A study of risk factors and clinical presentation of obstructive sleep apnea patients and its relationship with apnea-hypopnea index (AHI)

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Research Article

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A study of risk factors and clinical presentation of obstructive sleep apnea patients and its relationship with apnea-hypopnea index (AHI)

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Abstract

Aim and background: The aim of this study is to describe the epidemiology of obstructive sleep apnea (OSA) in Syria, study the severity of the disease and its relationship with smoking, identify the most common symptoms and risk factors and describe the extent to which patients adhere to treatment and its impact on their quality of life.

Methods and materials: This study is a retrospective cohort study, which included 100 patients with OSA diagnosed through home sleep test. Demographics, medical history, signs and symptoms, risk factors, body mass index (BMI), sleep test results and symptoms after treatment were collected from the medical records of the patients and filled out in the information form.

Results: Out of 100 cases, 64 were males, whereas 36 were females. The average age of cases was 54.7 years, most of them over 40 years of age. A statistically significant relationship was found between gender and the average of AHI. The average AHI of males was 43.1 which is significantly higher than the average of females which is 33.5.
We found a statistically significant relationship between the severity of the disease and the patient's symptoms (p-value<0.05), where silent apnea was a prominent symptom (84.8% in those with severe OSA and 84.2% among patients with moderate OSA)
We also found that the ratio of smoking males with severe OSA was 86.6%, while the ratio of smoking females with severe OSA was 57.1%. We found that 58% of patients were adherent to treatment, of which 35% were using Auto CPAP, whereas 42% were not committed to any treatment.

Conclusion: This study shows how important and dangerous this disorder is and therefore it is necessary to raise people's awareness about the risks and complications of the OSA and urge them to visit specialized centers to investigate this disease. Treatment devices must also be provided at a suitable price for everyone so that patients can use it and adhere to it. Since there are not enough studies on this disease in Syria, more research and studies are required about it.

Key words: Obstructive sleep apnea, Apnea hypopnea Index, Sleep medicine

Introduction:

Starting from the fact that good sleep is important for a vital and active lifestyle, since sleep-related disorders especially Obstructive Sleep Apnea (OSA) have significant negative effects on the patient's lifestyle as well as quality of life.

This disorder is very common in the world However, it remains undiagnosed. Hence studies need to be conducted to obtain a wider perspective and information on this disease, in order to raise the patient's awareness and to avoid complications as much as possible and to improve the quality of treatment for these patients.

This study aims to study OSA cases that presented at The Jisr- Al Abyad Specialized Center in Damascus since the year 2020 and review the investigations and diagnostic criteria required for these patients. It also aims to investigate the relationship between the risk factors and the severity of the disease. And to assess the patient's level of treatment adherence and the reasons of incompliance.

Methods:

We conducted a retrospective cohort study on the OSA patients who presented at the Jisr- Al Abyad Specialized Center. The study included 100 patients who presented at the center for OSA form 1/1/2020 to 22/3/2022 the patients was selected randomly. We used the patient's records in order to fill a form that was developed according to the guidelines of the American Association of Sleep Medicine (AASM).

Inclusion Criteria: All the medical records of patients who underwent polysomnography and were diagnosed with OSA from all ages

Exclusion criteria: Cases with a missing polysomnography test, cases with incomplete data, Cases in which Polysomnography was performed for less than 4 hours, and cases of deceased patients were excluded from the study

Instrumentation and Procedure: Demographic characteristics, and the distribution of the sample according to the study variables is described and analyzed using the SPSS V26 software.

Body Mass Index (BMI) is expressed as weight in kilograms, divided by length in square meters (Kg/m^2), the patients were assigned into 4 groups according to the BMI as the following:

Less than 18.5 Kg/m^2: as underweight

Between 18.5 – 24.9 Kg/m^2: as normal weight

Between 25-29.9 Kg/m^2: as overweight

More than 30 Kg/m^2: as obesity

The Apnea Hypopnea index (AHI) was calculated as the total number of apnea and hypopnea episodes divided by the number of sleeping hours, and the AHI is used to determine the severity of the OSA as the following:

Mild: 5-14

Moderate: 15-29

Severe: more than 30

The smoking rate was calculated based on the number of cigarettes smoked per day multiplied by the number of years. **Data Analysis:** Chi-Square independence test was used to test the independence of qualitative variables, as well as correlation tests according to crammer's V coefficient to study the relationship between qualitative variables, and spearman coefficient to study the relationship between quantitative variables

The means of the independent groups was compered using T-Test independent Samples and one way ANOVA tests. And Homogeneity testing was performed using Games-Howell and LSD tests.

Ethical considerations: Ethical approval was obtained from the Institutional Review Board (IRB) Faculty of Medicine, Syrian Private University, we ensure that all personal data will remain confidential and secure for all the patients

Results:

Demographic:

The study included 100 patients with obstructive sleep apnea (OSA), 64% of whom were males and 36% of them are females. The average age was 54.7 years, 90% were over 40 years old. 30% of the patients finished Primary education, 26% graduated from university, and 7% were uneducated (Fig. 2). 94% of patients were married. 84% of patients had a Body mass index (BMI) of over 30, with a mean BMI of 36.6. The average smoking index was 564.4 Cigarette - year (Table-1 Figure 1- Figure 3).

Table. 1 Demographics: N=100		
Sex:	Number (%)	
Male	64 (64%)	
Female	36 (36%)	
Age:		
< 60	60 (60%)	
≥ 60	40 (40%)	
Education Level		
Uneducated	7 (7%)	
Primary education	18 (18%)	
Middle Education	30 (30%)	
Secondary education	19 (19%)	
University	26 (26%)	
Marital status		
Single	6 (6%)	
Married	94 (94%)	
Body mass index (BMI)		
Normal	1 (1%)	
Overweight	15 (15%)	
Obese	84 (84%)	
Smoking		
Smoker	42 (42%)	
Non-smoker	58 (58%)	
Average Body mass index (BMI)		
Average (Standard deviation)	Least value	Greatest value
36.3 (8.6)	22.2	67.8
Age:		
Average (Standard deviation)	Least value	Greatest value
54.7 (13)	14	84
Smoking index		
Average (Standard deviation)	Least value	Greatest value
564.4 (329.1)	20	2000

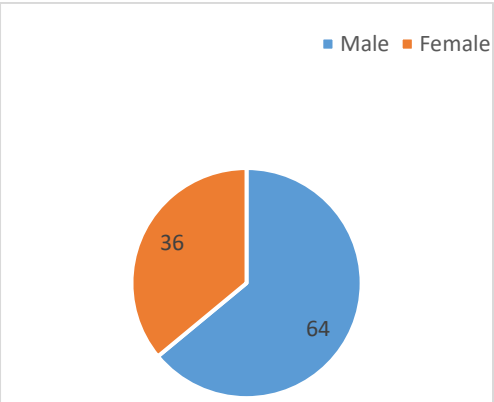


Figure (1): sample distribution by sex

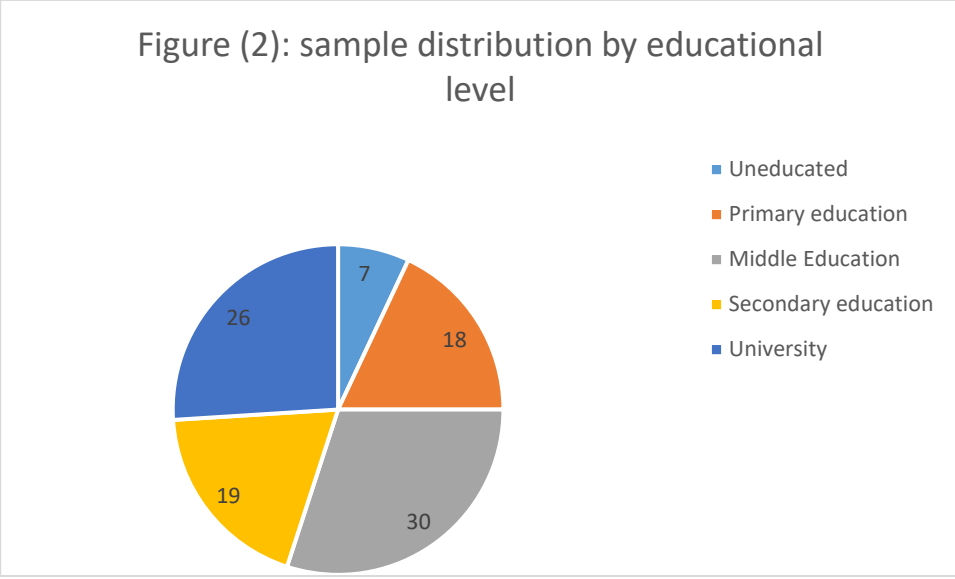


Figure (2): sample distribution by educational level

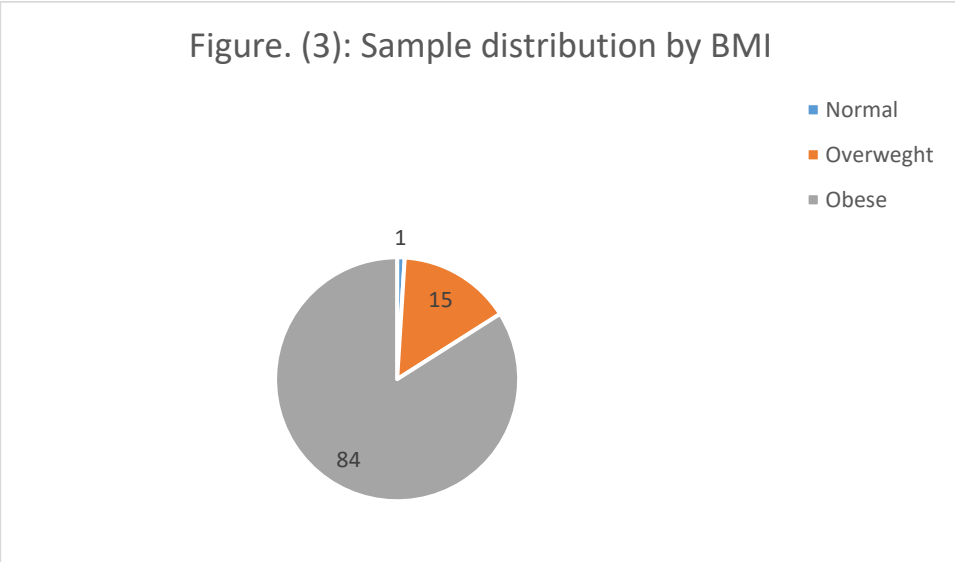


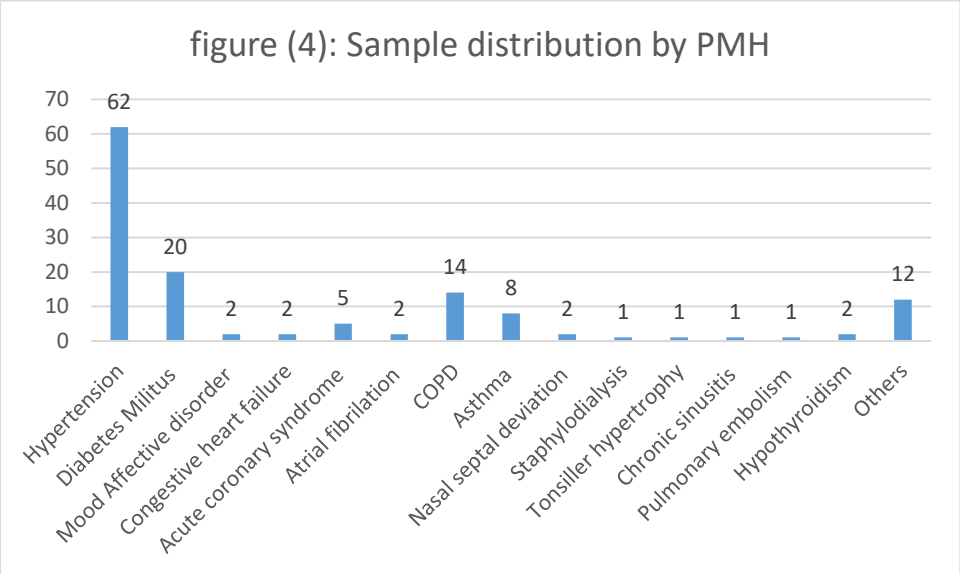
Figure. (3): Sample distribution by BMI

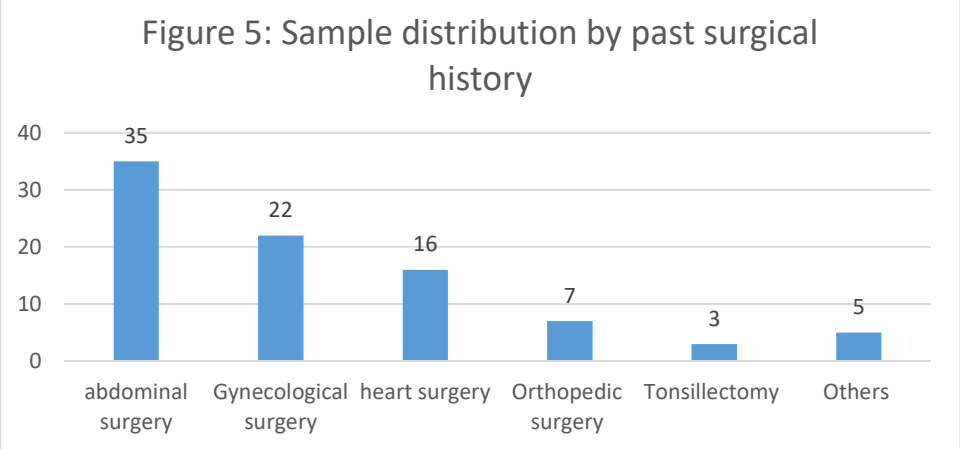
Past medical history (PMH) of OSA patient:

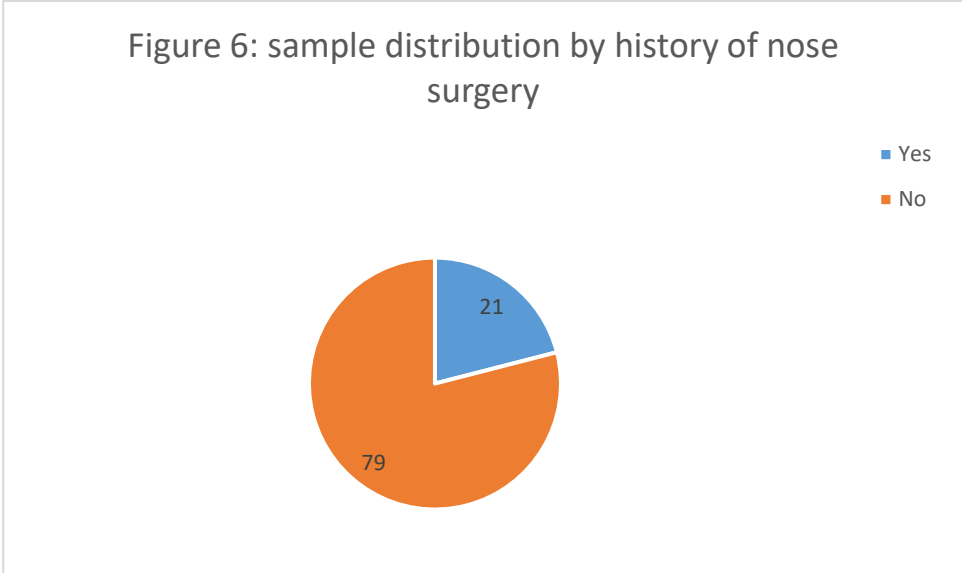
Most of the patients had positive PMH, as 62% had Hypertension, and 20% had diabetes Miletus (Figure 4). A lot of patients also had positive past surgical history as well, 35% have had abdominal surgeries, 22% had gynecological surgeries (Figure5), and only 18% had previous surgery on the nose (11% had turbinate reduction surgery and 7% had septoplasty). (Table 2 – Figure 6 – Figure 7)

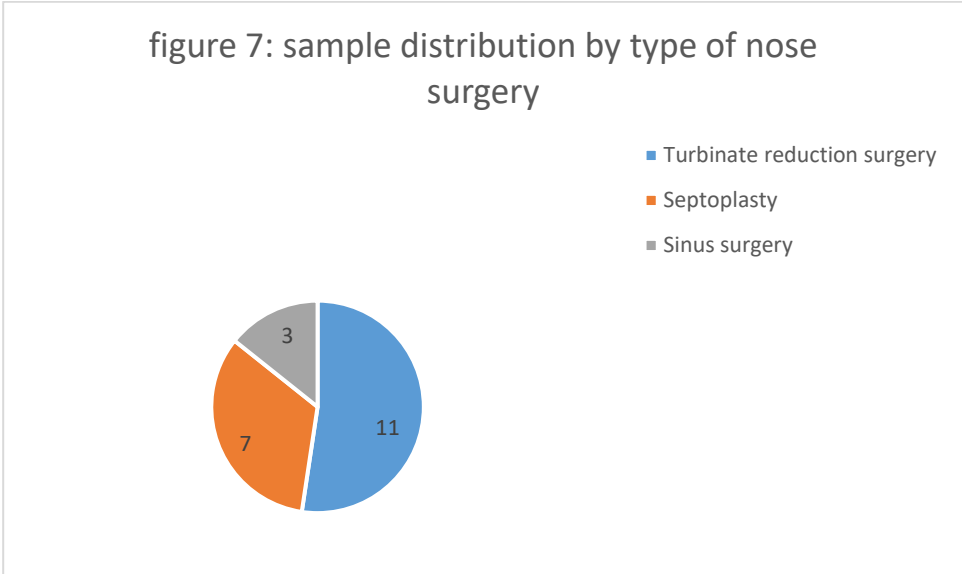
table (2): Past medical history for OSA patients	
Disease:	Number (%)
Hypertension	62 (62%)
Diabetes Miletus	20 (20%)
Mood Affective disorder	2 (2%)
Congestive heart failure	2 (2%)
Acute coronary syndrome	5 (5%)
Atrial fibrillation	2 (2%)
COPD	14 (14%)
Asthma	8 (8%)
Nasal septal deviation	2 (2%)

Staphylodialysis	1 (1%)
Tonsillar hypertrophy	1 (1%)
Chronic sinusitis	1 (1%)
Pulmonary embolism	1 1%)
Hypothyroidism	2 (2%)
Others	12 (12%)
Central analgesics:	
Yes	38 (38%)
No	62 (62%)
Allergies:	
Pollen	8 (8%)
Sweets	19 (19%)
Medications	6 (6%)
Aromas	8 (8%)
Past surgical history:	
Abdominal surgery	35 (35%)
Gynecological surgery	22 (22%)
Heart surgery	16 (16%)
Orthopedic surgery	7 (7%)
Tonsillectomy	3 (3%)
Others	5 (5%)
Previous nose surgery	
Yes	21 (21%)
No	79 (79%)
Type of nose surgery	
Turbinate reduction surgery	11 (11%)
Septoplasty	7 (7%)
Sinus surgery	3 (3%)





