI for patients with severe OSA.[47] These results indicate the importance of educating OMS residents about treatment modalities other than MMA surgery.

A second finding that needs attention is related to the suboptimal objective knowledge of these residents. For example, only slightly over 50% deemed a postsurgical PSG necessary. However, when surgery is chosen as a treatment modality, the American Academy of Sleep Medicine provided a clinical guidance statement that a post-operative PSG must be done to evaluate patients and follow them longitudinally.[48] Despite a high surgical success rate with MMA surgery, persistent OSA requiring treatment is common. For instance, in a large meta-analysis pooling 45 studies on MMA surgery for OSA, 455 patients with AHI data were found to have an overall surgical cure rate of 38.5%.[49] Subjects with a baseline AHI of < 30/hour, and 30 to < 60/hour, had a surgical cure rate of 55.7% and 45.8%, respectively. Moreover, subjects with higher pre-operative AHI also had the lowest likelihood of achieving a surgical cure. A recent prospective multicenter study confirmed these findings, noting a success rate of 74.1% (AHI<15/hour), with a surgical cure rate of 55.6%.[50] Despite this, for management of moderate to severe OSA (AHI > 15), maxillomandibular advancement (MMA) is more efficacious than uvulopalatopharyngoplasty (UPPP).[51] All this to say, a post-operative polysomnogram is a necessity to assess outcomes considering the variability in patient responsiveness to surgery and variability in utilization of treatment modalities and future OMS need to know that.

A third consideration raised by these findings is related to the respondents' knowledge and professional behavior related to diagnosing and treating OSA in pediatric patients. The prevalence of OSA in children is only between 1 to 10%.[52] However, research showed that the incidence of pediatric OSA is associated with a variety of physical and developmental sequelae.[48-49] Comprehensive training is therefore needed.

On the positive side of findings, it is noteworthy that single and dual training programs did not differ in the OSA-related education. One possible explanation of the finding that the length of being in a program did not correlate with the residents' objective knowledge and most training experiences could be that much of the learning in residency is independent. The fact that residents in the dual degree programs spend time in medical education and thus might be exposed to more information about OSA did not result in any differences between the residents in these two types of programs.

This study has several limitations. First, while the number of respondents was greater than the number required based on the a priori power analysis, we would have had more power to test differences between subgroups if we had more respondents. Second, the fact that we did not directly recruit respondents but instead asked program directors and experts to forward recruitment emails might also have limited the sample size. In addition, it prevented to determine an exact response rate. However, this problem is similar to the challenges encountered in other survey studies of this nature.[54-55] Third, this survey did not ask about the location of the residency program. It would have been interesting to explore regional differences. Fourth, no questions were asked about objective educational information such as how many hours of classroom-based training in which year of the program were provided. Future research might consider including such questions and also questions about the exact clinical experiences of the residents. Future research should also explore in a survey of OMS

faculty members which surgical approaches they include in their educational efforts. Fifth, additional questions concerning education through independent reading or attending additional continuing education programs about OSA would also have been informative. Finally, the COVID-19 pandemic might also have affected the response rate as well as the type of education provided in hybrid settings and with asynchronous lectures.

CONCLUSIONS

Based on the findings of this study, it can be concluded that the majority of OMS residents received classroom-based education in diagnosis, treatment and surgical and non-surgical management of OSA. However, less than half received education about oral appliance therapy for OSA. The majority received clinical training about the diagnosis, treatment, and surgical management of OSA, with limited clinical training about hypoglossal nerve stimulation as an option for managing OSA. Objective OSA-related knowledge as well as self-reported subjective knowledge are not optimal and do not improve over the course of the education.

Professional behavior related questions show that only 3 of 4 residents screen their adult patients and only one in four screen their pediatric patients. Overall, the screening modalities range widely. MMA surgery is the most widely taught of all OSA-related surgeries. The finding that only one resident was able to assess the severity of OSA when provided with an Apnea-Hypopnea index is concerning.

Comparisons between junior and senior residents and residents in single vs. dual programs showed no consistent differences.

Program directors should consider including a multi-disciplinary approach to OSA education. Moreover, defining specific adult and pediatric OSA-related training requirements through CODA may generate boarder adoption of these educational goals.

