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Disparities in Utilization of Jaw Surgery for Treatment of Sleep Apnea: A Nationwide Analysis

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Background: Maxillomandibular advancement has been shown to be one of the most effective operations for management of severe obstructive sleep apnea, yet pharyngeal surgery is more commonly performed. The goal of this study was to identify socioeconomic factors associated with this phenomenon.

Methods: Patients aged 14 or older with a primary hospital diagnosis of sleep apnea were identified using the National Inpatient Sample from 2005 to 2012. *ICD9* codes were used to determine whether a pharyngeal or jaw procedure was performed. Patient demographics, comorbidities, and complications were compared.

Results: Among 6316 sleep surgeries, 5964 (94.4%) were pharyngeal and 352 (5.6%) were jaw procedures. Women were significantly more likely to receive jaw surgery than men (odds ratio [OR] = 1.68, $P = 0.0007$). African Americans (OR = 0.19, $P < 0.0001$), Hispanics (OR = 0.42, $P = 0.0009$), Asians (OR = 0.41, $P = 0.0009$), and other non-Caucasians (OR = 0.19, $P = 0.0008$) had a significantly lower odds of receiving jaw surgery than Caucasians. Patients falling into lower-income brackets (OR = 0.39 and 0.57, $P = 0.02$ and 0.04) and patients with Medicare compared with private or Health Maintenance Organization insurance (OR = 0.46, $P = 0.008$) also had significantly decreased odds of undergoing jaw surgery. Comorbidities were similar between surgical groups, and there were no significant differences in bleeding, infection, or cardiopulmonary complications.

Conclusions: We identified no significant difference in complication rates between pharyngeal and jaw procedures. Nonetheless, African American, Hispanic, and Asian patients, in addition to lower-income patients and patients with Medicare, had a significantly lower odds of receiving jaw surgery. Awareness of these disparities may help guide efforts to improve patients' surgical options for sleep apnea.
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An estimated 13% of men and 6% of women have moderate-to-severe sleep disordered breathing.[1] The most common form of sleep-disordered breathing is obstructive sleep apnea (OSA), which is characterized by repetitive cycles of upper airway collapse leading to hypoxemia, nighttime arousal, and daytime somnolence. In addition to compromising quality of life, this common condition carries significant cardiovascular, metabolic, and neurocognitive morbidity.[2–4]

Surgical modification of the upper airway may significantly improve a patient's OSA and serve as an alternative or adjunct to continuous positive airway pressure (CPAP), which is the standard for treatment.[5,6] Many procedures have been described ranging from pharyngeal operations to facial skeletal surgeries including maxillomandibular advancement (MMA). Although MMA is a major operation, it is the only procedure aside from tracheostomy that the American Academy of Sleep Medicine has classified as an "option" for treatment of severe OSA.[7] This is because variable efficacy has been demonstrated with other sleep operations, as measured by apnea–hypopnea index (AHI), a metric for OSA severity. A meta-analysis

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found an average 33% reduction in AHI for uvulopalatopharyngoplasty, a common pharyngeal procedure, compared with an average 87% reduction in AHI for MMA.[8]

Even though MMA has demonstrated some of the strongest efficacy for surgical treatment of OSA, a review of inpatients undergoing sleep apnea procedures suggests that pharyngeal procedures are performed most commonly, and jaw procedures only account for a minority of procedures.[9] This may be explained by multiple factors, including patient and physician awareness of surgical options, patient referral patterns, patient preferences, and the relative magnitude of these operations.

Socioeconomic factors may also play a role in whether patients receive pharyngeal or jaw surgery for sleep apnea refractory to conservative treatment. Patient acceptance of CPAP, for example, has been shown to be significantly lower among patients of lower socioeconomic status.[10] However, associations between socioeconomic status and utilization of pharyngeal or jaw surgery have not been well studied. Here, we perform a nationwide analysis of differences in socioeconomic characteristics, comorbidities, and complications between patients undergoing pharyngeal and jaw surgery for treatment of sleep apnea.

METHODS

The National Inpatient Sample (NIS) database of the Healthcare Cost and Utilization Project was searched from 2005 to 2012 to identify patients with sleep apnea. The NIS is the largest available all-payer inpatient database in the United States and approximates a 20% stratified sample of discharges from US community hospitals.[11] It covers all patients, including individuals covered by Medicare, Medicaid, private insurance, and the uninsured. Data were collected and analyzed in accordance with the participation user agreement. Patients aged 14 and older were included.