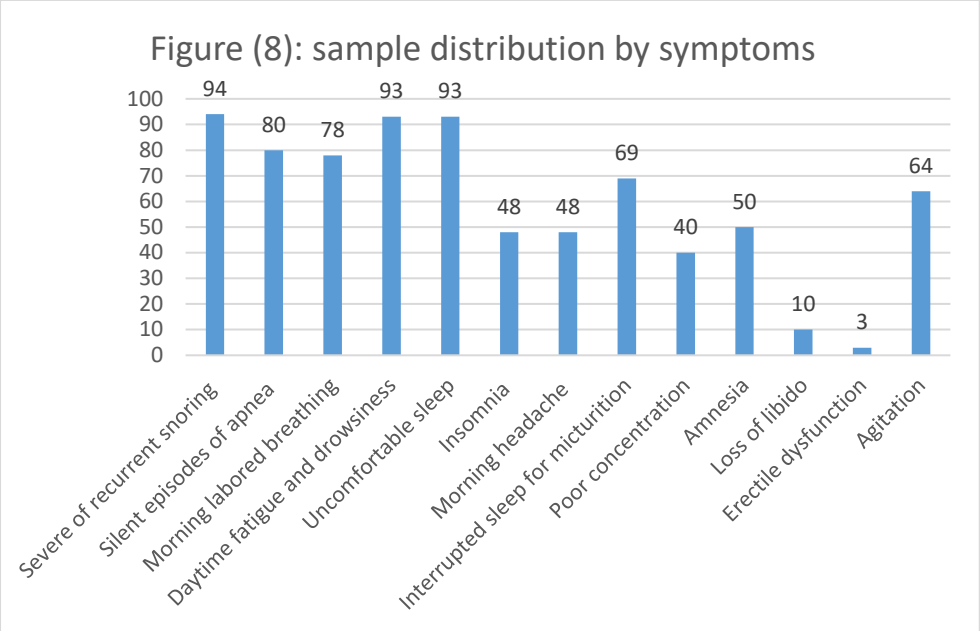


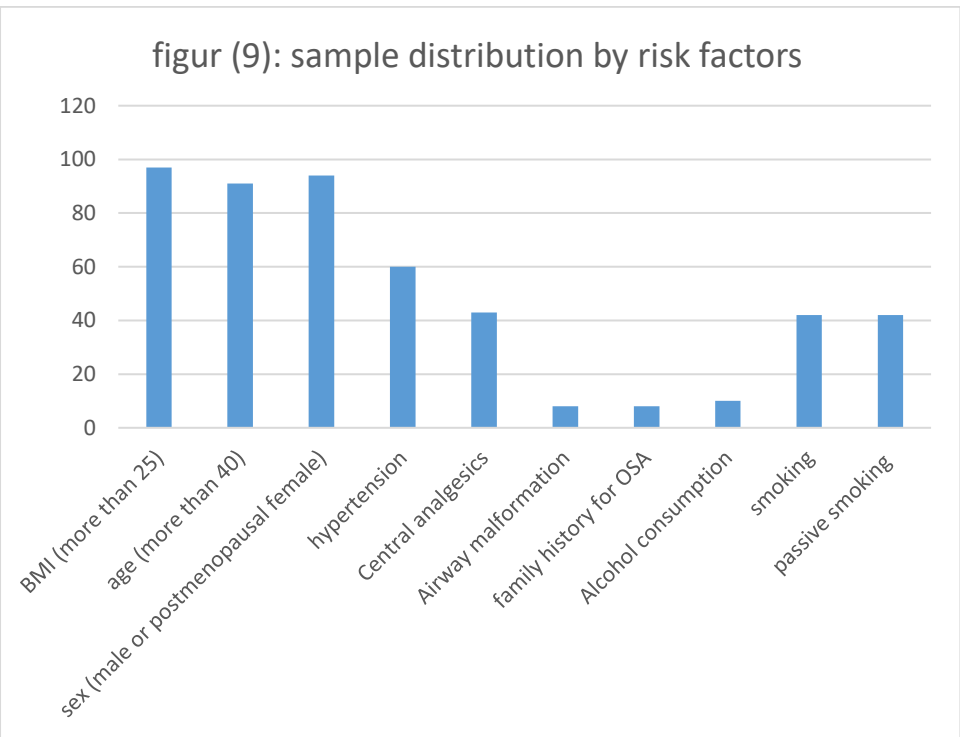


Risk factors and Signs and Symptoms of OSA:

We noticed that most of our patients suffered from severe or recurrent snoring, sleepiness and fatigue during the day, sleep disturbances and silent episodes of apnea among lots of other symptoms listed in table 3. Having a BMI of more than 25 was the most common risk factor in our patients with a percentage of 97%, being a male is the second most common risk factor as 94% of males have OSA and 91% of patient are above 40 years of age. The other risk factors are listed in table 3.

Table (3): sample distribution according to S&S and risk factors of OSA	
Sige or Symptom	Number (%)
Severe or recurrent snoring	94 (94%)
Episodes of silent apnea	80 (80%)
Morning labored breathing	78 (78%)
Daytime fatigue and drowsiness	93 (93%)
Uncomfortable sleep	93 (93%)
Insomnia	48 (48%)
Morning headache	48 (48%)
Interrupted sleep for micturition	69 (69%)
Poor concentration	40 (40%)
Memory disturbances	50 (50%)
Loss of libido	10 (10%)
Erectile dysfunction	3 (3%)
Agitation	64 (64%)
Risk factors	
BMI (more than 25)	97 (97%)
Age (more than 40)	91 (91%)
Sex (male or postmenopausal female)	94 (94%)
hypertension	60 (60%)
Central analgesics	43 (43%)
Airway malformation	8 (8%)
Family history for OSA	8 (8%)
Alcohol consumption	10 (10%)
Smoking	42 (42%)
Passive smoking	42 (42%)

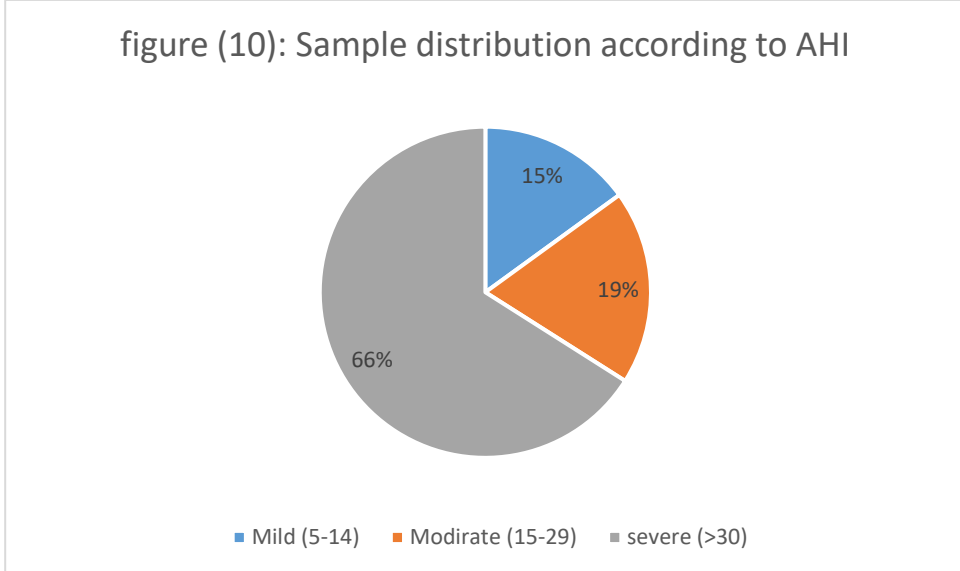




Assessing the severity of the disease:

The average oxygen saturation during sleeping was 54.7%, the average heart rate was 77.8 beat/ minute, and the average AHI was 39.6, 66% of which had high scores (>30) and 19% had Moderate scores (15-30). (Table 4 – Figure 10)

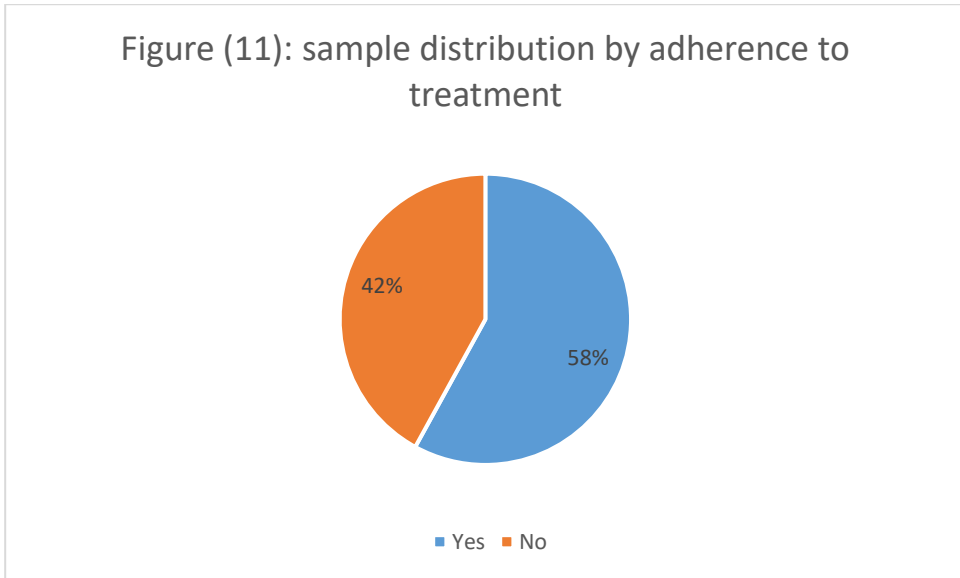
Table (4): Assessing disease severity			
	Mean (standard deviation)	Least value	Greatest value
O2 saturation during sleep	45.7 (10.2)	14	84
Heart rate during sleep	77.8 (10.4)	36	94
RI	41.8 (21.9)	4.9	102
Apnea	80.3 (91.1)	0	441
Hypopnea	78.7 (71)	0	323
AHI	39.6 (21.6)	5	98
Categories of AHI	Number (%)		
Mild (5-14)	15 (15%)		
Moderate (15-29)	19 (19%)		
severe (>30)	66 (66%)		

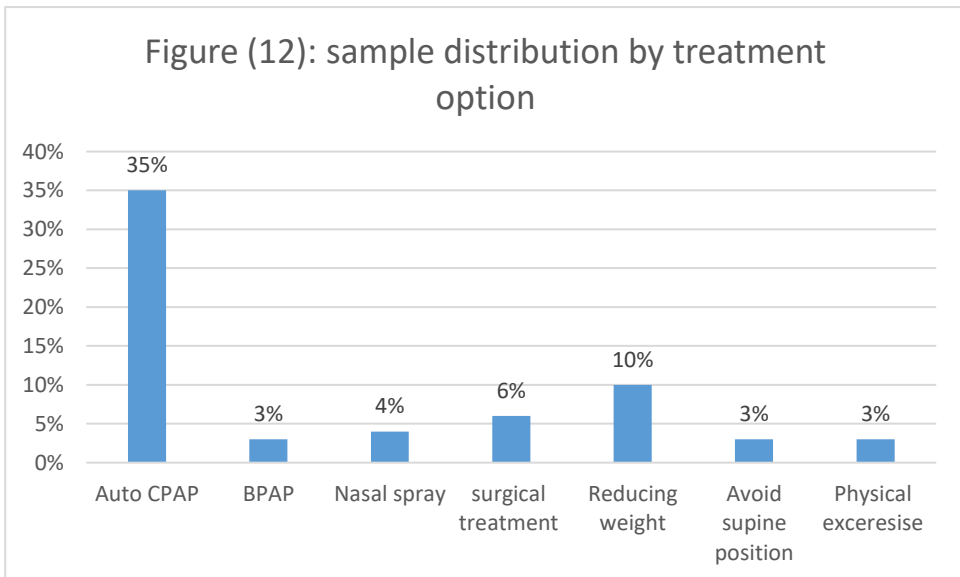


Treatment of OSA:

58% of patient were adherent to the treatment of OSA while 42% were incompliant (Figure 11). Auto CPAP was the most used treatment (35%) and 6% of the patient had surgeries for treatment (some of the patients received more than one treatment option). (Table 5 – Figure 12)

Table (5): Sample distribution by treatment	
Adherence	Number (%)
Yes	58 (58%)
No	42 (42%)
Treatment option	
Auto CPAP	35 (35%)
BPAP	3 (3%)
Nasal spray	4 (4%)
Surgical treatment	6 (6%)
Reducing weight	10 (10%)
Avoiding supine position	3 (3%)
Physical exercise	3 (3%)

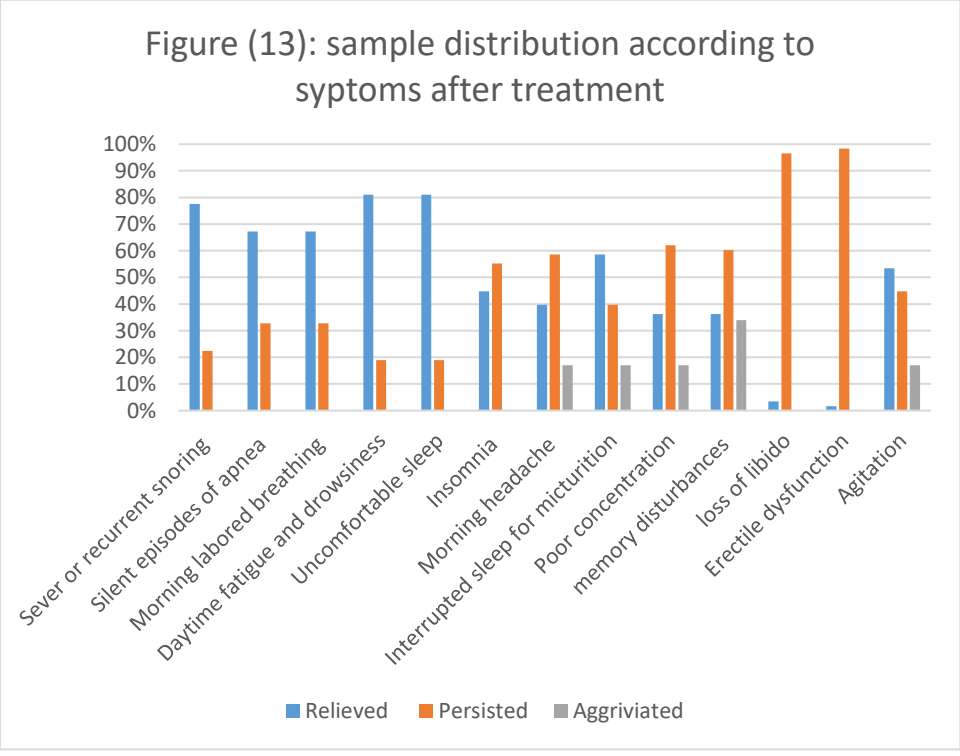




Symptoms after treatment:

After the treatment the symptoms that were relieved are Daytime fatigue and drowsiness, Uncomfortable sleep, severe or recurrent snoring and morning labored breathing. Meanwhile the symptoms that persisted are erectile dysfunction, Loss of libido, loss of concentration and memory disturbances. (Table 6 – Figure 13)

Table (6): sample distribution according to symptoms after treatment			
Symptom	Relieved	Persisted	Aggravated
Sever or recurrent snoring	78%	22%	0%
Episodes of silent apnea	67%	33%	0%
Morning labored breathing	67%	33%	0%
Daytime fatigue and drowsiness	81%	19%	0%
Uncomfortable sleep	81%	19%	0%
Insomnia	45%	55%	0%
Morning headache	40%	59%	17%
Interrupted sleep for micturition	59%	40%	17%
Poor concentration	36%	62%	17%
Memory disturbances	36%	60%	34%
loss of libido	3%	97%	0%
Erectile dysfunction	2%	98%	0%
Agitation	53%	45%	17%

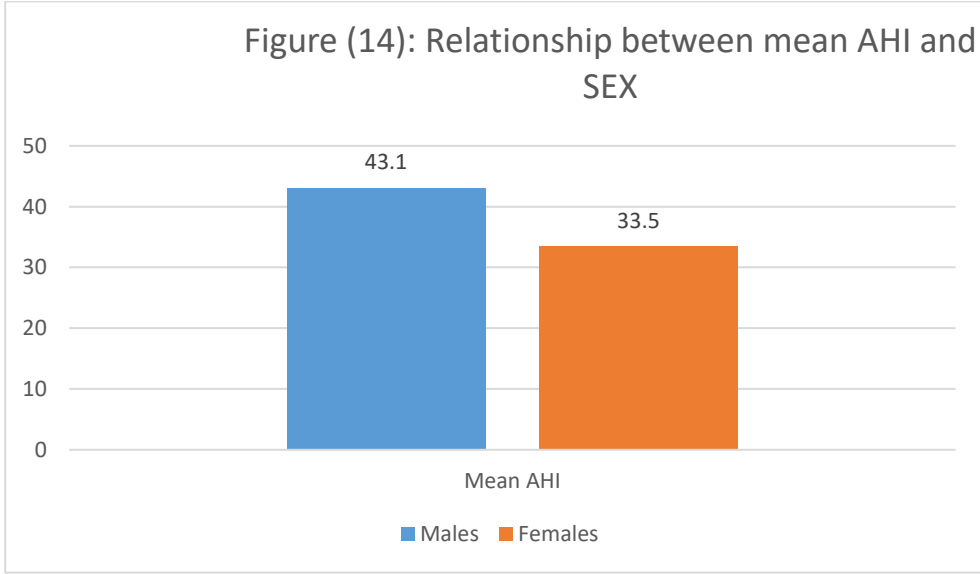


Inferential Analysis:

The relationship between AHI and demographics:

The study showed that there is statistical evidence that males had higher AHI mean (43.1) compared with females who had an AHI mean of 33.5 (P-value was less than 0.05) (Figure 14). On the other hand, there was no relationship between mean AHI and age, Education level, marital status, or BMI (Table 7).