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Table 1: Percentages of students in a single vs. a dual degree program by Post-graduate year and Percentages and average responses related to education about OSA

OMFS training is	**Post-graduate year (PGY)**					
	PGY-1 N = 23	**PGY-2 N = 15**	**PGY-3 N = 16**	**PGY-4 N = 16**	**PGY-5 N = 4**	**PGY-6 N = 6**
- a single degree program (N = 33)	33.3%	9.1%	24.2%	30.3%	3.0%	0.0%
- a dual degree program (N = 46)	26.1%	23.9%	17.4%	13.0%	6.5%	13.0%
- both programs (N = 79)	29.1%	17.7%	20.3%	20.3%	5.1%	7.6%
In my residency program, I received CLASSROOM-BASED EDUCATION about	**1[1]**	**2**	**3**	**4**	**5**	**Mean SD**
- the diagnosis of OSA.	5.0%	16.3%	8.8%	33.8%	36.3%	3.80 (1.237)
- the treatment of OSA.	3.8%	16.5%	5.1%	34.2%	40.5%	3.91 (1.211)

- the nonsurgical management of OSA.	6.3%	18.8%	10%	32.5%	32.5%	3.66 (1.282)
- continuous positive airway pressure [CPAP].	6.3%	18.8%	7.5%	41.3%	26.3%	3.63 (1.236)
- hypoglossal nerve stimulation as an option for management of OSA.	6.3%	28.7%	8.8%	35.0%	21.3%	3.36 (1.275)
- oral appliance therapy for OSA.	15.0%	33.8%	7.5%	27.5%	16.3%	2.96 (1.373)
- the surgical management of OSA.	2.5%	15.0%	6.3%	35.0%	41.3%	3.98 (1.147)
OSA-related classroom-based education index (alpha = 0.948)	***Mean = 3.62***		***SD = 1.098***		***Range:1 - 5***	
In my residency program, I received CLINICAL TRAINING about	**1[1]**	**2**	**3**	**4**	**5**	**Mean SD**
- the diagnosis of OSA.	1.3%	16.5%	17.7%	40.5%	24.1%	3.70 (1.054)
- the treatment options for OSA.	3.8%	17.5%	13.8%	40.0%	25.0%	3.65 (1.148)
- the surgical management of OSA.	2.7%	12.2%	10.8%	47.3%	27.0%	3.84 (1.047)
OSA-related clinical education index (alpha = 0.935)	***Mean = 3.75***		***SD = 1.002***		***Range: 1.33 to 5***	
Single item: I received CLINICAL TRAINING about	**1[1]**	**2**	**3**	**4**	**5**	**Mean SD**
- hypoglossal nerve stimulation as an option for management of OSA	20.3%	43.2%	16.2%	17.6%	2.7%	2.39 (1.083)

Legend:

1 Answers range from 1 = “disagree strongly”, 2 = “disagree”, 3 = “neither disagree nor agree”, 4 = “agree” to 5 = “strongly agree”.

Table 2: Percentages and average objective knowledge-related responses, self-reported knowledge and behavioral intentions

Objective knowledge-related statements	**1[1]**	**2**	**3**	**4**	**5**	**Mean SD**
Untreated OSA is associated with hypertension and cardiac arrhythmias. **(true)** – OSAKA[3]	0%	1.3%	1.3%	**42.5%**	**55.0%**	4.51 (0.595)
The gold standard for diagnosing OSA is an overnight-attended polysomnogram. **(true) -** OSAKA	0%	0%	2.5%	**42.5%**	**55.0%**	4.53 (0.551)
The loss of upper airway muscle tone during the sleep cycle contributes to the pathogenesis of OSA. **(true)** – OSAKA	0%	1.3%	3.8%	**65.0%**	**30.0%**	4.24 (0.579)
Large tonsils and adenoids are the most common cause for OSA in adults. **(false)** – adapted from OSAKA	**22.5%**	**52.5%**	7.5%	12.5%	5.0%	2.25 (1.097)
The first line therapy for severe OSA in adults is uvulopalato-pharyngoplasty. **(false)** - OSAKA	**31.3%**	**42.5%**	16.3%	10.0%	0%	2.05 (0.940)
In men, a collar size greater than 17 inches is associated with OSA. **(true)** – OSAKA	0%	1.3%	12.5%	**55.0%**	**31.3%**	4.16 (0.683)
Menopausal woman are at higher risk for developing obstructive sleep apnea compared to premenopausal women. **(true**)-ASKME[4]	0%	5.0%	37.5%	**43.8%**	**13.8%**	3.66 (0.779)
Oral and maxillofacial surgeons should be involved in the care of patients with obstructive sleep apnea. **(true)**	0%	2.5%	3.8%	**38.8%**	**55.0%**	4.46 (0.693)