Patients with a primary hospital diagnosis of sleep apnea were identified using *ICD9* codes 327.23, 780.51, 780.53, and 780.57. A random sample of patients without sleep apnea from the NIS was selected for demographic and socioeconomic comparison to patients with sleep apnea.

To identify patients who underwent surgery for their sleep apnea, a search for *ICD9* codes associated with nasal, tracheal, pharyngeal, and jaw procedures was performed. Because the goal of this study was to examine differences between patients undergoing pharyngeal and jaw procedures, we excluded patients who underwent tracheal procedures and patients who underwent combined pharyngeal and jaw surgery. We were left with 5964 patients who underwent pharyngeal procedures and 352 who underwent jaw procedures (Table 1). Patients in both groups also received nasal surgery. In the pharyngeal surgery group, there were 3180 patients who received pharyngeal surgery alone and 2784 patients who received pharyngeal and nasal surgery. In the jaw surgery group, there were 293 patients who received jaw surgery alone and 59 patients who received jaw and nasal surgery.

Comparisons of age, sex, race, income, and payor were made between pharyngeal and jaw surgery patient groups. Analyses were adjusted for data missing from the NIS database. Less than 3% of patients in both the pharyngeal and jaw surgery groups had missing observations for age, sex, income, and payor analyses. For race analyses, 21.1% of patients in the pharyngeal surgery group and 4.3% of patients in the jaw surgery group had missing observations.

Table 1. Procedural Codes for Sleep Apnea Patients

Procedure Distribution	*ICD9* Code	*n*
Pharyngeal (5964 patients)		
Tonsillectomy	28.2	3988
Tonsillectomy and adenoidectomy	28.3	3678
Partial glossectomy	25.2	441
Other operations, tongue	25.99	197
Adenoidectomy	28.6	177
Plastic repair of palate	27.69	5625
Plastic operation on pharynx	29.4	5543
Plastic operation on tongue	25.59	850
Jaw (352 patients)		
Other orthognathic surgery, mandible	76.64	288
Segmental osteoplasty, maxilla	76.65	287
Open osteoplasty, mandible ramus	76.62	130
Osteoplasty of body of mandible	76.63	115
Augmentation genioplasty	76.68	108
Total osteoplasty, maxilla	76.66	88
Closed osteoplasty, mandibular ramus	76.61	15
Reduction genioplasty	76.67	11
Other facial bone repair	76.69	63

Additionally, comorbidities and complications were compared by *ICD9* code between the pharyngeal and jaw surgery groups. There were no missing observations for these variables.

Statistical Analysis

Data management and statistical analyses were performed using the Statistical Analysis System (SAS version 9.4 SAS, Inc.; Cary, N.C.). Analyses included the Rao-Scott chi-square test for categorical variables and the Student's *t* test for continuous variables. Multivariable logistic regression models that account for survey methodology and hospital clustering were developed to analyze categorical outcomes while adjusting for covariates. All results in the regression model were presented by an odds ratio (OR) and 95% confidence interval. A *P* value <0.05 was considered significant.

RESULTS

Defining the Sleep Apnea Population

Patients with a primary hospital diagnosis of sleep apnea had significantly different socioeconomic features from the NIS (Table 2). Sleep apnea patients were younger (50.5 vs 56.5 y, $P < 0.001$), predominantly male (69.6% vs 39.8%, $P < 0.0001$), and characterized by a greater percent of non-Caucasians (34.1% vs 30.7%, $P < 0.0001$). Sleep apnea patients were also more likely to fall into the $63,000 or more income bracket (26.3% vs 21.1%, $P < 0001$) and have private or HMO insurance (50.0% vs 31.3%, $P < 0.0001$).