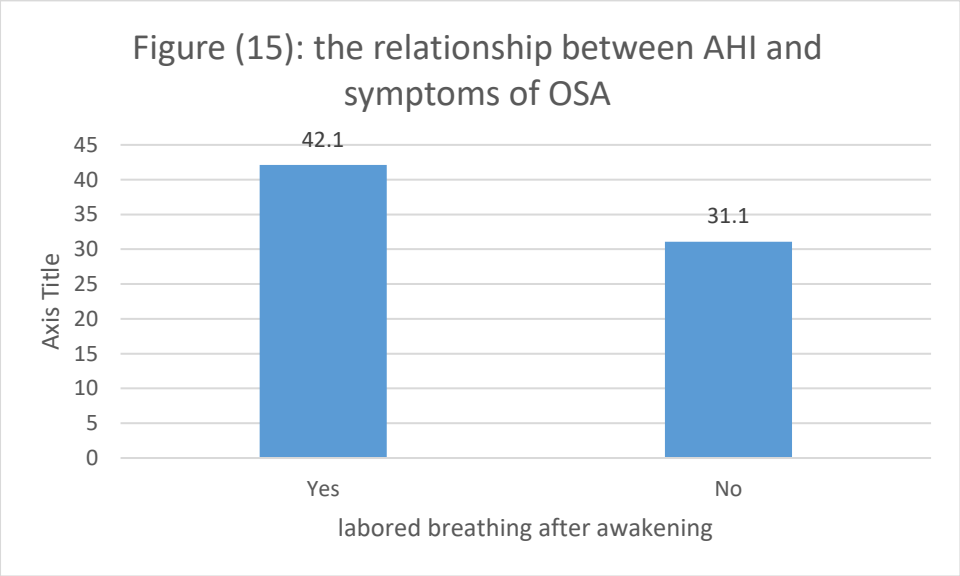
Table (7): Relationship between AHI and Demographics				
		Mean (Standard deviation)	F/T Value	P-Value
Sex	Male	**43.1 (23.3)**	2.81	0.032
	Female	33.5 (16.7)		
Age	<60	40.1 (22.3)	0.257	0.798
	≥ 60	39 (20.8)		
Educational level	Uneducated	53.1 (17.4)	1.642	0.17
	Primary education	41.7 (22.6)		
	Middle education	35.2 (22)		
	Secondary education	34.1 (21.5)		
	University	43.8 (20.5)		
Marital status	Single	38 (24)	0.197	0.844
	Married	39.8 (21.6)		
BMI	Normal	53	0.292	0.747
	Overweight	41.9 (23.1)		
	Obese	39.1 (21.5)		



The relationship between AHI and symptoms of OSA:

After studying the relationship between mean AHI and symptoms of OSA, the only symptom that had statistical significance was morning labored breathing, as those who had morning labored breathing had a mean AHI of 42.1 which is higher than those who don't have this symptom, (P-value was less than 0.05). (Table 8 – Figure 15)

Table (8): the relationship between AHI and symptoms of OSA				
		Mean (Standard deviation)	F/T Value	P- Value
Sever or recurrent snoring	Yes	39.8 (21.6)	0.235	0.814
	No	37.6 (23.5)		
Silent episodes of apnea	Yes	41.5 (20.1)	1.708	0.091
	No	32.3 (26)		
Morning labored breathing	Yes	42.1 (21.3)	2.143	0.035
	No	31.1 (20.9)		
Daytime fatigue and drowsiness	Yes	39.8 (21.7)	0.316	0.752
	No	37.1 (22.7)		
Uncomfortable sleep	Yes	21.7 (2.2)	1.471	0.144
	No	18.7 (7)		
Insomnia	Yes	41.7 (19.5)	0.924	0.358
	No	37.7 (23.4)		
Morning headache	Yes	43.1 (20.3)	1.542	0.126
	No	36.5 (22.5)		
Interrupted sleep for micturition	Yes	43.1 (22.5)	1.542	0.126
	No	36.5 (22.5)		
Poor concentration	Yes	39 (21)	0.431	0.667
	No	41 (23.1)		
Memory disturbances	Yes	43.6 (22.2)	0.984	0.137
	No	37 (21)		
Loss of libido	Yes	42.2 (22.9)	0.58	0.242
	No	37.1 (20.2)		
Erectile dysfunction	Yes	40.6 (9.7)	0.078	0.938
	No	39.6 (21.9)		
Agitation	Yes	40.7 (21)	0.639	0.524
	No	37.8 (22.8)		



The relationship between AHI and Risk factors of OSA:

There was no statistical significance between AHI and Risk factors for OSA.

Table (9): the relationship between AHI and Risk factors for OSA				
		Mean (Standard deviation)	F/T Value	P- Value
BMI (More than 25)	Yes	39.4 (21.8)	0.574	0.283
	No	46.6 (12.7)		
Age (more than 40)	Yes	40.3 (21.5)	1.020	0.310
	No	32.6 (23)		
Sex (Male or postmenopausal female)	Yes	40.2 (21.7)	1.049	0.297
	No	30.7 (20.2)		
Hypertension	Yes	38.4 (19.9)	0.720	0.473
	No	41.6 (24.1)		
Central analgesics	Yes	38.1 (21.5)	0.892	0.526
	No	40.8 (21.9)		
Airway malformation	Yes	32 (21.2)	- 1.044	0.299
	No	40.3 921.2)		
Family history for OSA	Yes	32 (26.4)	- 1.046	0.299
	No	40.3 (21.2)		
Alcohol consumption	Yes	34.2 (19.1)	- 0.844	0.401
	No	40.3 (21.9)		
Smoking	Yes	43.1 (24.4)	1.371	0.174
	No	37.1 (19.2)		
Passive smoking	Yes	40.9 (19.3)	0.517	0.606
	No	38.6 (23.5)		

The relationship between AHI categories and demographics:

The study showed that 66.7% of male patients had high AHI scores compared to only 33.3% of female patient. There was no statistical significance when studying the relationship between the AHI categories and gender. We noticed also that 90.6% of patients who are more than 40 years old were under the category of severe AHI but there is no statistical significance between age, educational level, marital status or BMI and AHI categories. (Table 10).

Table (10): Relationship between AHI categories and demographics:						
		AHI categories			Chi-square value	p-value
		Mild N / (%)	Moderate N / (%)	Severe N / (%)		
sex	Male	9 (60%)	11 (57.9%)	44 (66.7%)	0.615	0.735
	Female	6 (40%)	8 (42.1)	22 (33.3)		
Age	< 60	9 (60%)	11 (57.9)	40 (60.6%)	0.045	0.978
	≥ 60	6 (40%)	8 (57.9%)	26 (39.4%)		
Educational level	Uneducated	0 (0%)	1 (5.3%)	6 (9.1%)	12.500	0.130
	Primary education	2 (13.3%)	4 (21.1%)	12 (18.2%)		
	Middle education	9 (60%)	3 (15.8%)	18 (27.3%)		
	Secondary education	3 (20%)	6 (31.6%)	10 (15.2%)		
	University	1 (6.7%)	5 (26.3%)	20 (30.3%)		
Marital status	Single	1 (6.7%)	2 (10.5%)	3 (4.5%)	0.950	0.622
	Married	14 (93.3%)	17 (89.5%)	63 (95.5%)		
BMI	Normal	0 (0%)	0 (0%)	1 (1.5%)	1.120	0.891
	Overweight	3 (20%)	2 (10.5%)	10 (15.2%)		
	Obese	12 (80%)	17 (89.5%)	55 (83.3%)		

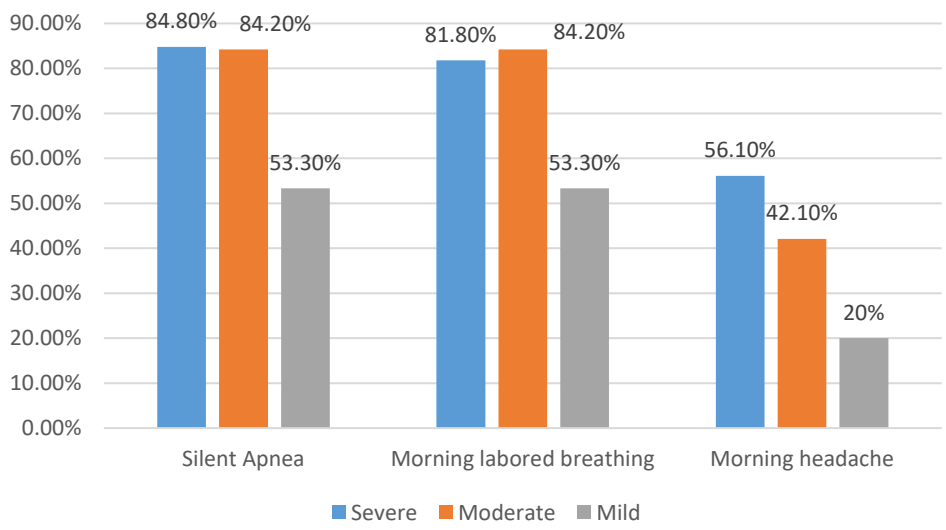
The relationship between AHI categories and OSA symptoms:

We found a relationship with statistical significance between AHI Categories and OSA symptoms, silent apnea was a common symptom in those with severe AHI score with a percentage of 84.8%. (P-value < 0.05). Morning labored breathing was the most common symptom in patients who have moderate AHI score with a percentage of 84.2% (P-value <0.05). 56.1% of patients who have morning headache had severe AHI score (P-value <0.05). (Table 11 – Figure 16)

Table (11): Relationship between AHI index and OSA symptoms

Symptoms	AHI index			Chi-square value	p-value
	Mild N / (%)	Moderate N / (%)	Severe N / (%)		
severe or recurrent snoring	14 (93.3%)	17 (89.5%)	63 (95.5%)	0.950	0.622
Silent Apnea	8 (53.3%)	16 (84.2%)	56 (84.8%)	7.847	0.020
Morning labored breathing	8 (53.3%)	16 (84.2%)	54 (81.8%)	6.306	0.043
daytime fatigue and drowsiness	13 (86.7%)	19 (100%)	61 (92.4%)	2.388	0.303
Uncomfortable sleep	12 (80%)	19 (100%)	62 (93.9%)	5.414	0.067
Insomnia	4 (26.7%)	8 (42.1%)	36 (54.5%)	4.132	0.127
Morning headache	3 (20%)	8 (42.1%)	37 (56.1%)	6.694	0.035
Interrupted sleep for micturition	10 (66.7%)	14 (73.7%)	45 (68.2%)	0.254	0.881
Poor concentration	5 (33.3%)	4 (21.1%)	31 (47%)	4.456	0.108
Memory disturbances	7 (46.7%)	7 (36.8%)	36 (54.5%)	1.928	0.381
Loss of Libido	1 (6.7%)	2 (10.5%)	7 (10.6%)	0.218	0.897
erectile dysfunction	0 (0%)	0 (0%)	3 (4.5%)	1.593	0.451
Agitation	7 (46.7%)	13 (68.4%)	44 (66.7%)	2.321	0.313

Figure (16): Relationship between AHI categories and OSA sympmtoms



Relationship between AHI categories and OSA risk factors:

After studying the relationship between AHI categories and OSA risk factors we found no statistically significant relation between them. (Table 12).

Table (12): Relationship between AHI index and OSA risk factors

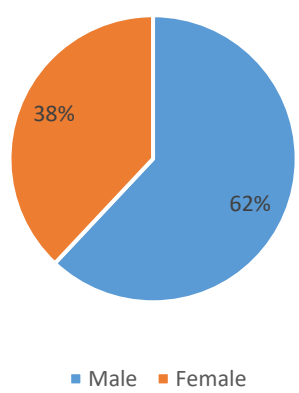
Risk Factor	AHI index			Chi-square value	p-value
	Mild N / (%)	Moderate N / (%)	Severe N / (%)		
BMI (more than 25)	15 (100%)	19 (100%)	63 (95.5%)	1.593	0.451
Age (more than 40)	12 (80%)	17 (89.5%)	62 (93.9%)	2.966	0.227
Sex (Male or postmenopausal female)	14 (93.3%)	17 (89.5%)	63 (95.5%)	0.950	0.622
Hypertension	9 (60%)	11 (57.9%)	40 (60.6%)	0.045	0.978
Central analgesics	8 (53.3%)	7 (36.8%)	28 (42.4%)	0.956	0.620
Airway malformation	3 (20%)	2 (10.5%)	3 (4.5%)	4.170	0.124
Family history for OSA	1 (6.7%)	1 (5.2%)	6 (9.1%)	0.336	0.845
Alcohol consumption	2 (13.3%)	2 (10.5%)	6 (9.1%)	0.252	0.882
Smoking	7 (46.7%)	7 (36.8%)	28 (42.4%)	0.346	0.841
Passive smoking	5 (33.3%)	8 (42.1%)	32 (48.5%)	1.213	0.545

As for the relationship between Gender and OSA symptoms, there was statistically significant relation between them. 57.8% of males have memory disturbances while only 36.1% of females have it, (P-value <0.05) (Figure 18) this was the only relation between gender and OSA symptoms.

Table (13): Relationship between Gender and OSA symptoms

Symptoms	Gender		Chi-square value	p-value
	Male N / (%)	Female N / (%)		
Severe or recurrent snoring	59 (92.2%)	35 (97.2%)	1.036	0.309
Silent Apnea	50 (78.1%)	30 (83.3%)	0.391	0.532
Morning labored breathing	51 (79.7%)	27 (75%)	0.295	0.587
Daytime fatigue and drowsiness	60 (93.8%)	33 (91.7%)	0.154	0.695
Uncomfortable sleep	61 (95.3%)	32 (88.9%)	1.460	0.227
Insomnia	27 (42.2%)	21 (58.3%)	2.406	0.121
Morning headache	28 (43.8%)	20 (55.6%)	1.287	0.257
Interrupted sleep for micturition	41 (64.1%)	28 (77.8%)	2.026	0.155
Poor concentration	30 (46.9%)	10 (27.8%)	3.501	0.061
Memory disturbances	37 (57.8%)	13 (36.1%)	4.340	0.037
Loss of Libido	8 (12.5%)	2 (5.6%)	1.235	0.267
Erectile dysfunction	2 (3.1%)	1 (2.8%)	0.010	0.922
Agitation	41 (64.1%)	23 (63.9%)	0.000	0.986

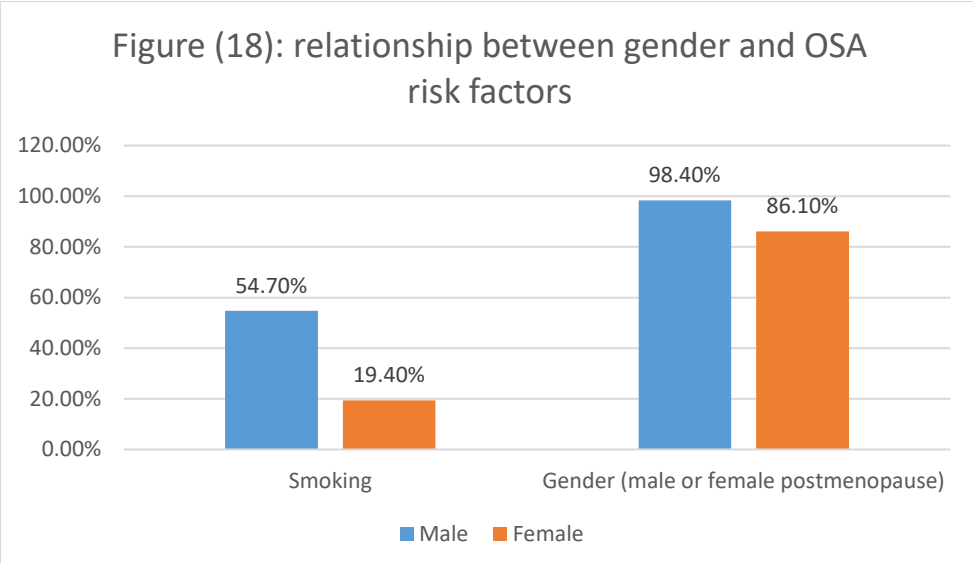
Figure (17): Relationship between gender and memory disturbances



The relationship between gender and OSA risk factors:

The results showed that there is a relationship between gender and OSA risk factors. As Being a male was an important risk factor for OSA. 54.7% of males were smokers while only 19.4% of females were. (P-value <0.05) (Table 15)

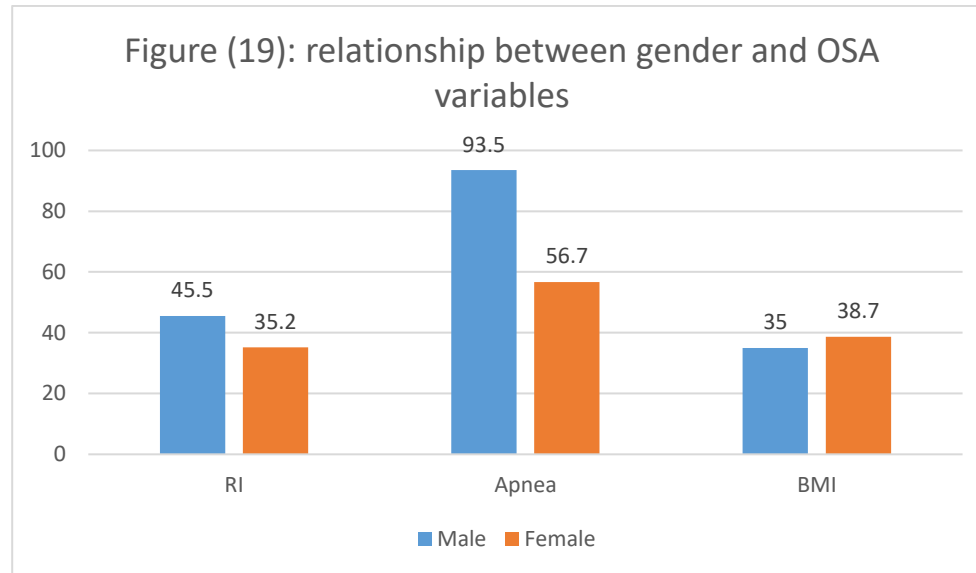
Table (14): Relationship between gender and OSA risk factors				
Risk Factor	Gender		Chi-square value	p-value
	Male N / (%)	female N / (%)		
BMI (more than 25)	63 (98.4%)	34 (94.4%)	1.262	0.261
Age (more than 40)	56 (87.5%)	35 (97.2%)	2.659	0.103
Sex (Male or postmenopausal female)	63 (98.4%)	31 (86.1%)	6.207	0.013
Hypertension	37 (57.8%)	23 (63.9%)	0.354	0.552
Central analgesics	24 (37.5%)	19 (52.8%)	2.194	0.139
Airway malformation	6 (9.4%)	2 (5.6%)	0.457	0.499
Family history for OSA	5 (7.8%)	3 (8.3%)	0.008	0.927
Alcohol consumption	9 (14.1%)	1 (2.8%)	3.260	0.071
Smoking	35 (54.7%)	7 (19.4%)	11.748	0.001
Passive smoking	25 (39.1%)	20 (55.6%)	2.532	0.112



Relationship between gender and OSA variables:

When studying the relationship between sex and vital signs, the results showed a statistically significant relationship between them. Males had an average RI of 45.5, higher than that of the females which is 35.2, with a value (P < 0.05). Males had a mean number of apnea episodes of 93.5 times, greater than females who had a mean of 56.7, with a value (P<0.05). Most of the female OSA patients had a mean BMI of 38.7which is higher than the 35 of males, with a value (P < 0.05), (Table 16-Figure 20).