A post-operative overnight attended polysomnogram is not necessary following surgical treatment of OSA. **(false)**	**15.0%**	**37.5%**	30.0%	17.5%	0%	2.50 (0.955)
Sum of knowledge scores[2]	***Mean = 10.38***		***SD = 3.577***		***Range: 0 to 18***	
OSA related self-reported knowledge and skills	**1[1]**	**2**	**3**	**4**	**5**	**Mean SD**
- I understand the diagnostic criteria for OSA in adults.	3.8%	11.3%	5.0%	51.2%	28.7%	3.90 (1.063)
- I understand the diagnostic criteria for OSA in children.	7.5%	31.3%	17.5%	32.5%	11.3%	3.84 (1.182)
- I understand non-surgical treatments of OSA.	3.8%	8.8%	17.5%	47.5%	22.5%	3.90 (1.022)
- I am comfortable providing surgical treatment for OSA in adults.	7.5%	23.8%	15.0%	33.8%	20.0%	1.254)
- I am comfortable providing surgical treatment for OSA in children.	12.5%	42.5%	10.0%	27.5%	7.5%	3.35 (1.207)
OSA-related subjective knowledge Index (alpha = 0.869)	***Mean = 3.37***		***SD = 0.931***		***Range: 1 to 5***	
Behavioral intentions: After completion of my residency training:	**1[1]**	**2**	**3**	**4**	**5**	**Mean SD**
- I am likely to provide surgical treatment for OSA in adults.	1.3%	13.8%	10.0%	50.0%	25.0%	3.84 (0.999)
- I am likely to provide surgical treatment for OSA in children.	8.8%	32.5%	23.8%	25.0%	10.0%	2.95 (1.157)
- I will feel confident performing a surgical procedure for OSA.	6.3%	12.5%	13.8%	42.5%	25.0%	3.68 (1.167)

- I will feel confident performing maxillomandibular advancement surgery for treatment of OSA.	2.5%	7.5%	7.5%	41.3%	41.3%	4.11 (1.006)
OSA-related surgical considerations after completion Index (alpha = 0.785)	***Mean = 3.64***		***SD = 0.846***		***Range: 1.75 to 5***	

Legend:

1 Answers range from 1 = "disagree strongly", 2 = "disagree", 3 = "neither disagree nor agree", 4 = "agree" to 5 = "strongly agree".

2 The "Sum of knowledge scores" was computed by adding the knowledge scores received for all items.

3 These items were adapted from the OSAKA Scale (Schotland HM, Jeffe DB. Development of the obstructive sleep apnea knowledge and attitudes (OSAKA) questionnaire. *Sleep Med*. 2003;4(5):443-450).

4 These items were adapted from the ASKME Scale (Zozula R, Bodow M, Yatcilla D, Cody R, Rosen RC: Development of a Brief, Self-Administered Instrument for Assessing Sleep Knowledge in Medical Education: "The ASKME Survey. *Sleep*. 2001;24(2):227-233).

Table 3: Comparison of average educational experiences and knowledge of junior vs. senior and of dual vs. single degree students

Educational experiences	**Students**		**Programs**	
CLASSROOM BASED EDUCATION	**Junior**	**Senior**	**Single**	**Dual**
- the diagnosis of OSA.	3.58[3]	4.09	3.82	3.78
- the treatment of OSA.	3.78	4.09	3.88	3.93
- the nonsurgical management of OSA.	3.51	3.85	3.76	3.58
- continuous positive airway pressure [CPAP].	3.62	3.62	3.52	3.69
- hypoglossal nerve stimulation as an option for management of OSA.	3.29	3.44	3.48	3.24
- oral appliance therapy for OSA.	2.84	3.09	2.91	2.96
- the surgical management of OSA.	3.84	4.15	4.00	3.98
CLINICAL EDUCATION				