Socioeconomic Characteristics of Pharyngeal and Jaw Surgery Patients

Significant socioeconomic differences were identified between patients who underwent pharyngeal or

Table 2. Demographics of NIS Versus Sleep Apnea Patients

	NIS	Sleep Apnea	*P*
n	15,335	15,334	—
Age (mean, SEM)	56.5 (0.2)	50.5 (0.2)	<0.001
Sex (no, %)			<0.0001
Male	6057 (39.8)	9978 (65.6)	
Female	9149 (60.1)	5222 (34.4)	
Race (no, %)			<0.0001
Caucasian	8725 (69.3)	8058 (65.8)	
African American	1765 (14.1)	2105 (17.3)	
Hispanic	1352 (10.7)	1316 (10.7)	
Asian	241 (1.9)	284 (2.3)	
Native American	89 (0.7)	74 (0.6)	
Other	413 (3.3)	396 (3.3)	
Income (no, %)			<0.0001
$1–38,999	4339 (29.3)	3699 (25.0)	
$39,000–47,999	3831 (25.7)	3575 (24.1)	
$48,000–62,999	3552 (23.9)	3650 (24.6)	
$63,000 or more	3128 (21.1)	3919 (26.3)	
Payor (no, %)			<0.0001
Medicare	6740 (44.3)	4462 (29.4)	
Medicaid	2326 (15.3)	1821 (12.0)	
Private insurance	4761 (31.3)	7597 (50.0)	
Self-pay	787 (5.2)	604 (4.0)	
Other	591 (3.9)	698 (4.6)	

Table 3. Demographic Comparison of Pharyngeal and Jaw Surgery Patients

	Pharyngeal Surgery	Jaw Surgery	*P*
Age (mean, SEM)	43.7 (0.2)	44.8 (0.6)	0.068
Sex (no, %)			0.02
Male	4501 (76.0)	248 (70.5)	
Female	1423 (24.0)	104 (29.5)	
Race (no, %)			<0.0001
Caucasian	3180 (67.4)	248 (87.6)	
African American	553 (11.9)	8 (2.7)	
Hispanic	564 (12.0)	16 (5.7)	
Asian	183 (3.8)	6 (2.2)	
Native American	15 (0.3)	2 (0.8)	
Other	211 (4.6)	3 (1.1)	
Income (no, %)			0.0004
$1–38,999	1040 (18.0)	30 (8.8)	
$39,000–47,999	1196 (20.6)	64 (18.8)	
$48,000–62,999	1541 (26.6)	74 (21.7)	
$63,000 or more	2027 (34.8)	175 (50.7)	
Payor (no, %)			0.003
Medicare	638 (10.8)	20 (5.7)	
Medicaid	435 (7.4)	8 (2.2)	
Private insurance	4578 (77.0)	301 (86.2)	
Self-pay	66 (1.1)	5 (1.5)	
Other	220 (3.7)	15 (4.3)	

jaw surgery for their primary hospital diagnosis of sleep apnea (Table 3). Women underwent jaw surgery significantly more often than men (6.8% vs 5.2%, $P = 0.02$). Non-Caucasians were significantly less likely to undergo jaw surgery than Caucasian patients (2.2% vs 7.2%, $P < 0.0001$). African American, Hispanic, and Asian patient groups were each significantly less likely to receive jaw surgery ($P < 0.0001$). Patients undergoing jaw surgery were significantly more likely to fall into the $63,000 or more income bracket (50.7% vs 34.8%, $P = 0.0004$) and were significantly more likely to have private or HMO insurance than patients undergoing pharyngeal procedures (86.2% vs 77.1%, $P = 0.003$).

Differences between Men and Women Undergoing Sleep Surgery

A comparison of men and women undergoing any sleep surgery, including both pharyngeal and jaw procedures, revealed that non-Caucasian patients had significantly greater female than male representation (33.8% vs 30.7%, $P < 0.0001$, Table 4). Women were significantly less likely to fall into the $63,000 or more income bracket (30.1% vs 37.4%, $P < 0.0001$) and were significantly less likely to have private or HMO insurance (71.0% vs 79.6%, $P < 0.0001$).

When examining differences between men and women who underwent jaw procedures specifically, there were no significant differences in racial stratification, income, or insurance (Table 5).