Table (15): The Relationship between gender and OSA variables				
variable	gender		F/T Value	p-value
	male	female		
O2 saturation during sleep	77.5 (9.9)	78.3 (10.2)	0.408	0.684
Heart Rate during Sleep	73.5 (10.2)	73.1 (10.9)	0.372	0.851
RI	45.5 (23.6)	35.2 (17)	2.316	0.023
Apnea	93.5 (102.7)	56.7 (60)	2.259	0.026
Hypopnea	74.7 (68)	85.7 (76.6)	0.429	0.461
BMI	35 (6.5)	38.7 (11.1)	2.115	0.037
Smoking Index	596.3 (409.9)	400 (244.9)	1.581	0.141



Relationship between OSA severity and smoking:

68.6% of male patients who are smokers had a severe AHI score compared to 57.1% of female smokers who had severe AHI scores. But when studying the relationship between the severity of OSA based on gender, age, or BMI with smoking, the results did not show any statistically significant differences between them (Table 16).

Table (16): Relationship between OSA severity and smoking						
			Smoking		Chi-square value	P- Value
			Yes	No		
Gender	male	mild	5(14.3%)	4 (13.8%)	0.003	0.998
		moderate	6 (17.1%)	5 (17.2%)		
		severe	24 (68.6%)	20 (69%)		
	female	mild	2 (28.6%)	4 (13.8%)	1.008	0.604
		moderate	1 (14.3%)	7 (24.1%)		
		severe	4 (57.1%)	18 (62.1%)		
Age	<60	mild	5 (17.2%)	4 (12.9%)	0.236	0.889
		moderate	5 (17.2%)	6 (19.4%)		
		severe	19 (65.5%)	21 (67.7%)		
	>60	mild	2 (15.4%)	4 (14.8%)	0.260	0.878
		moderate	2 (15.4%)	6 (22.2%)		
		severe	9 (69.2%)	17 (63%)		
BMI	Normal	mild	0 (0%)	0 (0%)	.	.
		moderate	0 (0%)	0 (0%)		
		severe	0 (0%)	1 (100%)		
	Overweight	mild	2 (28.6%)	1 (12.5%)	0.670	0.715
		moderate	1 (14.3%)	1 (12.5%)		
		severe	4 (57.1%)	6 (75%)		
	Obese	mild	5 (14.3%)	7 (14.3%)	0.372	0.83
		moderate	6 (17.1%)	11 (22.4%)		
		severe	24 (68.6%)	31 (63.3%)		

Relationship between treatment adherence and OSA symptoms:

When studying the relationship between adherence to treatment and symptoms of obstructive apnea after treatment, the results showed a statistically significant relationship between them. Severe or recurrent snoring decreased by 77.6%, silent episodes of apnea by 67.2%, and morning labored breathing was reduced by 67.2%. daytime drowsiness and fatigue by 81%, uncomfortable sleep in 81%, interrupted sleep for micturition by 58.6%, and agitation by 53.4%, all these changes happened in patients who are adherent to treatment. (Figure 21). While the symptom of insomnia did not change in 55.2% of patients, morning headaches in 58.6%, poor concentration in 62.1%, memory disturbances in 60.3%, loss of libido at 96.6%, and erectile dysfunction in 98.3% of those who adhere to the treatment (Table 18 - Figure 22).

Table (17): Relationship between Treatment adherence and OSA symptoms					
		Treatment Adherence		Chi-square value	P-Value
		Yes (N=58)	No (N/A)		
Severe or recurrent snoring	Reduced	45 (77.6%)	0 (0%)	100	0
	No change	13 (22.4%)	0 (0%)	100	0
Silent episode of apnea	Reduced	39 (67.2%)	0 (0%)	100	0
	No change	19 (32.8)	0 (0%)	100	0
Morning labored breathing	Reduced	47 (81%)	0 (0%)	100	0
	No change	11 (19%)	0 (0%)	100	0
Daytime fatigue and drowsiness	Reduced	47 (81%)	0 (0%)	100	0
	No change	11 (19%)	0 (0%)	100	0
Uncomfortable sleep	Reduced	47 (81%)	0 (0%)	100	0
	No change	11 (19%)	0 (0%)	100	0
Insomnia	Reduced	26 (44.8%)	0 (0%)	100	0
	No change	32 (55.2%)	0 (0%)	100	0
Morning headache	Reduced	23 (39.7%)	0 (0%)	100	0
	No change	34 (58.6%)	0 (0%)	100	0
	Increased	1 (1.7%)	0 (0%)	100	0
Interrupted sleep for micturition	Reduced	34 (58.6%)	0 (0%)	100	0
	No change	23 (39.7%)	0 (0%)	100	0
	Increased	1 (1.7%)	0 (0%)	100	0
Poor concentration	Reduced	21 (36.2%)	0 (0%)	100	0
	No change	36 (62.1%)	0 (0%)	100	0
	Increased	1 (1.7%)	0 (0%)	100	0
Memory disturbances	Reduced	21 (36.2%)	0 (0%)	100	0
	No change	35 (60.3%)	0 (0%)	100	0
	Increased	2 (3.4%)	0 (0%)	100	0
Loss of libido	Reduced	2 (3.4%)	0 (0%)	100	0
	No change	56 (96.6%)	0 (0%)	100	0
Erectile dysfunction	Reduced	1 (1.7%)	0 (0%)	100	0
	No change	57 (98.3%)	0 (0%)	100	0
Agitation	Reduced	31 (53.4%)	0 (0%)	100	0
	No change	26 (44.8%)	0 (0%)	100	0

Figure (20): Relationship between treatment adherence and OSA symptoms

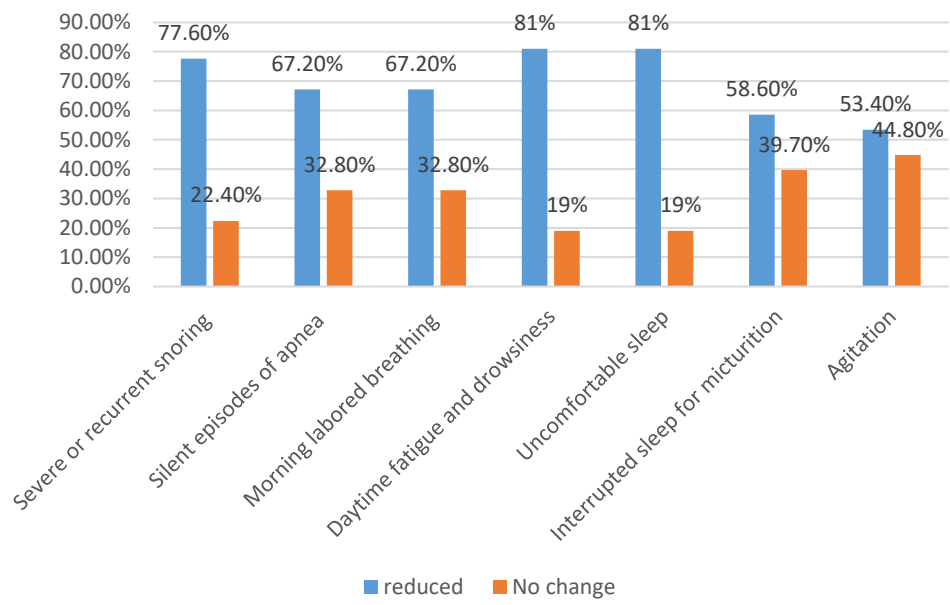
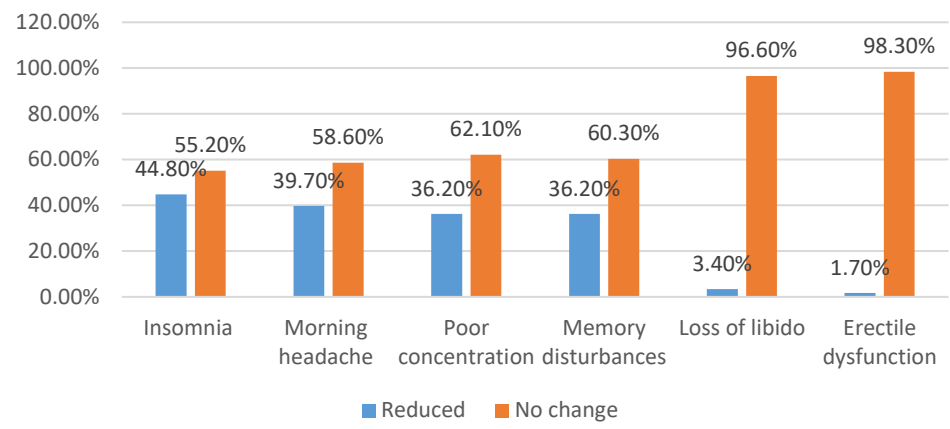


Figure (21): Relationship between treatment adherence and OSA symptoms.



Discussion

We found a relationship of a statistical significance between the mean of the AHI and gender, as it was in males 23.3 ± 43.1, and 16.7 ± 33.5 In females, with a (P-value =0.032), which is consistent with the results of the study by Ozge can Bostan and his colleagues in Turkey in 2021 which showed that the mean of the AHI In males, 21.9 ± 26.8, while in females, 20.1 ± 22.1, with a value (P-value=0.001) [71].

There are statistically significant differences between the proportion of patients who smoke and gender, as (P-value=0.001). These differences were in favor of male patients with 54.7% compared to 19.4% for female patients, and this is consistent with the results of the study by Ozge can Bostan and his colleagues in Turkey in 2021 which showed that the mean of AHI in males is 21.9 ± 26.8 and in females 20.1 ± 22.1. [71]

We also noted that there was no statistically significant relationship between the BMI and the average AHI, which is consistent with the results of a study done by Domenico ciavarella in Italy in 2018 [72].

We found statistically significant differences between gender and memory disorder, as (P-value=0.037), and these differences were in favor of males at 57.8% compared to females at 36.1%.

We found that treatment adherence was associated with relieved symptoms of OSA with a p-value=0.000

We also noted that there was no statistically significant relationship between nocturnal urination and gender in patients with OSA, and this contradicts with the results of the study conducted by Beyza Akcan in Turkey in 2021 [74]

We found that there was no statistically significant relationship between morning headache and gender in OSA patients which contradicts with the results of the study of Beyza Akcan in Turkey in 2021.

We didn't find a relationship between smoking and the severity of OSA In both genders which agrees with the study of Ayse Didem Esen conducted in Turkey in 2020

There was no statistically significant relationship between smoking and BMI which corresponds to the findings of a study done in turkey in 2021 by Sebnem Yosunkaya.

There was no relationship between Alcohol consumption and gender in OSA patients which conflicts with the findings of Ozen K.Basolgu in 2018 which showed a relationship between these variables with a p-value <0.001

Our study didn't find a statistically significant relationship between the symptoms (morning drowsiness and snoring) and gender in OSA patients which goes along with a study conducted in turkey by Ozen K. Nasoglu in 2018.

Study Limitations

The sample size was limited due to the missing information in the records and their poor organization. We also faced Difficulty in obtaining sufficient information about patients who adhere to treatment due to their limited knowledge about the treatment and the procedures they underwent. We also faced Difficulties in communication and follow up with the patients outside the center. Patients did not comply with the correct instructions on how to place and use the home sleep apnea test device, and they did not adhere to treatment.

Regarding the importance of obstructive sleep apnea syndrome, and the ongoing international research and studies about this topic, we recommend Spreading awareness among members of the community about the signs and symptoms, and how to diagnose this syndrome, Carrying out serious studies that explain the extent of this syndrome, its causes and risk factors in Syria, urging the medical staff to take a full detailed history and perform full clinical examination of patients and to take care of organizing and arranging the patients records. We also recommend Providing specialized medical centers and hospitals with polysomnography devices and provide CPAP devices at affordable prices that suit all members of society.

Conclusion:

Obstructive sleep apnea occurs at any age, due to complete or partial recurrent narrowing of the upper airway during the period of deep sleep (REM-Phase of the sleep cycle), which leads to a significant change in intrathoracic pressure causing hypoxemia and apnea attacks.

OSA patient suffers from many symptoms that negatively affect their lifestyle. The most common of these symptoms is snoring, especially snoring followed by suffocation. However, not all patients who suffer from Snoring are diagnosed with obstructive apnea.

One of the basic methods used to diagnose OSA is the full polysomnography test, provided that it is conducted for more than 4 hours in one of the specialized centers that are Equipped with the required special equipment.

There are many treatment options for OSA, the most important of which is the CPAP device, but the adherence of its use is somewhat minimal, the main reason for that is the discomfort associated with its use.

Declarations:

Ethics approval and consent to participate:

The Research Ethics Committee in the Syrian Private University and the ethical committees in the concerned hospitals approved the study protocol. Verbal informed consent was obtained from every participant before participation. All procedures performed in studies involving human participants were by the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards.

Consent for publication:

Not applicable.

Availability of data and materials:

All data related to this paper's conclusion are available and stored by the authors. All data are available from the corresponding author on a reasonable request.

Conflict of interest:

The authors declare that they have no conflict of interest

Funding:

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Authors' contributions:

H.B and L.N conceptualized the study. H.B, I.G, Y.I, and M,S wrote the study protocol, performed the statistical analysis, participated in data collection, and did the literature search. Y.I and M.S participated in the literature search, interpret the results, wrote the main manuscript, and prepared the tables. L.N. revised the draft. All authors read and approved the final draft.

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Figures

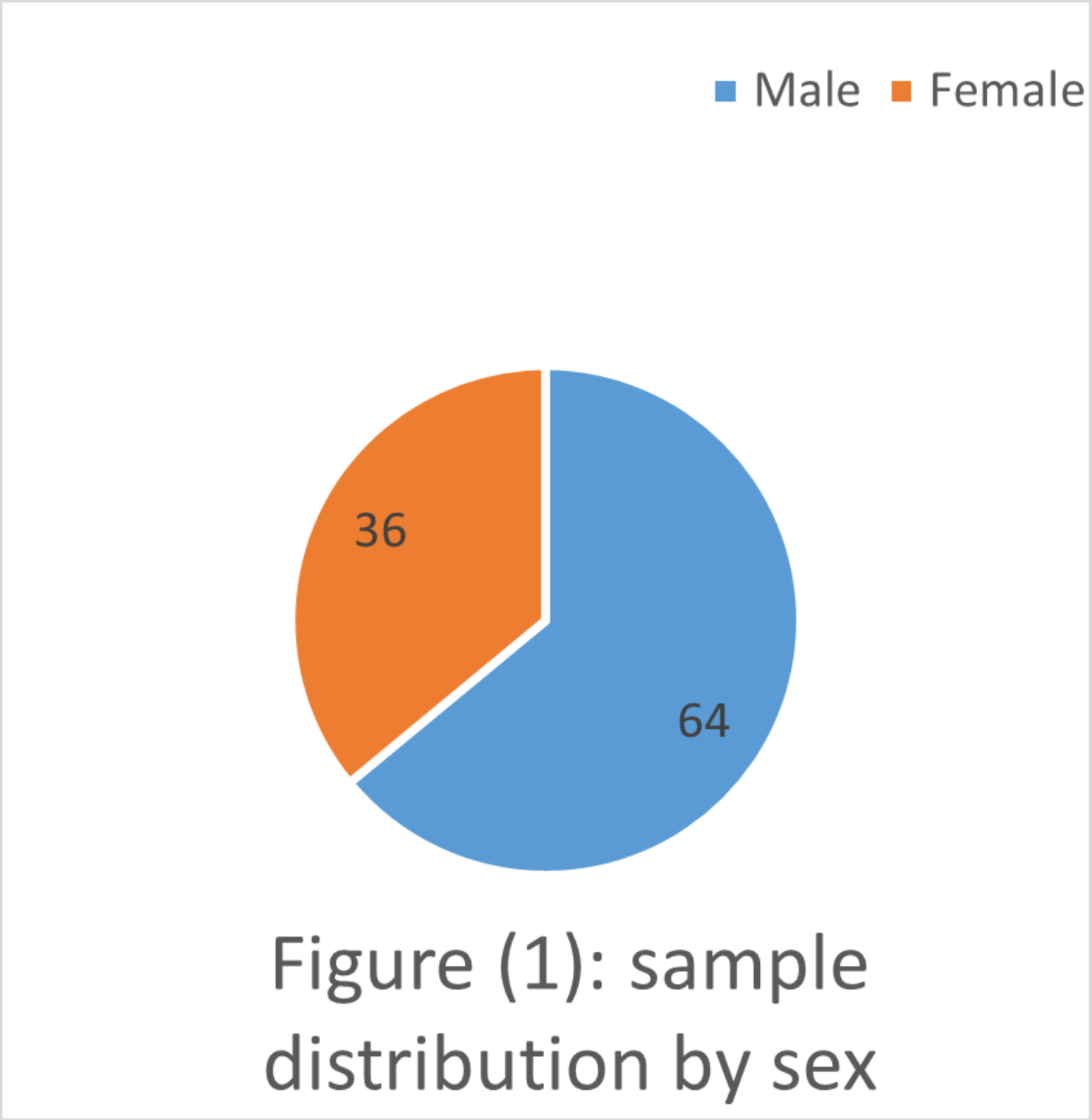

Figure 1

Blue: Male - Orange: Female

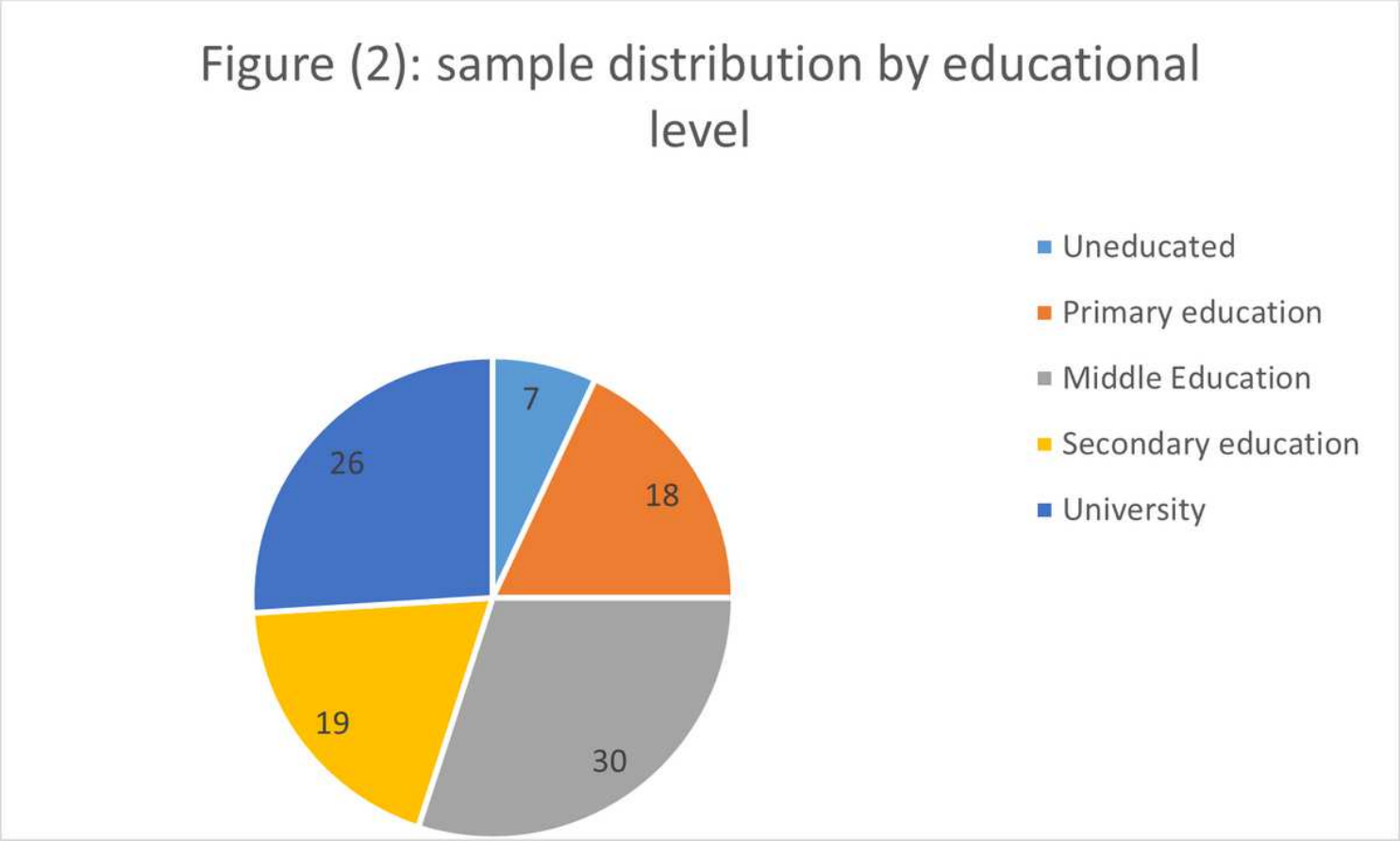

Figure 2

Blue: Uneducated - Red: Primary education - Gray: Middle education - Yellow: Secondary education - Dark blue: University