- the diagnosis of OSA.	3.66	3.74	3.64	3.73
- the treatment options for OSA.	3.58	3.74	3.70	3.60
- the surgical management of OSA.	**3.62**	**4.13***	3.91	3.77
- hypoglossal nerve stimulation as an option for management of OSA	2.55	2.13	2.39	2.31
Objective knowledge-related statements	**Junior**	**Senior**	**Single**	**Dual**
Untreated OSA is associated with hypertension and cardiac arrhythmias.[1] **(true)**	1.56[3]	1.50	1.30	1.71
The gold standard for diagnosing OSA is an overnight-attended polysomnogram.[1] **(true)**	1.53	1.53	1.39	1.64
The loss of upper airway muscle tone during the sleep cycle contributes to the pathogenesis of OSA.[1] **(true)**	1.27	1.24	1.12	1.36
Large tonsils and adenoids are the most common cause for OSA in adults.[1] **(false)**	1.04	0.91	0.85	1.11
The first line therapy for severe OSA in adults is uvulopalato-pharyngoplasty.[1] **(false)**	1.09	1.03	0.97	1.16
In men, a collar size greater than 17 inches is associated with OSA.[1] **(true)**	1.16	1.21	1.00	1.31
Menopausal woman are at higher risk for developing obstructive sleep apnea compared to premenopausal women.[2] **(true)**	0.78	0.62	0.67	0.73
Oral and maxillofacial surgeons should be involved in the care of patients with obstructive sleep apnea. **(true)**	1.47	1.50	1.33	1.60
A post-operative overnight attended polysomnogram is not necessary following surgical treatment of OSA. **(false)**	0.69	0.68	0.55	0.80
Sum of knowledge scores[4]	***10.58***	***10.21***	***9.18***	***11.42***

Table 3 continued:

OSA related self-reported knowledge and skills	**Junior**	**Senior**	**Single**	**Dual**
- I understand the diagnostic criteria for OSA in adults.	3.84	3.97	4.06	3.76
- I understand the diagnostic criteria for OSA in children.	2.93	3.26	3.21	3.00
- I understand non-surgical treatments of OSA.	3.64	3.91	3.88	3.67
- I am comfortable providing surgical treatment for OSA in adults.	**3.02**	**3.76****	3.55	3.18
- I am comfortable providing surgical treatment for OSA in children.	2.73	2.74	2.61	2.80
OSA-related subjective knowledge Index (alpha = 0.869)	***3.24 1.017***	***3.53 0.795***	***3.46 0.729***	***3.2800 1.069***
Behavioral intentions: After completion of my residency training:	**Junior**	**Senior**	**Single**	**Dual**
- I am likely to provide surgical treatment for OSA in adults.	3.93	3.71	3.79	3.87
- I am likely to provide surgical treatment for OSA in children.	3.29	2.47	2.70	3.09
- I will feel confident performing a surgical procedure for OSA.	3.73	3.59	3.76	3.60
- I will feel confident performing maxillomandibular advancement surgery for treatment of OSA.	3.98	4.29	4.27	4.04
OSA-related surgical considerations after completion Index (alpha = 0.785)	***3.73 0.900***	***3.51 0.776***	***3.63 0.818***	***3.65 0.893***

Legend:

1 These items were adapted from the OSAKA Scale (Schotland HM, Jeffe DB. Development of the obstructive sleep apnea knowledge and attitudes (OSAKA) questionnaire. Sleep Med. 2003;4(5):443-450).

2 These items were adapted from the ASKME Scale (Zozula R, Bodow M, Yatcilla D, Cody R, Rosen RC: Development of a Brief, Self-Administered Instrument for Assessing Sleep Knowledge in Medical Education: "The ASKME Survey. Sleep. 2001;24(2):227-233).

3 One knowledge point was assigned to a response of "agree" to a "true" statement and a response of disagree to a "false" statement. Two knowledge points were given for a response of "strongly agree" to a "true" statement and a response of "strongly disagree" to a "false" statement.

4 The "Sum of knowledge scores" was computed by adding the knowledge scores received for all items.

Table 4: Respondents' professional behavior related to diagnosing and treating patients with OSA overall and by type of student and type of program

Screening questions	**All respondents**		**Students**		**Programs**	
	Yes	**No**	**Junior % Yes**	**Senior % Yes**	**Single % Yes**	**Dual % Yes**
Do you screen for OSA in your adult patients?	73.4%	26.6%	**64.4%**	**85.3%***	78.8%	68.9%
Do you screen for OSA in your pediatric patients?	26.6%	73.4%	26.7%	26.5%	30.3%	24.4%
Which of the following to you use for screening?	**Yes**	**No**	**Junior % Yes**	**Senior % Yes**	**Single % Yes**	**Dual % Yes**
Epworth Sleeping Scale for Children and Adolescents	40.7%	59.3%	35.6%	50.0%	42.4%	42.2%
Pediatric Sleep Questionnaire (PSQ)	6.2%	93.8%	4.4%	8.8%	6.1%	6.7%
STOP-Bang Questionnaire	59.3	40.7%	57.8%	64.7%	69.7%	55.6%
Pittsburgh sleep quality index	7.4%	92.6%	6.7%	8.8%	9.1%	6.7%

