A Predictive Performance of STOP-BANG Score and Epworth Sleepiness Scale in Suspected Sleep Apnea Individuals

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ABSTRACT

Background: Incidence of sleep apnea is rising globally. STOP-BANG (Snoring, Tiredness, Observed choking, Pressure, Body Mass Index (BMI), Age, Neck girth, Gender) Score and Epworth sleepiness scale (ESS) are outpatient assessment scores available to suspect and estimate the severity of obstructive sleep apnea (OSA) that is compared with gold standard test overnight polysomnography.

Objective: The objective of the article was to validate and establish a correlation of variables of STOP-BANG Score, ESS, and Apnea–Hypopnea Index (AHI) from polysomnography.

Methods: Retrospective study in patients aged 18 or more who were referred to the Department of Pulmonary Medicine, BJMC, Ahmedabad, between April 2017 and December 2020 who had complaints of excessive daytime sleepiness underwent overnight polysomnography after physical examination in the outpatient department.

Results: Of our study population (n = 200), number of men were 137 (68.5%) and women were 63 (31.5%) with a male:female ratio of 2.17:1. Mean BMI, neck girth, ESS, STOP-BANG Score, and AHI were 32.78 ± 6.9 kg/m², 39.49 ± 5.97 cm, 14.48 ± 3.91, 5.34 ± 1.7, and 48.22 ± 23, respectively, and the number of patients according to severity was mild 16 (8%), moderate 36 (18%), and severe 146 (73%). The Pearson correlation counted between neck girth (r = 0.68), ESS (r = 0.73) and STOP-BANG Score (r = 0.55) with AHI with a significant p value (<0.0001).

Conclusion: Snoring is the most common symptom in suspected OSA individuals. The study showed a positive correlation of BMI, neck girth, ESS >10, STOP-BANG Score >3 with severity of OSA depicted in polysomnography.

Keywords: Apnea–Hypopnea Index, Epworth sleepiness scale, Obstructive sleep apnea, obese, gender and age, Snoring, STOP-BANG questionnaire.

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INTRODUCTION

Worldwide, rates of overweight and obesity have raised three times in the past 40 years.¹ There are around 2 billion adults overweight, of those 650 million are considered to be affected by obesity (Body Mass Index (BMI) ≥30 kg/m²). That equates to 39% (39% of men and 40% of women) of adults aged 18 or over who were overweight, with 13% obese. The worldwide prevalence of obesity nearly tripled between 1975 and 2016. If current trends continue, it is estimated that 2.7 billion adults will be overweight, over 1 billion affected by obesity, and 177 million adults severely affected by obesity by 2025.² From 1975 to 2014, age-standardized obesity (BMI ≥30 kg/m²) increased up to three times (10.8%) in men; and 2.5 times (14.9%) in women.³ In 2017, 39% of world population suffered from overweight (BMI >25 kg/m²) and 13% were obese (BMI >30 kg/m²).⁴ As per recent data of 2019–2020 of the age of 15–49 years of the Indian population, the prevalence of overweight and obesity was 18.7% (20% of men and 17.2% of women) and 5.5% (4.7% of men and 6.3% of women), respectively.⁵

Snoring is a highly prevalent disorder,⁶ and it is one of the most common symptoms of obstructive sleep apnea syndrome (OSAS) and may affect sleep architecture and quality of sleep. Therefore, snoring must be screened and considered as an important element of OSAS.⁷,⁸ Patient himself usually does not aware of his snoring. Mostly, family members raise the problem of snoring that makes a reason for consultation. It is a typical inspiratory breathing noise occurring during sleep, even though a small expiratory component can be heard.⁹,¹⁰ The sound source is the segment pharyngeal upper airways. It is the audible sign of increased upper airway resistance.¹²

Habitual snoring (HS) has also been associated with impaired glucose tolerance¹³ and obesity.¹⁴ Obesity and neck circumference are the risk factors for snoring; moreover, increased negative intraluminal pressure during breathing leads to collapse of upper airway and vibration of pharynx.¹⁵

In a few studies, weight problems were regarded to be causal in snoring;¹⁶ however, there has been an increasing number of puzzles as similar studies confirmed that weight loss had very modest consequences on snoring.¹⁷ Other studies, however, indicate that HS will also be connected to weight gain via way of means of contributing to metabolic load.¹⁸ HS seems to boom dangerous elements related to weight problems inclusive of sleep fragmentation, impaired circulatory function, hypertension, metabolic syndrome, diabetes, and impaired glucose control.¹⁹,²⁰

A large neck circumference has been related to a multiplied danger of OSA. Neck circumference can also additionally correlate with OSA higher than BMI. In one study, subjects with OSA have
a neck circumference 40 cm more than subjects without OSA. Neck girth >40 cm had a sensitivity of 61% and specificity of 91%, irrespective of the person’s sex.21

The occurrence of hypertension has been anticipated 50–60% of recognized OSA and OSA has been suggested >30% of hypertensive individuals22 and can be a reason for drug-resistant hypertension.23

Although obstructive sleep apnea is a pretty regularly occurring sickness in both men and women, only a few instances are understood for intercourse variations withinside the pathogenesis of this sickness.