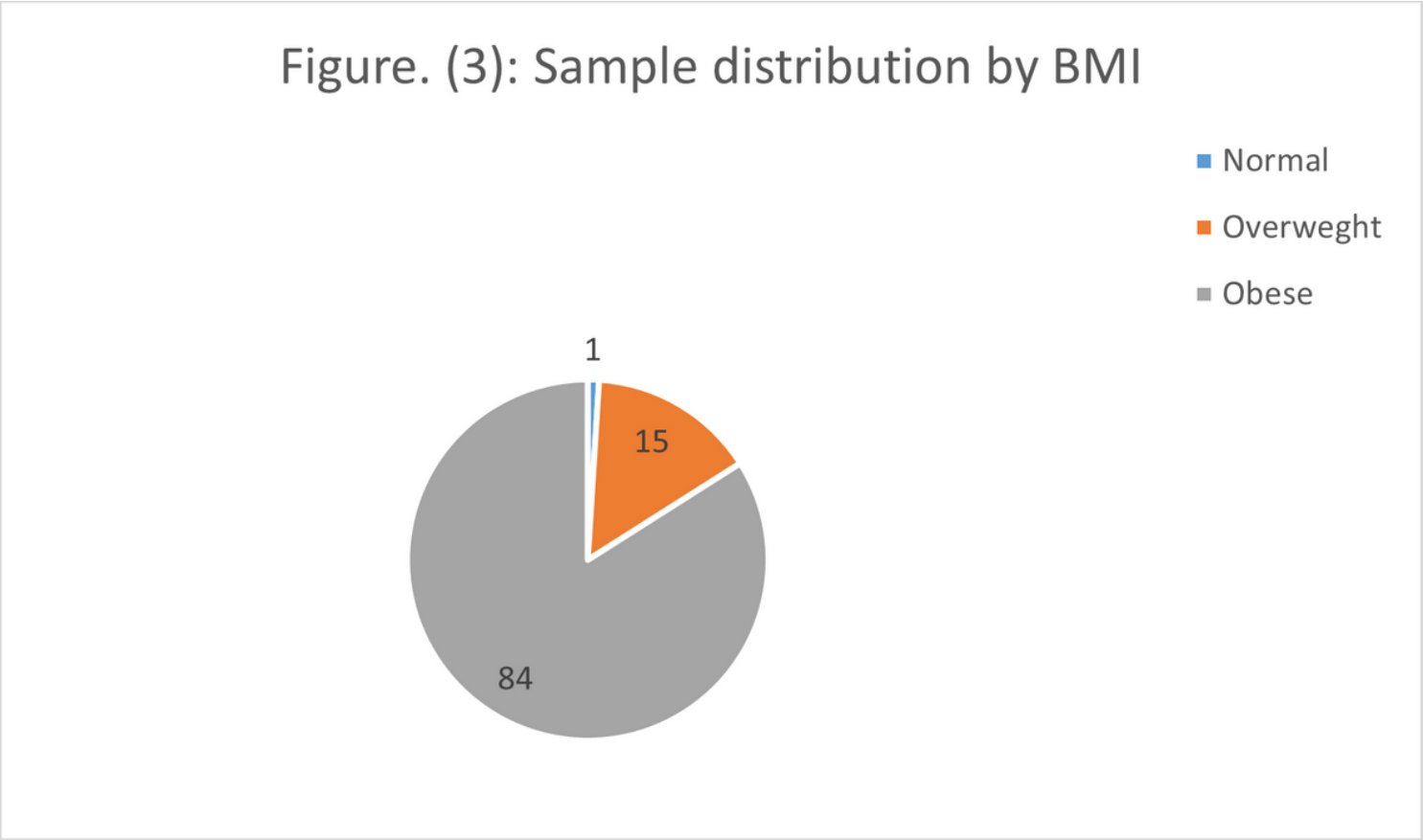

Figure 3

Blue: Normal - Orange: Overweight - Gray: Obese

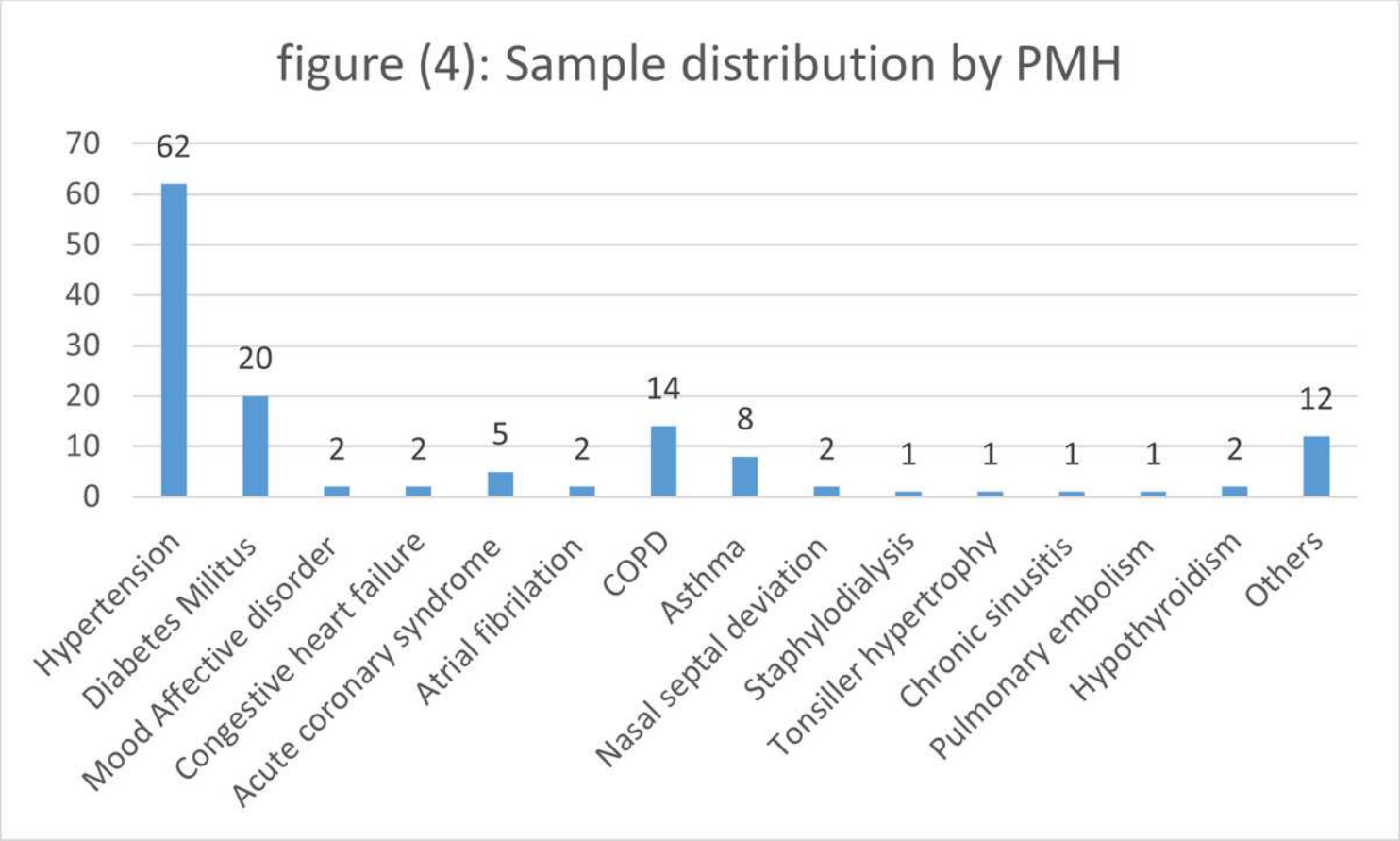

Figure 4

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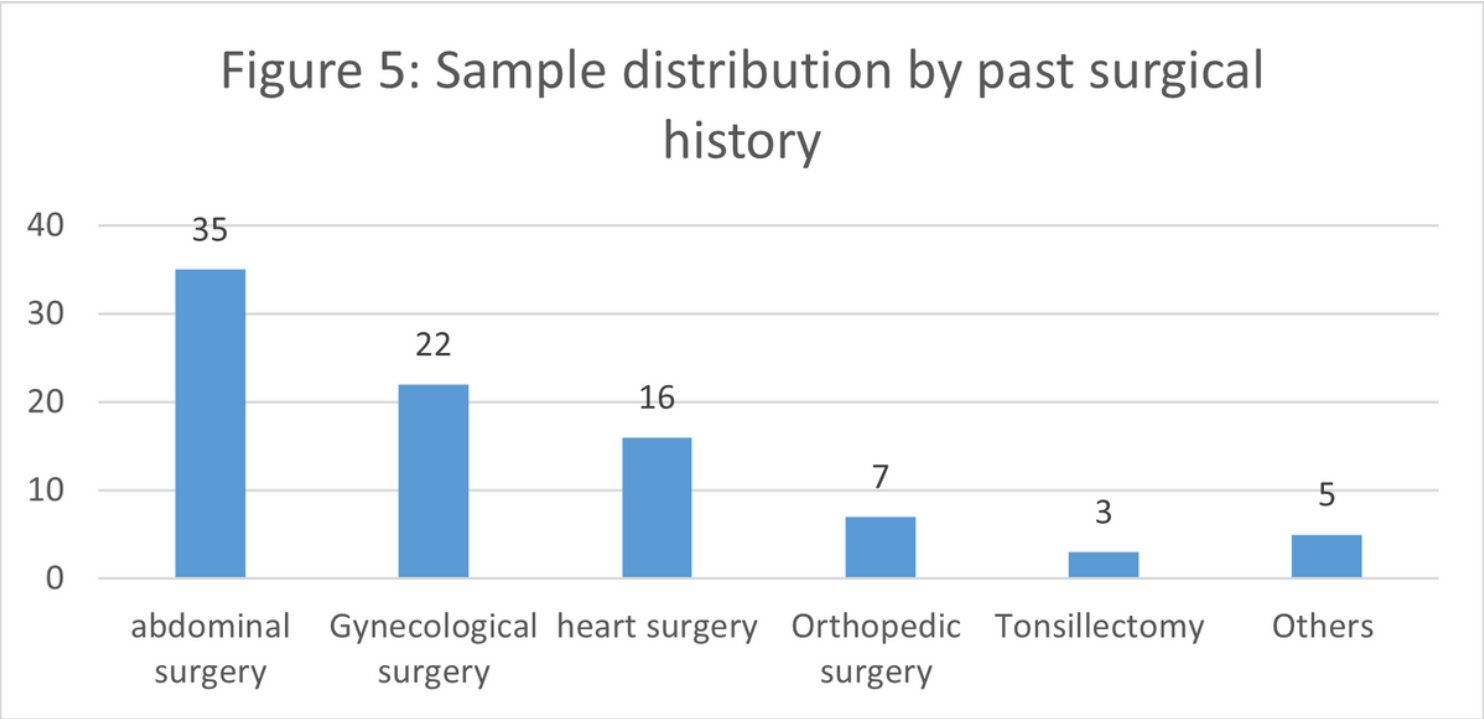

Figure 5

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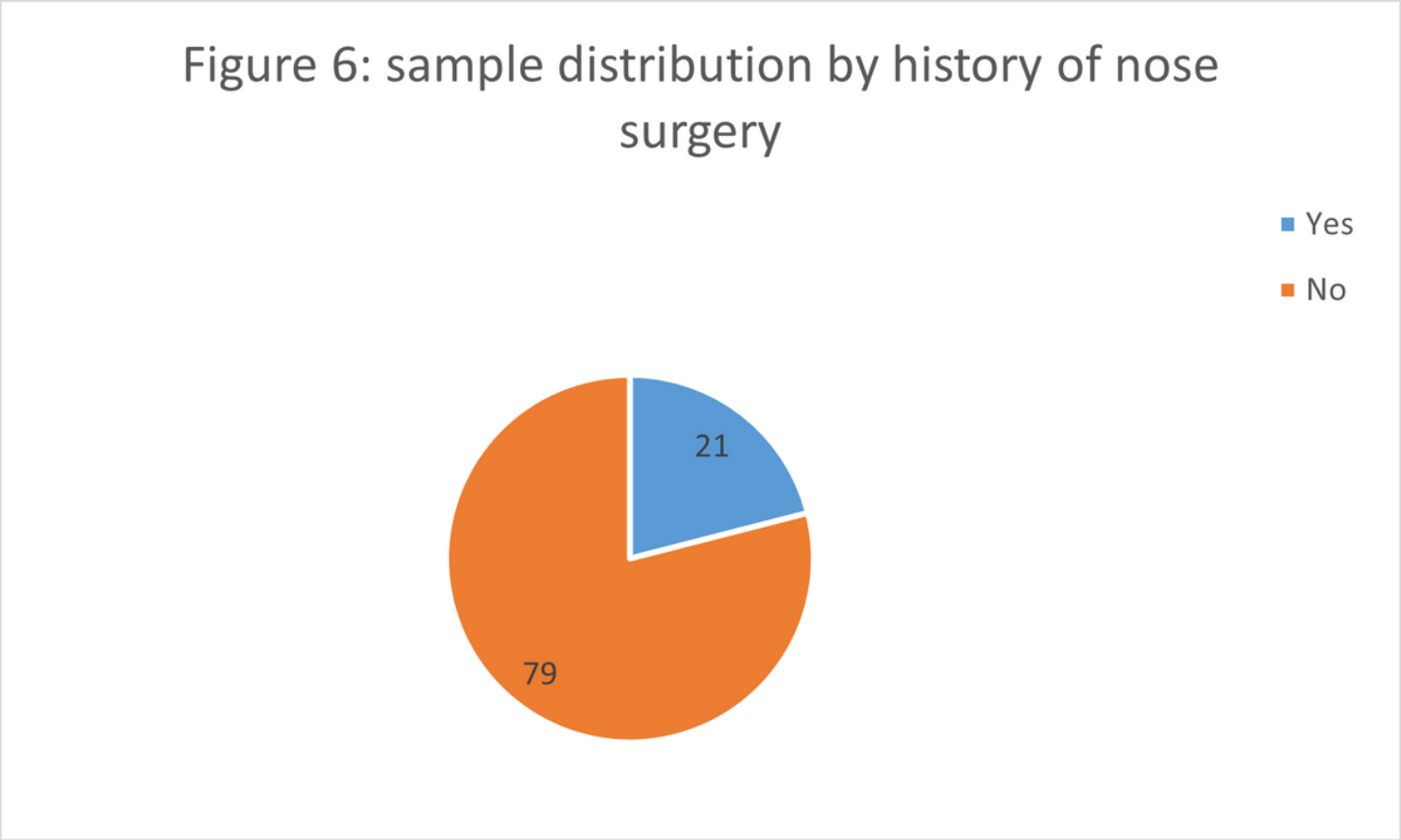