Differences between Caucasians and Non-Caucasians Undergoing Sleep Surgery

A comparison of Caucasians and non-Caucasians undergoing any sleep surgery, including both pharyngeal and jaw procedures, revealed that non-Caucasians had significantly greater female representation than Caucasians (25.7% vs 23.2%, $P = 0.027$, Table 6). Additionally,

Table 4. Comparison of Men and Women with Sleep Apnea Undergoing Pharyngeal or Jaw Surgery

	Men	Women	*P*
Age (mean, SEM)	43.3 (0.20)	45.2 (0.37)	<0.0001
Race (no, %)			<0.0001
Caucasian	2629 (69.3)	799 (66.2)	
African American	364 (9.7)	197 (16.7)	
Hispanic	459 (12.2)	121 (10.0)	
Asian	157 (4.0)	32 (2.6)	
Native American	11 (0.3)	6 (0.5)	
Other	166 (4.5)	48 (4.0)	
Income (no, %)			<0.0001
$1–38,999	735 (12.0)	335 (22.6)	
$39,000–47,999	930 (20.1)	326 (21.7)	
$48,000–62,999	1232 (26.6)	380 (25.6)	
$63,000 or more	1735 (37.4)	455 (30.1)	
Payor (no, %)			<0.0001
Medicare	447 (9.4)	211 (13.8)	
Medicaid	279 (5.9)	163 (10.8)	
Private insurance	3781 (79.6)	1080 (71.0)	
Self-pay	55 (1.2)	15 (1.0)	
Other	182 (3.9)	52 (3.4)	

non-Caucasians were significantly less likely to fall into the $63,000 or greater income bracket (30.7% vs 39.9%, $P < 0.0001$) and significantly less likely to have private or HMO insurance (73.8% vs 80.6%, $P < 0.0001$).

Further examination of differences between Caucasians and non-Caucasians undergoing jaw procedures revealed no significant differences in sex composition, income, or insurance (Table 7).

Independent Predictors of Undergoing Jaw Surgery

A multivariate logistic regression analysis was performed to identify demographic factors independently associated with a greater likelihood of receiving a jaw procedure (Table 8). Female patients (OR = 1.68, $P = 0.0007$) had a significantly greater likelihood of undergoing jaw surgery than male patients. African American (OR = 0.19, $P < 0.0001$), Hispanic (OR = 0.42, $P = 0.0009$),

Table 5. Comparison of Men and Women with Sleep Apnea Undergoing Jaw Surgery

	Men	Women	*P*
Age (mean, SEM)	44.8 (0.60)	44.9 (1.30)	0.92
Race (no, %)			0.41
Caucasian	171 (86.7)	77 (89.7)	
African American	7 (3.5)	1 (1.0)	
Hispanic	12 (6.2)	4 (4.6)	
Asian	5 (2.6)	1 (1.2)	
Native American	1 (0.6)	1 (1.1)	
Other	1 (0.5)	2 (2.4)	
Income (no, %)			0.28
$1–38,999	19 (7.9)	11 (11.0)	
$39,000–47,999	50 (21.1)	14 (13.5)	
$48,000–62,999	53 (22.2)	21 (20.5)	
$63,000 or more	118 (48.8)	57 (55.0)	
Payor (no, %)			0.77
Medicare	15 (6.1)	5 (4.8)	
Medicaid	4 (1.6)	4 (3.6)	
Private insurance	214 (86.8)	87 (84.8)	
Self-pay	3 (1.3)	2 (2.0)	
Other	10 (4.2)	5 (4.8)	

Table 6. Comparison of Caucasians and Non-Caucasians with Sleep Apnea Undergoing Pharyngeal or Jaw Surgery

	Caucasian	Non-Caucasians	*P*
Age (SEM)	45.1 (0.25)	42.2 (0.29)	<0.0001
Sex (no, %)			0.027
Male	2629 (76.8)	2120 (74.3)	
Female	799 (23.2)	728 (25.7)	
Income (no, %)			<0.0001
$1–38,999	444 (13.3)	626 (22.6)	
$39,000–47,999	655 (19.5)	605 (21.7)	
$48,000–62,999	911 (27.3)	704 (25.1)	
$63,000 or more	1340 (39.9)	862 (30.7)	
Payor (no, %)			<0.0001
Medicare	381 (11.2)	277 (9.6)	
Medicaid	145 (4.3)	298 (10.5)	
Private insurance	2762 (80.6)	2117 (73.8)	
Self-pay	27 (0.8)	44 (1.6)	
Other	107 (3.2)	128 (4.5)	

Table 7. Comparison of Caucasians and Non-Caucasians with Sleep Apnea Undergoing Jaw Surgery