Informal questions during patient interview	34.6%	65.4%	33.3%	38.2%	36.4%	33.3%
Other: 2 x CBCT imaging for airway ESS for adults	2.5%	97.5%	2.2%	2.9%	0.0%	4.4%
# surgical procedures performed during residency	**N**	**Percentages**	**Junior % Yes**	**Senior % Yes**	**Single % Yes**	**Dual % Yes**
- maxillomandibular advancement (MMA)?						
None	37	46.8%	**67.4%**	**18.2%***	39.4%	53.3%
1-10	37	46.8%	28.3%	72.7%	54.5%	40.0%
11-20	4	5.1%	2.2%	9.1%	6.1%	4.4%
>20	1	1.3%	2.2%	0.0%	0.0%	2.2%
- genioglossus advancement surgeries?						
None	53	67.1%	80.4%	48.5%	57.6%	75.6%
1-10	24	30.4%	19.6%	45.5%	36.4%	24.4%
11-20	1	1.3%	0.0%	3.0%	3.0%	0.0%
>20	1	1.3%	0.0%	3.0%	3.0%	0.0%
- hyoid suspension surgeries?						
None	76	96.2%	97.8%	93.9%	97.0%	95.6%
1-10	3	3.8%	2.2%	6.1%	3.0%	4.4%

Table 4: continued

- palatal or pharyngeal surgeries?						
None	69	87.3%	93.5%	78.8%	84.8%	88.9%
1-10	8	10.1%	6.5%	15.2%	9.1%	11.1%
11-20	1	1.3%	0.0%	3.0%	3.0%	0.0%
>20	1	1.3%	0.0%	3.0%	3.0%	0.0%

Table 5: Case analysis

Adult patient presents with an Apnea-Hypopnea index AHI of 17 events per hour	**1 = mild**	**2 = moderate**	**3 = moderate to severe**	**4 = severe**
What severity of OSA diagnosis would you make?	4 (6.6%)	1 (1.6%)	47 (77.0%)	9 (14.8%)
What would be your first step in the management of this patient?	**Frequency Yes**	**Percentage Yes**		
Medical treatment:	27	32.9%		
- CPAP, Reassessment/assess surgical appropriateness	27	32.9%		
Diagnostics:	20	24.4%		
- asleep fiberoptic pharyngoscopy/determine level of obstruction/laryngoscopy	6	7.3%		
- CPAP trial	3	3.7%		
- History, physical, full workup, risk factor assessment	4	4.9%		
- Referral/Polysomnography/sleep study	6	7.3%		

- CBCT	1	1.2%		
Lifestyle modification	19	23.1%		
- Behavior modifications	2	2.4%		
- weight loss, diet, exercise	14	17.0%		
- conservative	3	3.7%		
Dental treatment	11	13.4%		
- dental splint	1	1.2%		
- MAD	2	2.4%		
- oral appliance	8	9.8%		
Surgical treatment:	3	3.7%		
- Adenotonsillectomy	1	1.2%		
- remove local obstruction	1	1.2%		
- multilevel surgery	1	1.2%		

Table 6: Correlations

OSA-related educational experiences	OSA-related educational responses			OSA-related knowledge related responses		
	Post-graduate year	Classroom based education	Clinical education	Objective knowledge	Self-reported knowledge	Behavioral intentions
Average classroom-based education Index	0.14	1	0.67***	0.29**	0.70***	0.42***
Average clinical education Index	0.15	0.67***	1	0.25*	0.71***	0.54***
OSA-related knowledge						
Objective knowledge score	0.00	0.29**	0.25*	1	0.12	0.08
Self-reported knowledge score	0.22	0.70***	0.71***	0.12	1	0.59***
Behavioral intentions	-0.03	0.42***	0.54***	0.08	0.59***	1
OSA-related behavior - Diagnosis						
Screening sum score	0.20	0.22	0.34**	-0.04	0.45***	0.30**
OSA-related behavior - Treatment						
- maxillomandibular advancement?	0.39***	0.40***	0.40**	0.01	0.42***	0.21
- genioglossus advancement surgeries?	0.28*	0.08	0.05	-0.24*	0.16	0.06
- hyoid suspension surgeries?	0.12	0.06	0.04	0.05	0.8	-0.03

- palatal or pharyngeal surgeries?	0.21	-0.01	-0.03	-0.13	0.7	-0.01

Legend:

* = p<0.05, ** = p<0.01, *** = p<0.001