Figure 6

Blue: yes - Orange: No

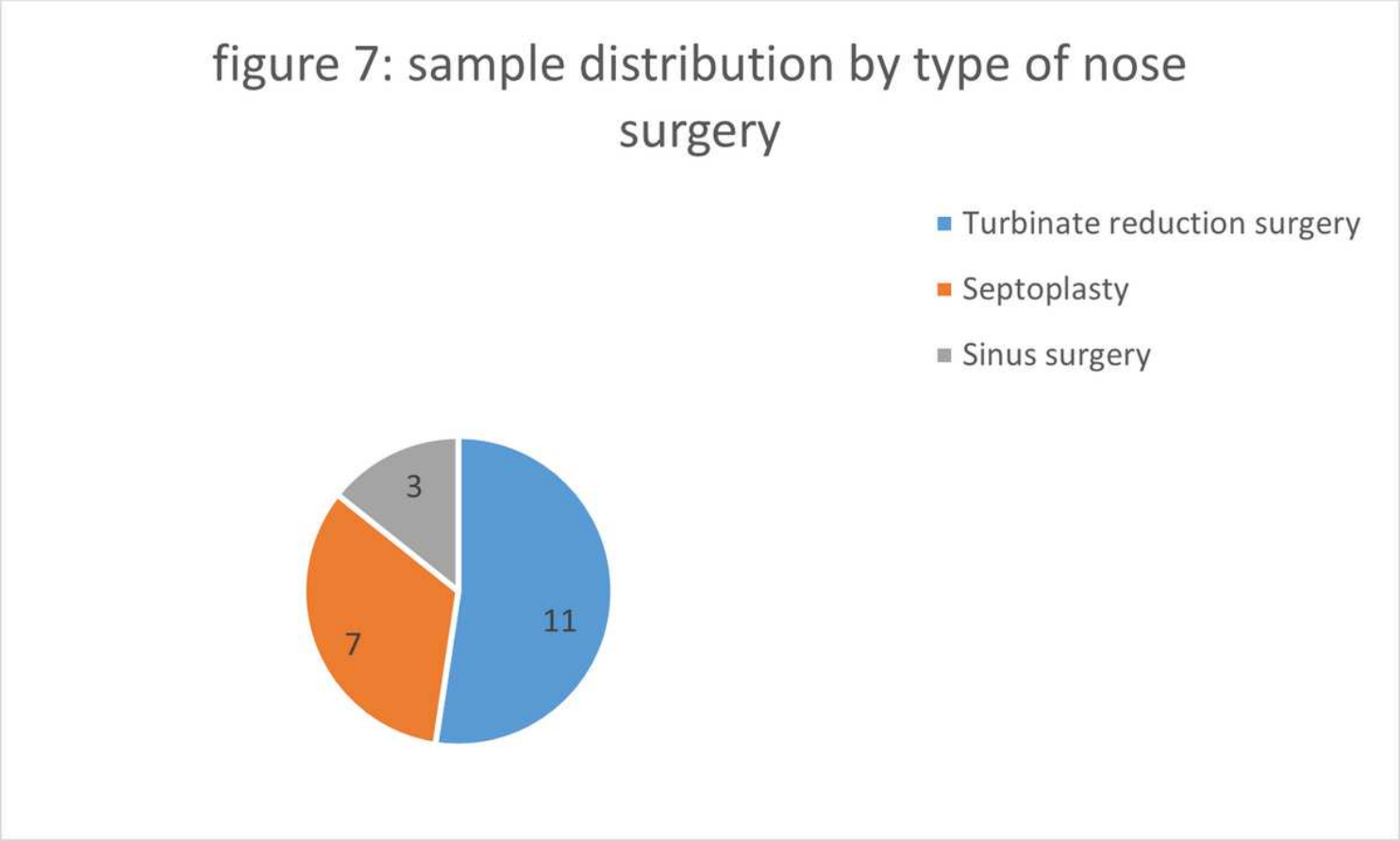

Figure 7

Blue: Turbinate reduction surgery - Orange: Septoplasty - Gray: Sinus surgery

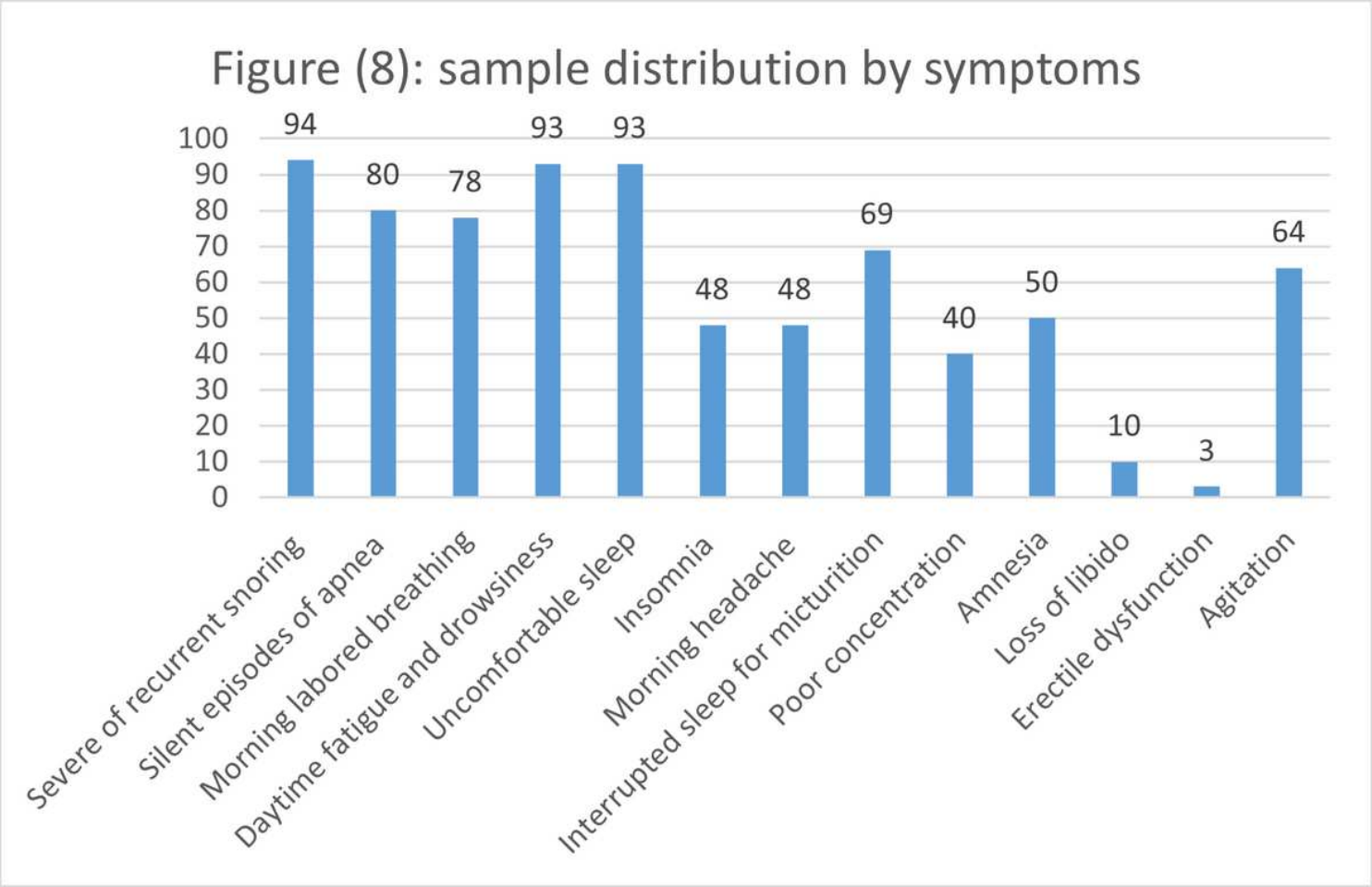

Figure 8

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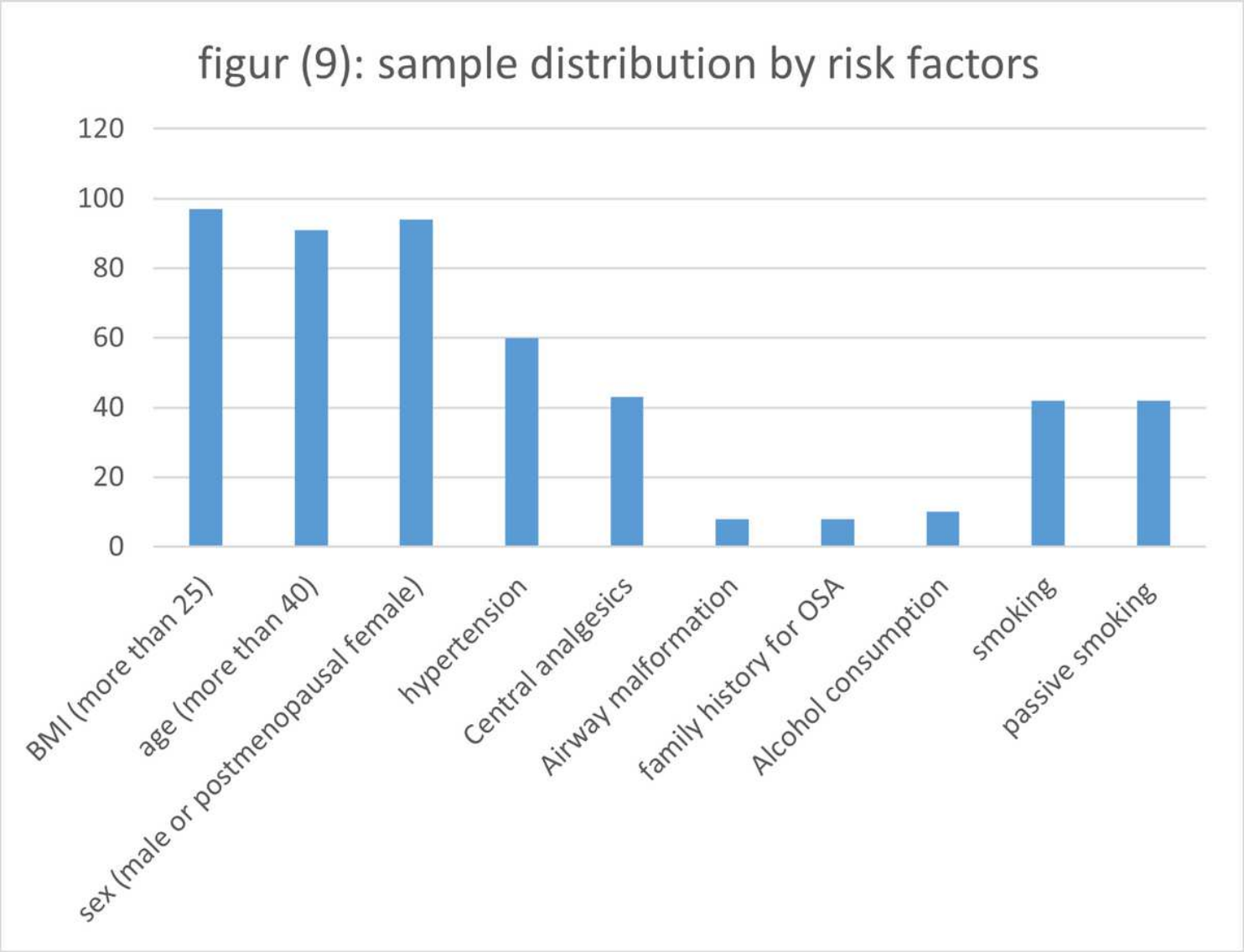

Figure 9

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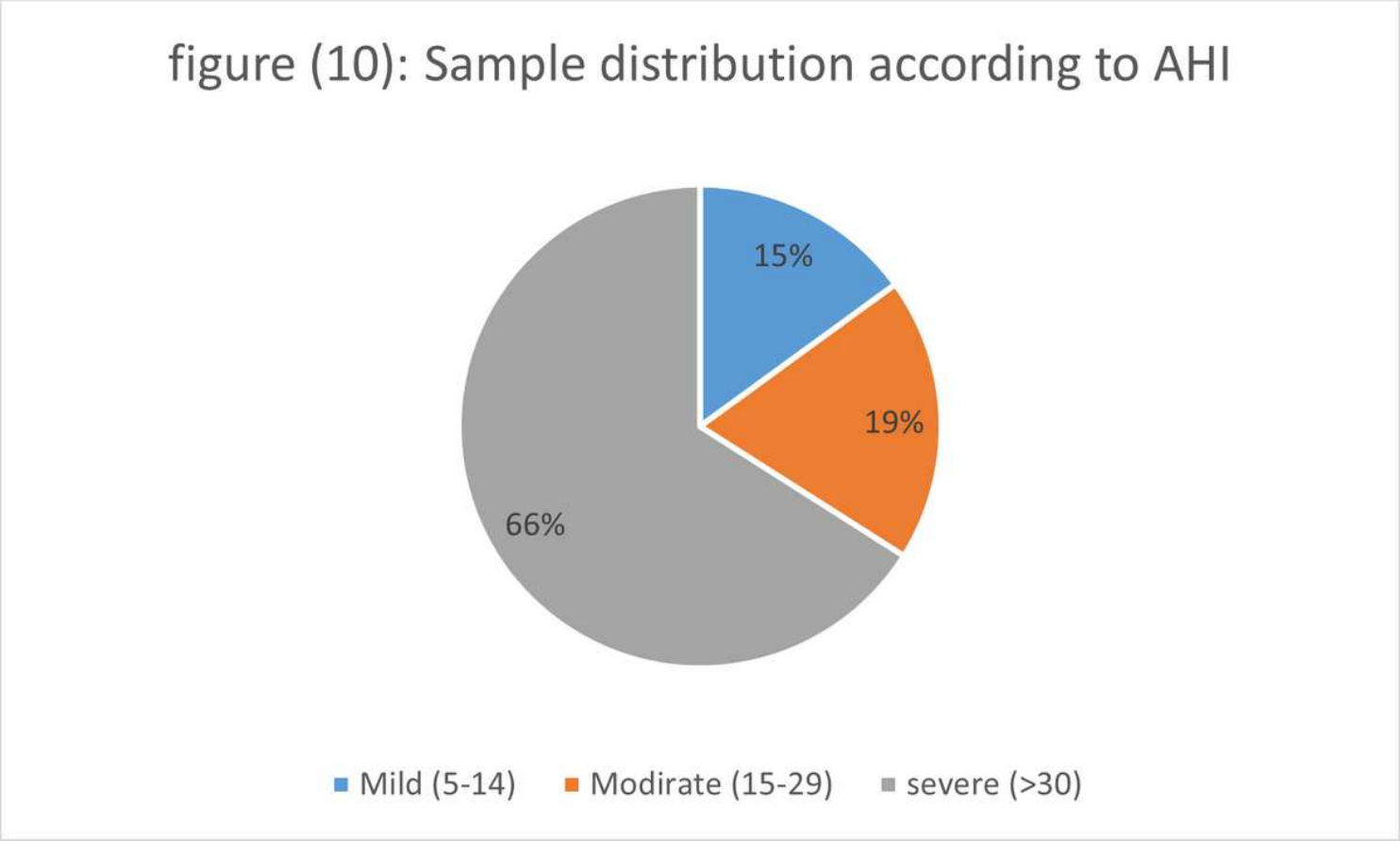

Figure 10

Blue: Mild (5-14) - Orange: Moderate (15-29) - Gray: Severe (>30)