	Caucasian	Non-Caucasians	*P*
Age (SEM)	45.5 (0.76)	43.2 (0.98)	<0.0001
Sex (no, %)			0.16
Male	171 (69.0)	77 (74.8)	
Female	77 (31.0)	27 (25.2)	
Income (no, %)			0.27
$1–38,999	20 (8.3)	10 (9.9)	
$39,000–47,999	38 (15.9)	26 (25.6)	
$48,000–62,999	54 (22.3)	20 (20.1)	
$63,000 or more	130 (53.4)	45 (44.3)	
Payor (no, %)			0.41
Medicare	14 (5.8)	6 (5.6)	
Medicaid	4 (1.6)	4 (3.7)	
Private insurance	217 (88.1)	84 (81.6)	
Self-pay	2 (0.86)	3 (3.1)	
Other	9 (3.7)	6 (6.0)	

Asian (OR = 0.41, *P* = 0.02), and other non-Caucasian (OR = 0.19, *P* = 0.0008) patients had a significantly lower likelihood of undergoing jaw surgery compared with Caucasian patients. Additionally, patients in the income bracket of $1–38,999 and $48,000–62,999 were significantly less likely to undergo jaw surgery than patients earning $63,000 or more per year. Patients with Medicare had a significantly lower odds of receiving jaw surgery than patients with private or HMO insurance coverage (OR = 0.46, *P* = 0.008).

Table 8. Multivariate Logistic Regression: Factors Associated with Likelihood of Receiving Jaw Surgery

Demographic Factor*	OR	95% Confidence Interval	*P*
Female	1.68	1.24–2.26	0.0007
African American	0.19	0.10–0.39	<0.0001
Hispanic	0.42	0.25–0.70	0.0009
Asian or Pacific Islander	0.41	0.20–0.86	0.02
Native American	2.43	0.58–10.20	0.23
Other	0.19	0.07–0.5	0.0008
Income $1–38,999	0.39	0.18–0.87	0.02
Income $39,000–47,999	0.62	0.32–1.19	0.15
Income $48,000–62,999	0.57	0.33–0.97	0.04
Medicaid	0.46	0.20–1.04	0.06
Medicare	0.46	0.25–0.81	0.008
Self-pay	1.42	0.20–10.31	0.73
Other	1.08	0.49–2.41	0.85

*Male is the reference category for female, Caucasian is the reference category for race, income of $63,000 or more is the reference category for income, and private insurance/HMO is the reference category for payor.

Comorbidities and Complications in Pharyngeal and Jaw Surgery Patients

A comparison of comorbidities between patients undergoing pharyngeal and jaw surgery revealed no significant difference in prevalence of hypertension, diabetes, congestive heart failure, asthma, respiratory distress, esophageal reflux, or morbid obesity (Table 9). There was a significantly higher rate of obesity among patients undergoing pharyngeal surgery (21.4% vs 14.2%, *P* = 0.003).

There was no significant difference in complication rates between patients undergoing pharyngeal and jaw surgery (Table 9). The most common complications were postoperative hemorrhage (1.3% vs 1.1%), epistaxis (0.4% vs 1.1%), aspiration pneumonia (0.4% vs 0.6%), postoperative hematoma (0.2% vs 0.3%), and pneumonia

Table 9. Comorbidities and Complications of Sleep Surgery

	Pharyngeal	Jaw	*P*
Comorbidities (no, %)			
Hypertension	1974 (33.2)	106 (30.1)	0.42
Diabetes mellitus	623 (10.5)	26 (7.4)	0.11
Congestive heart failure	67 (1.1)	3 (0.9)	0.57
Asthma	521 (8.8)	21 (6.0)	0.08
Esophageal reflux	1084 (18.2)	76 (21.6)	0.16
Respiratory distress	140 (2.4)	4 (1.1)	0.13
Obesity	1271 (21.4)	50 (14.2)	0.003
Morbid obesity	428 (7.2)	14 (4.0)	0.06
Complications (no, %)			
Myocardial infarction	3 (0.05)	0	—
Stroke	0	0	—
Deep venous thrombosis	0	0	—
Pulmonary embolus	0	0	—
Postoperative hemorrhage	78 (1.3)	4 (1.1)	0.57
Postoperative hematoma	13 (0.2)	1 (0.3)	0.74
Epistaxis	25 (0.4)	4 (1.1)	0.05
Infection	0	0	—
Pneumonia	3 (0.05)	1 (0.3)	0.14
Aspiration pneumonia	24 (0.4)	2 (0.6)	0.66
Upper airway obstruction	103 (1.7)	0	—

(0.05% vs 0.3%). Rare complications that did not occur in jaw surgery patients but occurred in pharyngeal surgery patients included myocardial infarction (0.05%) and upper airway obstruction (1.7%). No patients had documentation of stroke, deep venous thrombosis, pulmonary embolus, or infection.