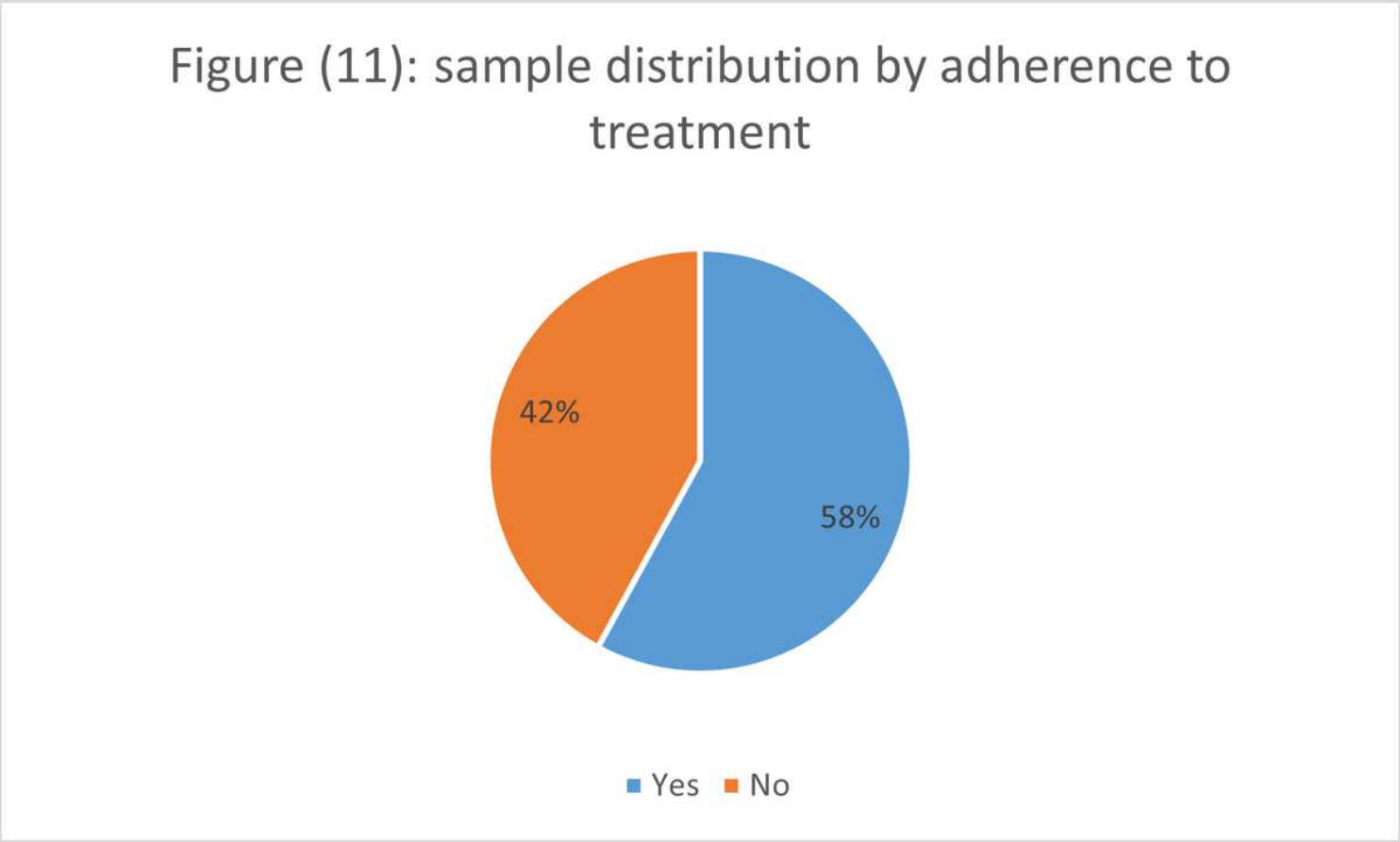

Figure 11

Blue: Yes - Orange: No

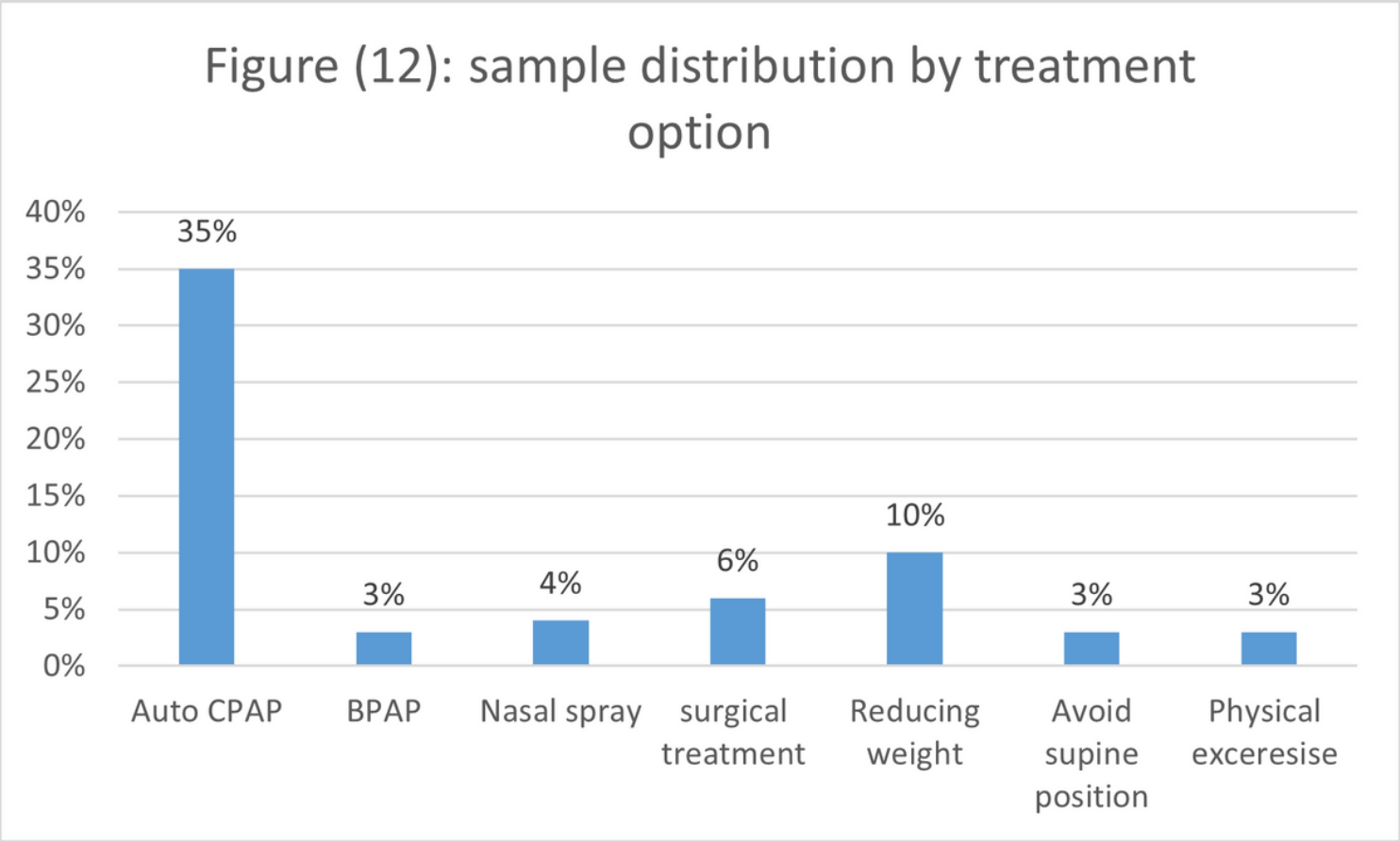

Figure 12

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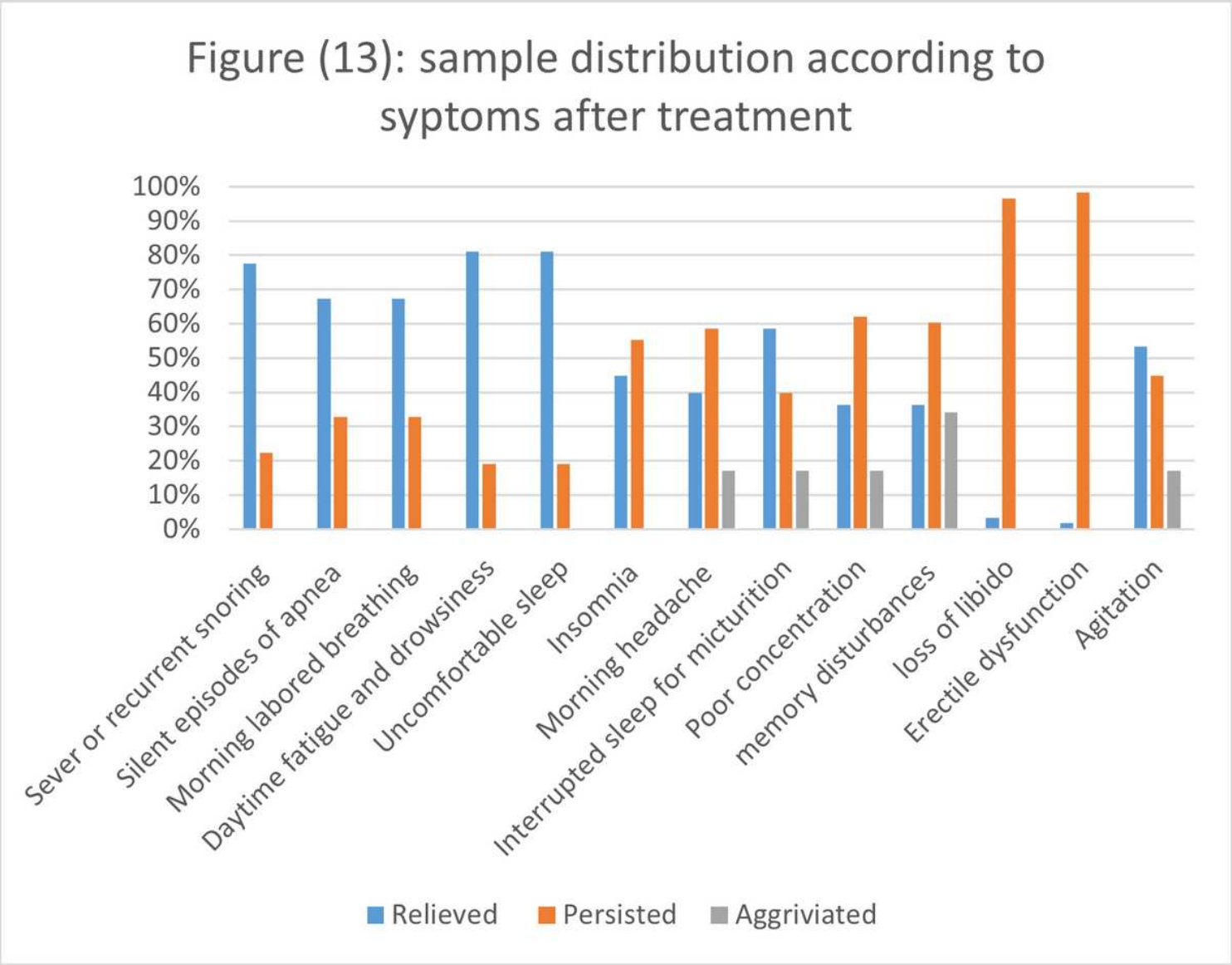

Figure 13

Blue: Relieved - orange: Persisted - Gray: Aggriviated

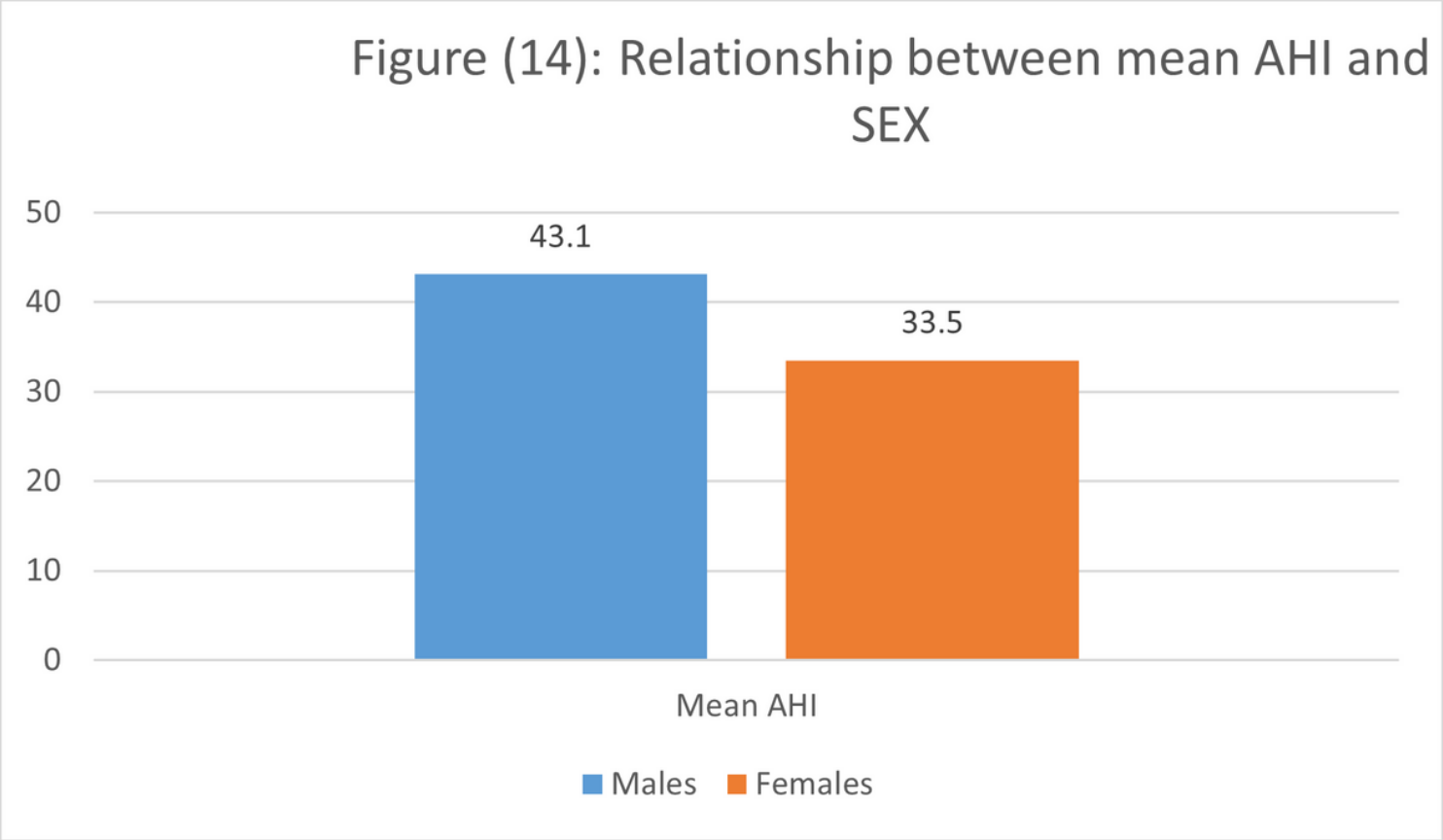

Figure 14

Blue: Males - Orange: Females

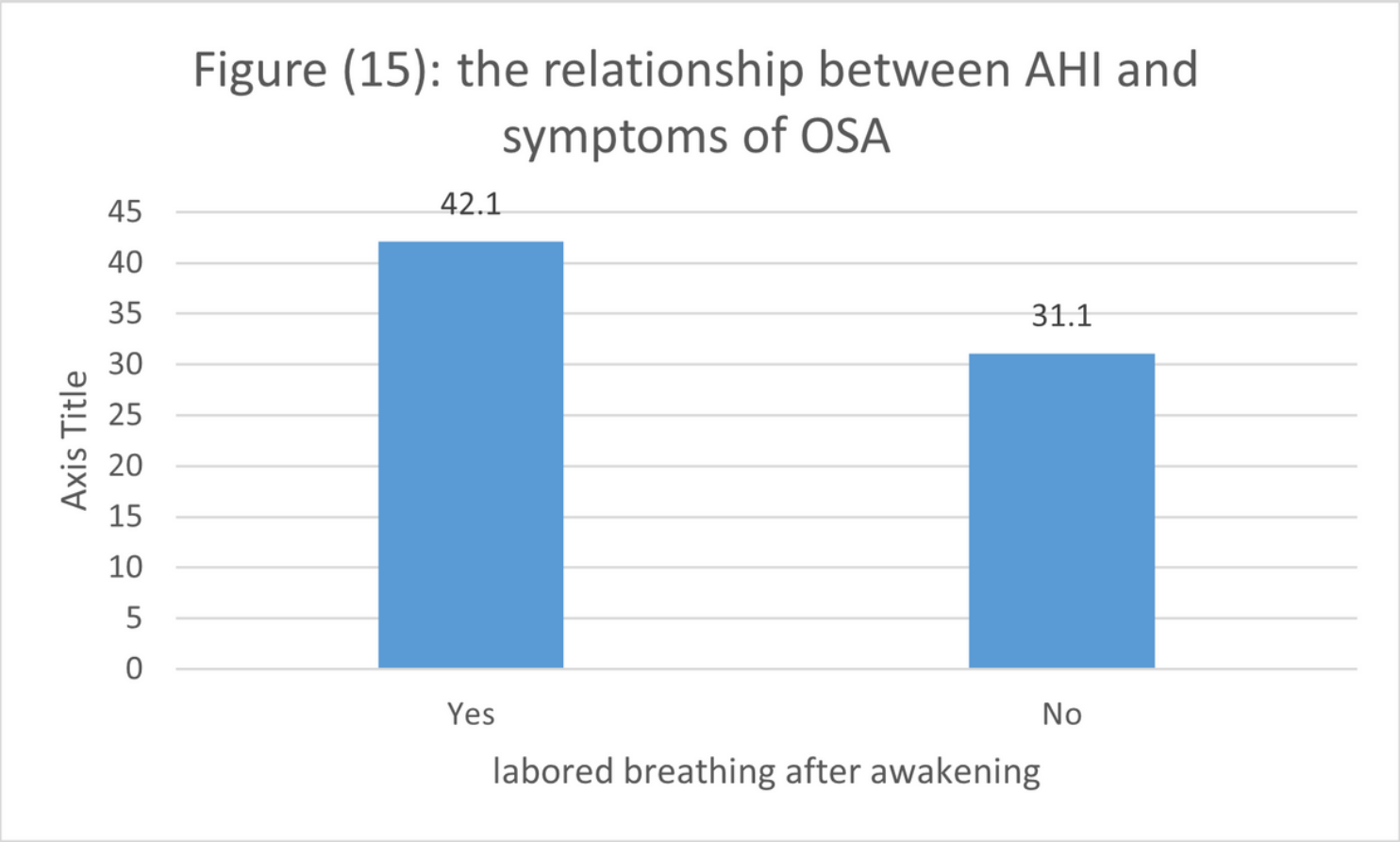

Figure 15

See image above for figure legend.