DISCUSSION

This nationwide study identifies significant economic, racial, and sex differences between patients undergoing pharyngeal and jaw procedures for management of sleep apnea. Patients with Medicare as opposed to private or HMO insurance and those falling into a lower-income bracket, non-Caucasians, and men had a significantly lower likelihood of receiving jaw surgery, which accounted for 5.6% of sleep procedures over the 8-year study period. Patient comorbidities and complications do not explain the difference in procedural rates. Although patients undergoing pharyngeal surgery had a higher obesity rate, there were no other significant differences in comorbidities. There were also no significant differences in immediate perioperative complications between the groups, including hemorrhage, hematoma, infection, and pneumonia. This suggests that these operations have a similar overall safety profile and that complications are not the major factor impacting choice of procedure.

Financial Considerations

Patients who fell into a lower-income bracket or had Medicare as opposed to private or HMO insurance had a significantly lower odds of receiving jaw surgery for treatment of their sleep apnea. The independent association of income and payor with rates of jaw surgery may relate to the fact that plastic and oral surgeons are having increasing difficulty obtaining insurance coverage and receiving insufficient reimbursement for the amount of time invested in planning and performing these surgeries.[12]

Some insurance companies place extensive restrictions on who is eligible for coverage of orthognathic procedures and reimburse surgeons at a rate that is less than 70% of the reimbursement rate in the 1980s.[13] A national survey of plastic and oral surgeons found that because of the low reimbursement for orthognathic surgery, approximately 60% of surgeons offer orthognathic surgery on a fee for service basis.[14] It is also possible that there are fewer surgeons training to perform jaw procedures for sleep apnea patients because of the low reimbursement. The implication is that there is limited surgeon availability for performing jaw surgery, and patients with lower incomes or with insurance plans that provide lower reimbursement will have less access to these important procedures.

Given the potential benefit of jaw surgery for sleep apnea patients and the magnitude of the financial problem in supporting these surgeries, it is possible that increasing use of ambulatory centers for surgery may make it more cost-effective for patients who must pay out of pocket.[15] However, the safety of same-day discharge for a patient with severe sleep apnea is questionable. Alternatively, surgeons who use virtual planning may reduce time spent on preoperative planning, making a lower rate of reimbursement by insurance companies more sustainable.[16]

Racial Considerations

A striking difference between patients undergoing pharyngeal and jaw surgery was that patients undergoing jaw surgery were significantly less likely to be non-Caucasian. Income brackets and private insurance rates among non-Caucasians were similar to Caucasian patients who underwent jaw surgery. This can be explained by the current financial environment for orthognathic surgery. However, when considering all patients who underwent jaw or pharyngeal surgery, incomes and private insurance rates were significantly lower among non-Caucasians, and multivariate logistic regression analysis revealed that being African American, Hispanic, or Asian was associated with a significantly lower odds of receiving jaw surgery. This suggests that belonging to one of these specific groups was independently associated with a decreased odds of receiving jaw surgery. Our findings are consistent with racial disparities demonstrated in multiple areas of medicine. African Americans, for example, have been shown to have a significantly lower likelihood of receiving cardiac catheterization after myocardial infarction, temporal lobectomy for intractable epilepsy, and breast reconstruction.[17–19]

The racial disparities in performance of jaw surgery for sleep apnea among African Americans, Hispanics, and Asians are concerning given the prevalence of sleep apnea among non-Caucasian populations. Our comparison of NIS and sleep apnea patients demonstrated that non-Caucasians had significantly higher rates of sleep apnea. This finding is corroborated by multiple studies showing that sleep-disordered breathing is prevalent among African American and Hispanic patients[20,21] and that these groups have higher snoring rates than Caucasians.[22] Another study found that oxygen desaturation rates occurred approximately 3 times more often among African American and Hispanic patients than Caucasians.[23] Some of the strongest evidence showing racial differences in severity of sleep apnea exists for Asian patients. A comparison of Asian and white men who were matched for body mass index demonstrated significantly worse respiratory disturbance index scores for Asian patients.[24]

The disparity in jaw surgery rates between non-Caucasians and Caucasians is important not only because sleep apnea may be more prevalent among non-Caucasian groups but also because some non-Caucasian groups, including Hispanics and Asians, may have a greater contribution of their craniofacial anatomy to their sleep apnea than Caucasians. A cephalometric assessment of Hispanic, Caucasian, and African American patients demonstrated that Hispanic patients with moderate-to-severe OSA had statistically significant bimaxillary retroposition relative to their ethnic mean sella-nasion-subspinale and sella-nasion-supramentale angles.[25] Caucasian patients did not vary significantly with their ethnic means, and African Americans had higher average angles than the mean for their ethnic group.

Additionally, cephalometric differences between Asian and Caucasian patients suggest that Asian patients may

have craniofacial features that play a larger role in their sleep apnea. A comparison of body mass index–matched Asian and white men demonstrated that Asian patients had a more acute flexion angle of the cranial base as reflected by the nasion-sella-basion angle, and they also had lower lying hyoid bones as reflected by the mandibular plane (gnathion to gonion) to hyoid bone distance.[24] Another study comparing anthropometric features of Asian and white patients found that Asian patients had higher Mallampati scores, decreased thyromental distance, and larger thyromental angles, suggesting the presence of underlying skeletal features contributing to their upper airway obstruction.[26] The results of these studies suggest that craniofacial structure makes a significant contribution to sleep apnea among Asian patients and that this population may receive particular benefit from orthognathic jaw procedures.

Given the prevalence of sleep apnea among non-Caucasian patients and the potential benefit of orthognathic jaw procedures for certain groups, greater emphasis must be placed on finding ways to facilitate access to the best surgical intervention for all sleep patients warranting surgical treatment. Additional research is also needed into the attitudes of different racial groups toward jaw surgery. It is possible that some groups may be less inclined to choose a major jaw procedure or to select a procedure that has the potential to alter facial appearance. Greater understanding of patient perspectives can help surgeons communicate with patients about their concerns and improve educational efforts.

Sex Considerations

Although women represented a minority of sleep apnea patients, we found that a greater proportion of female patients with sleep apnea received jaw surgery than men. Women undergoing a pharyngeal or jaw surgery procedure had significantly lower incomes and less private insurance than men. However, women who underwent jaw surgery specifically had comparable incomes and payment patterns to male patients undergoing jaw surgery. This suggests that financially equipped women had a greater tendency toward pursuing orthognathic treatment for their sleep apnea than men.

Multiple studies have demonstrated that women tend to undergo jaw procedures more frequently than men. One study notes that women received orthognathic surgery at a 2:1 ratio with men throughout the 1990s.[27] Another study reports that women with dental malocclusion tend to be less satisfied with their facial appearance and more often pursue corrective jaw surgery.[28] It is possible that women with sleep apnea and dentofacial deformities experience greater motivation to pursue orthognathic procedures, which could contribute to the higher rates observed among women in our study.

Both men and women have been shown to have craniofacial contributions to their sleep apnea, including the presence of a low-lying hyoid bone, retrognathia, and a short posterior airway space.[29] However, there are some differing cephalometric features between men and women of unclear significance. A study of mostly Caucasian adult men and women found that adult males tended to have a greater anterior cranial base length than women and developed greater maxillary and mandibular height after age 14.[30] A study of Taiwanese patients found that as OSA severity increased, men tended to have greater anterior lower facial height and a more low-lying hyoid bone, whereas women tended to have shorter posterior facial height and a more anterior hyoid bone.[31] Further studies are needed to define the contributions of cephalometric differences between men and women to OSA.

CONCLUSIONS

OSA is a growing public health problem, and jaw surgery is one of the only procedures shown to have comparable results to CPAP for patients with severe OSA. This study identified significant socioeconomic disparities in patient utilization of jaw surgery. Although women had a greater odds of undergoing jaw surgery than men, African Americans, Hispanics, Asians, patients with low incomes, and patients with Medicare as opposed to private or HMO insurance had a significantly lower odds of receiving jaw surgery. These findings should help stimulate further research into patient and physician attitudes toward sleep surgery, barriers to treatment, and strategies to improve the spectrum of surgical options available to all patients with sleep-disordered breathing.

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