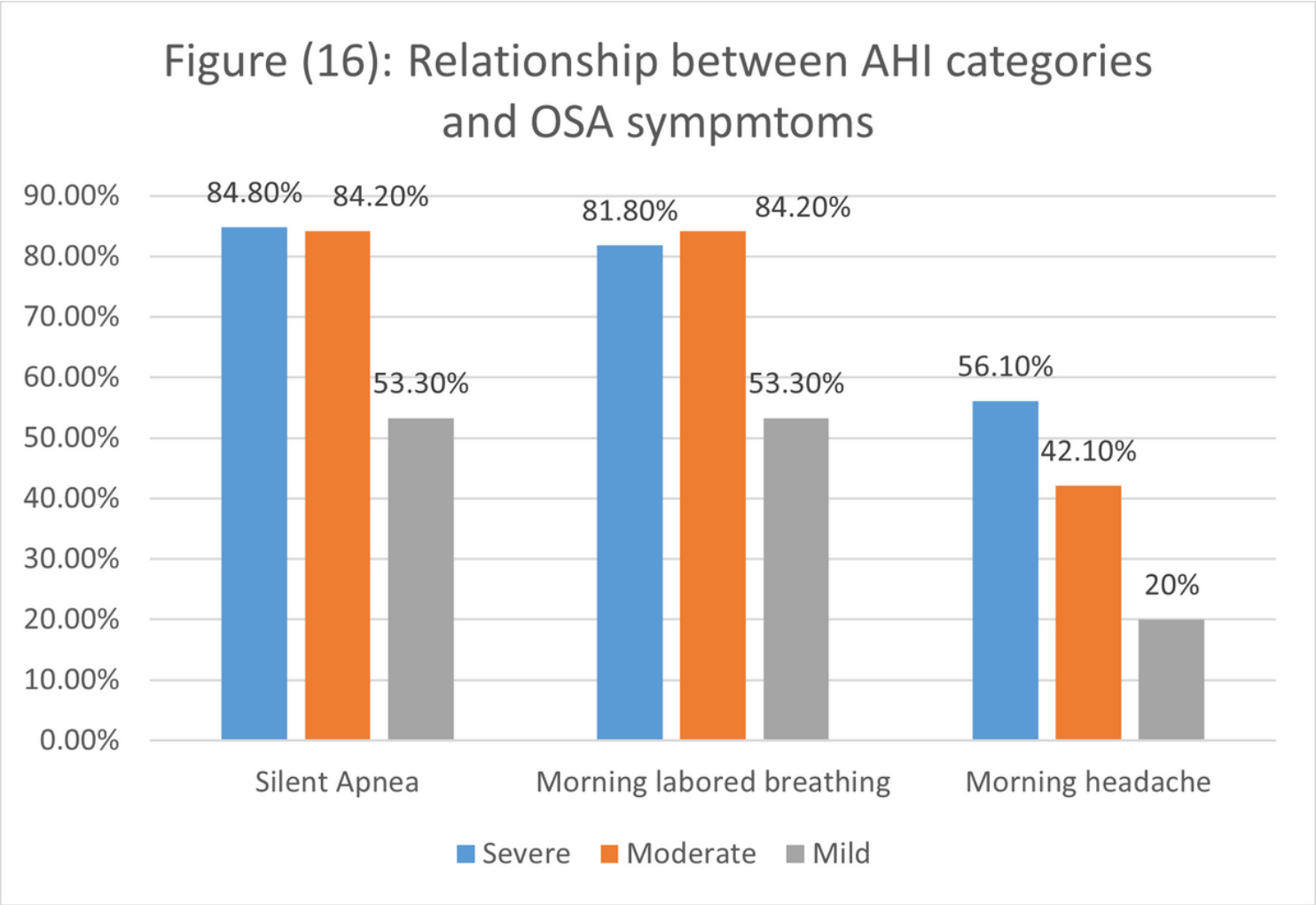

Figure 16

Blue: Severe - Orange: Moderate - Gray: Mild

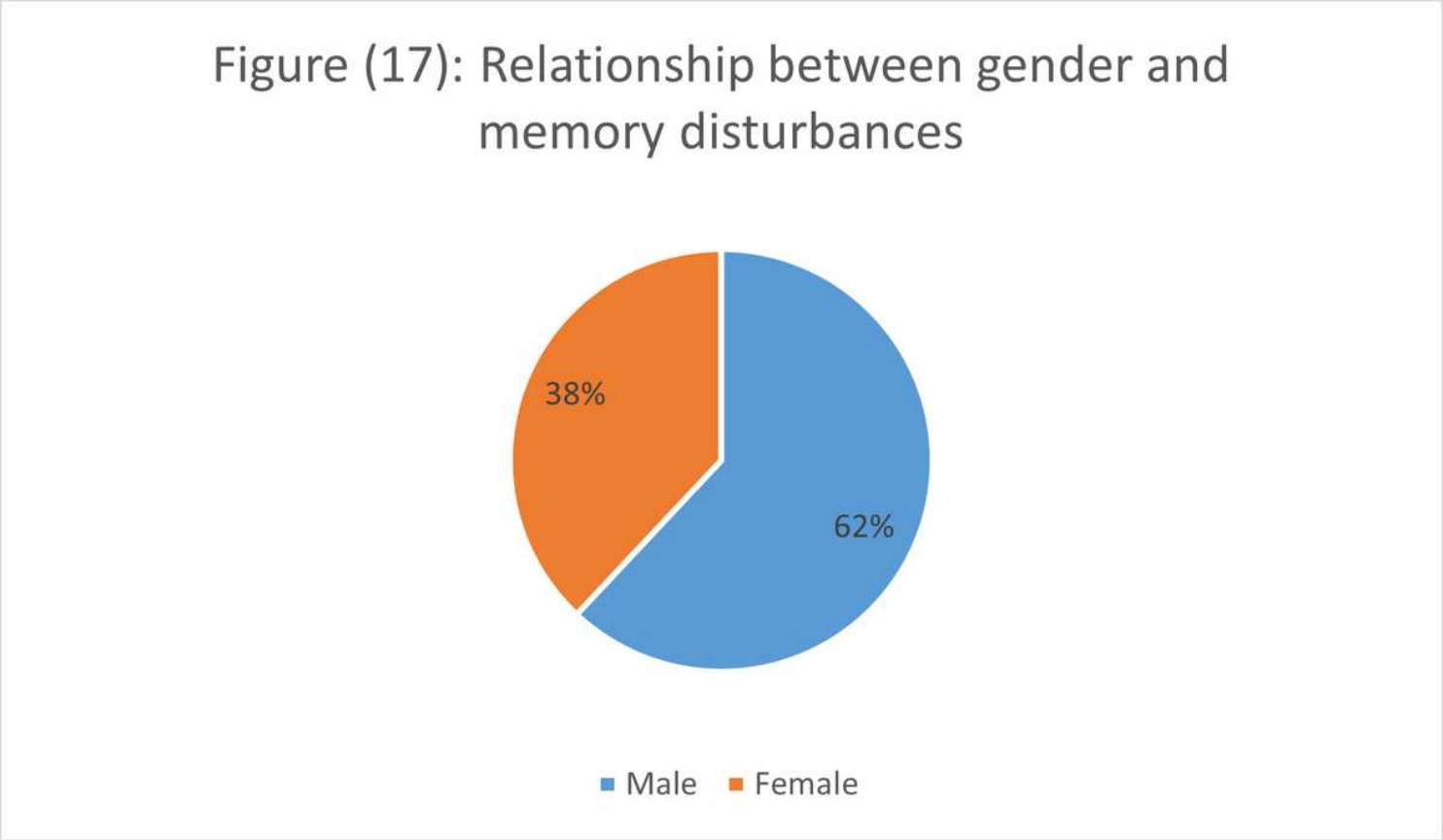

Figure 17

Blue: Male - Orange: Female

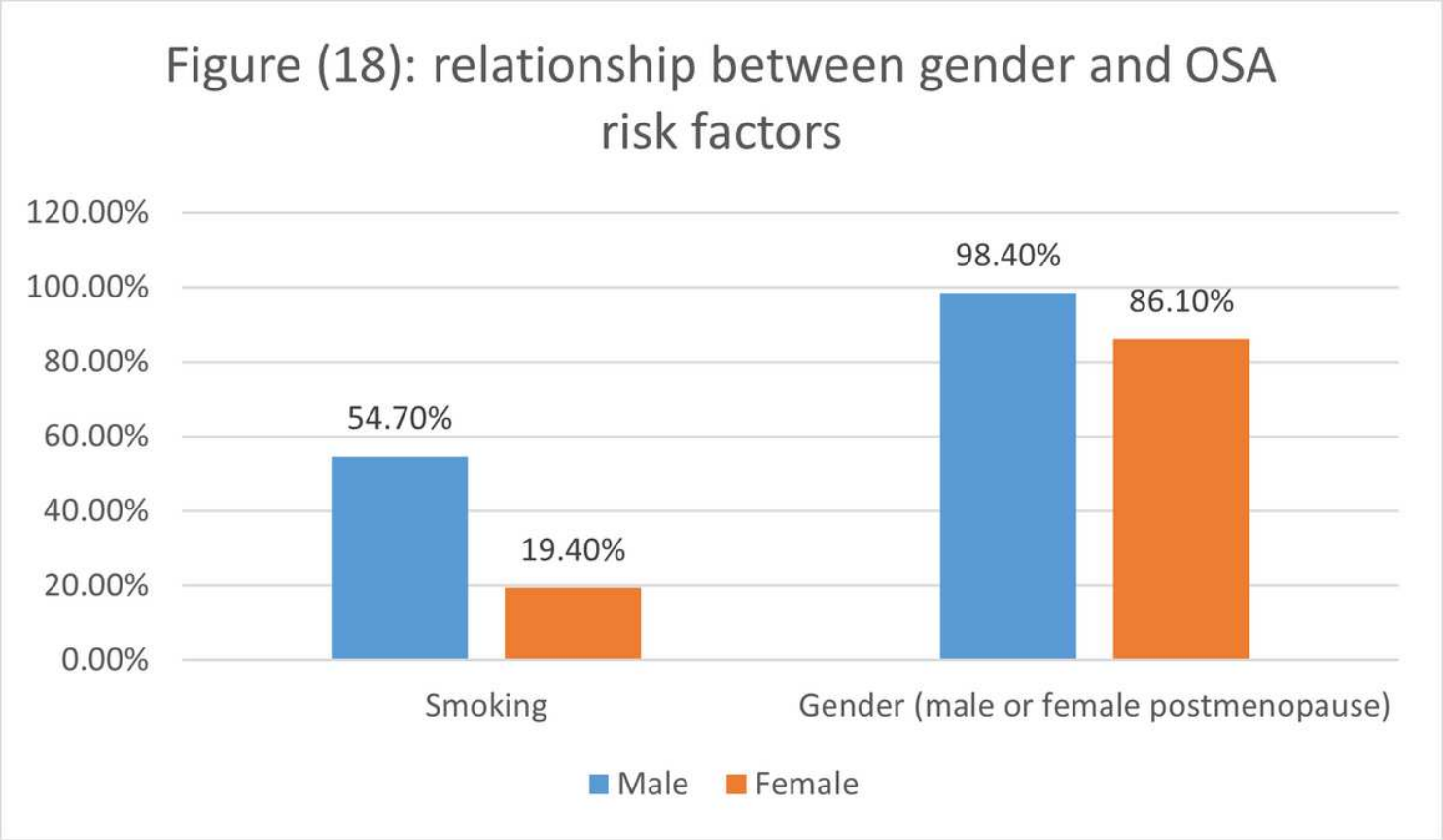

Figure 18

Blue: Male - Orange: Female

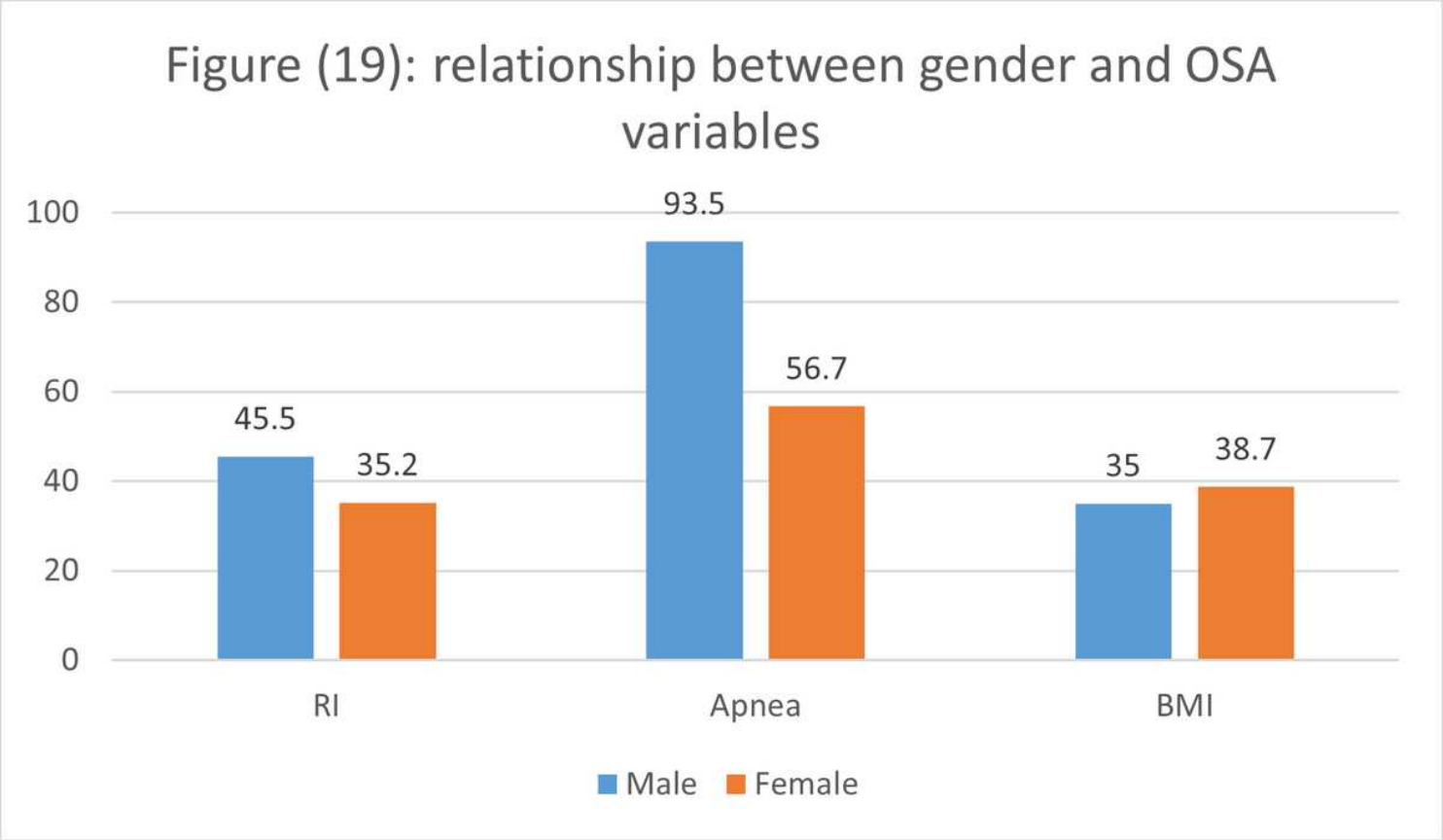

Figure 19

Blue: Male - Orange: Female

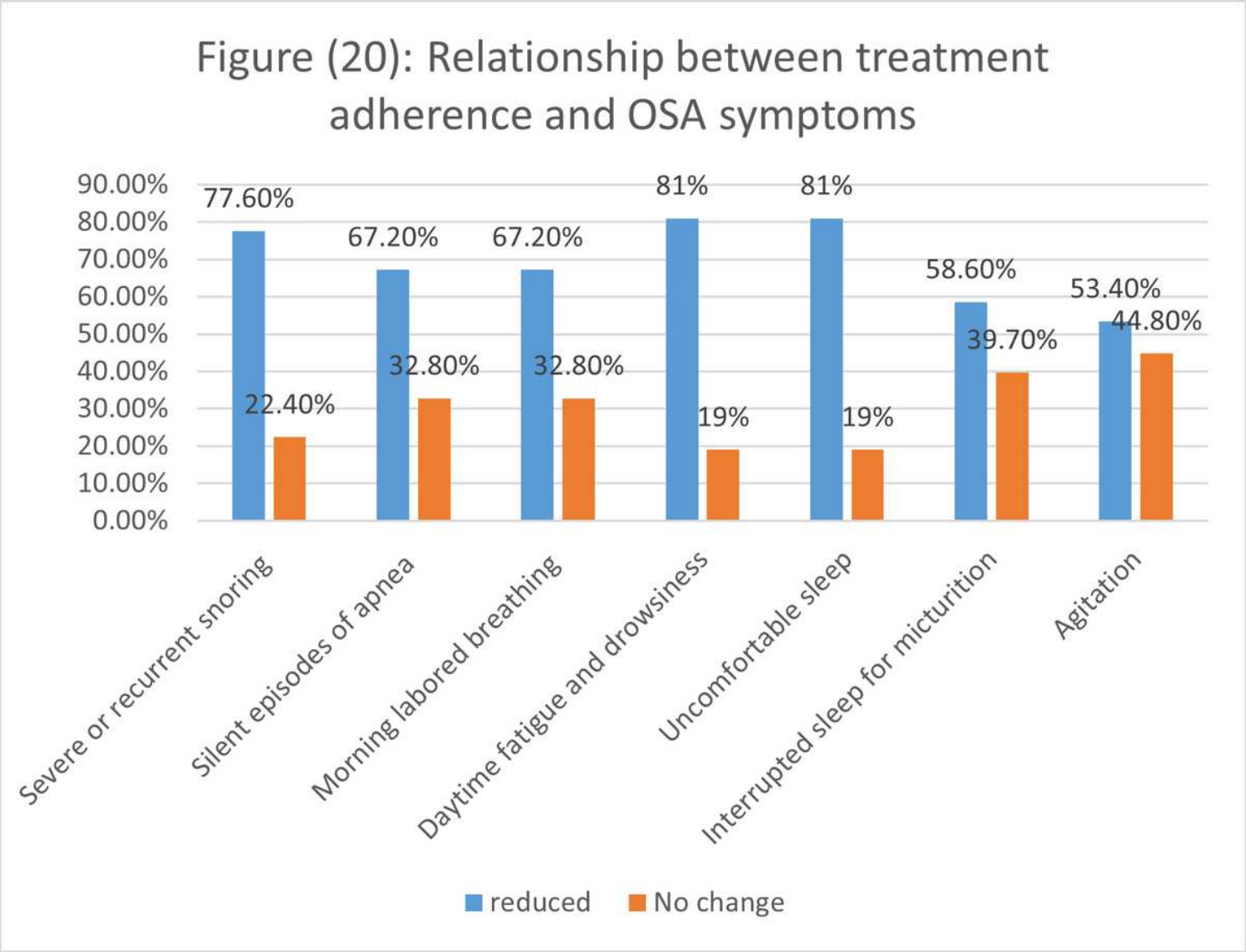

Figure 20

Blue: Reduced - Orange: No change

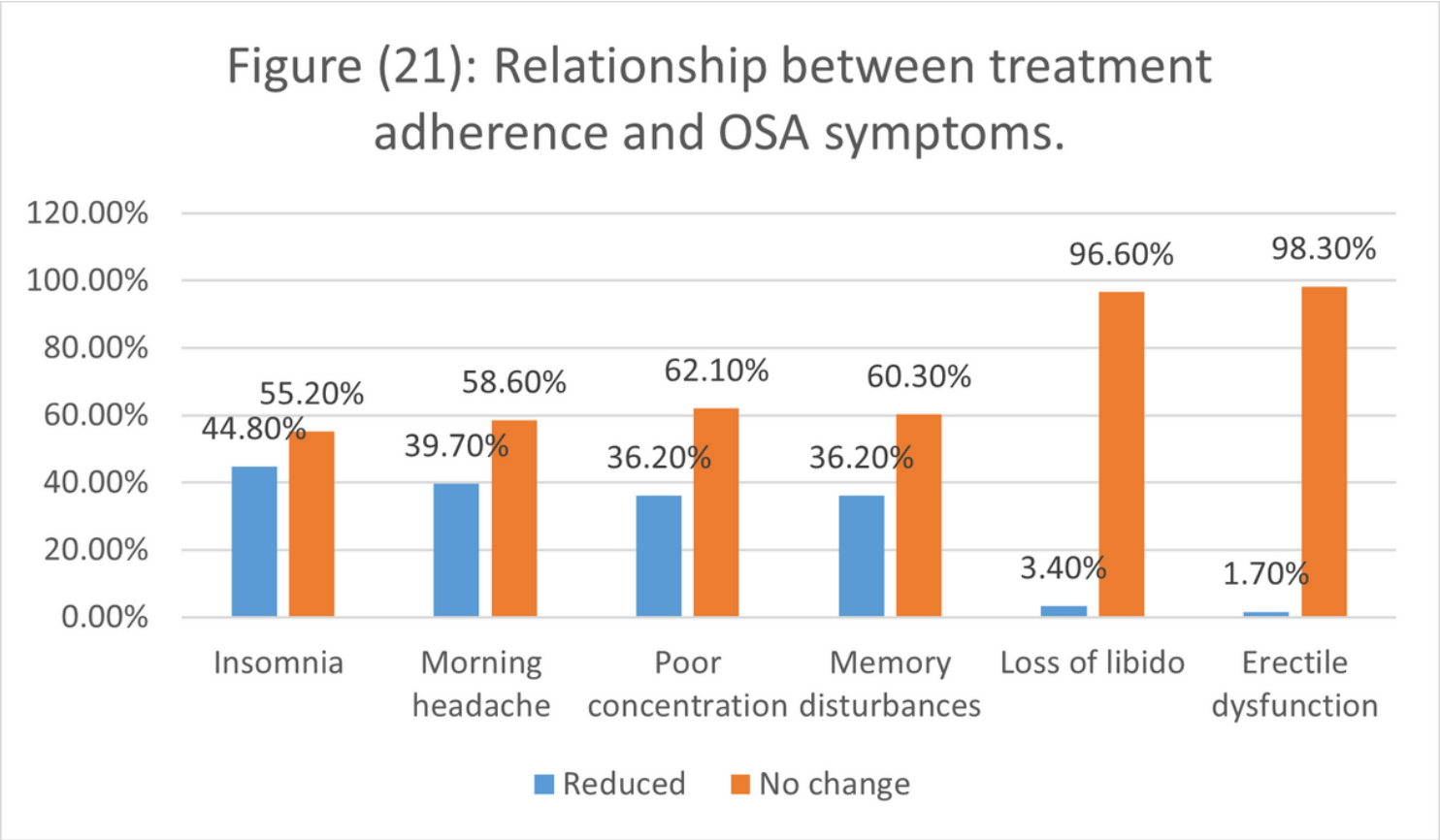

Figure 21

Blue: Reduced - Orange: No change