Initial studies22,23,24 indicated that sleep apnea becomes a whole lot greater in men than in women. It becomes at the start idea that the male-to-female ratio for obstructive sleep apnea becomes 8:1. However, most latest and rigorous epidemiological studies22,23,24 have proven that the male-to-female ratio for sleep apnea is 2:1. Youngs reported a prevalence of excessive daytime drowsiness-related OSA in a population of 30–60 years of age to be 4% in men and 2% in women. Studies have shown that the clinical symptoms of sleep apnea are similar in men and women, but the prevalence is increasing in men.25 One of the reasons for the high prevalence in men may be that women are less likely to report symptoms associated with sleep apnea.26 However, some studies27–30 show sex differences due to differences in the structure and physiological behavior of the upper airways. These data imply not only that gender differences in the prevalence of sleep apnea are associated with underreporting of symptoms, but also that men and women are associated with pathological differences in symptoms of the condition.

**Methods**

**Subjects**

We retrospectively analyzed 200 records of patients aged 18 or more who were referred to the Department of Pulmonary Medicine, BJMC, Ahmedabad, between April 2017 and December 2020 who had complaints of excessive daytime sleepiness. We have done the physical examination, and anthropometric features like age, BMI, and neck circumference were recorded. All individuals were evaluated for Epworth sleepiness scale (ESS) and calculated STOP-BANG Score. Then in eligible patients, we performed level II polysomnography.

**Polysomnography**

Respiratory polygraphy done an overnight period of a minimum of 6-hour duration was performed to all participants and included the following: measurement of blood oxygen saturation by pulse oximetry and nasobuccal airflow, position analysis, and snoring quantification with recording of tracheal sound from an air-coupled microphone (sensor) attached on the neck. When the larynx vibrates sufficiently, the sensor detects the vibration and records the loud breathing time of respiratory cycle. Polygraphy recordings were scored according to the criteria of the American Academy of Sleep Medicine.31–33 Apnea is defined as complete cessation of airflow at least 10s. Hypopnea is defined as the reduction of more than 30% of the airflow signal with an associated fall of at least 3% in oxygen saturation. Apnea–Hypopnea Index (AHI) was defined as the number of apneas and hypopneas per hour of sleep. Patients with AHI at least five events per hour were diagnosed as having OSAS. As a result of polysomnography, patients were classified into four groups according to AHI: normal (AHI <5), mild OSAS group (5 ≤ AHI <15), moderate OSAS group (15 ≤ AHI <30), and severe OSAS group (AHI ≥30). ESS divided into the following category: 0–10 = normal range of sleepiness, 11–14 = slight sleepiness, 15–17 = moderate sleepiness, and 18–24 = intense sleepiness.34

**Statistical Analysis**

Statistical analysis was achieved with SPSS 20.0 software. All statistics were provided as a mean ± SD for continuous variables and frequencies (percent) for categorical variables. Difference in the proportion of categorical variables was assessed by t-test and Chi-square test. Pearson correlation coefficient was used to research among the total AHI with neck circumference, ESS, and STOP-BANG Score by socscistatics.com facility.

**Results**

In our study population (n = 200), a number of men were 137 (68.5%) and women were 63 (31.5%) with a male: female ratio of 2.17:1. Mean BMI, neck girth, ESS, STOP-BANG Score, and AHI were 32.78 ± 6.9 kg/m², 39.49 ± 5.97 cm, 14.48 ± 3.91, 5.34 ± 1.7, and 48.22 ± 23, respectively. The baseline traits of 200 patients in our study are presented in Table 1.

| Table 1: Baseline characteristic of 200 patients |
|-----------------------------------------------|
| Variables                                      |
| Age (years)                                    | 51.82 ± 13.4 |
| Sex (M/F)                                      | 2.17:1       |
| Weight (kg)                                    | 86.19 ± 19.93|
| Height (cm)                                    | 161.89 ± 10.22|
| BMI (kg/m²)                                    | 32.78 ± 6.90 |
| Neck girth (cm)                                | 39.49 ± 5.97 |
| ESS                                           | 14.48 ± 3.91 |
| STOP-BANG Score                               | 5.34 ± 1.70  |
| AHI                                           | 48.22 ± 24.53|
| STOP-BANG Score n (%)                         | 137 (68.5)   |
| Snoring                                       | 179 (89.5)   |
| Tiredness                                     | 179 (89.5)   |
| Observed choking                              | 144 (72)     |
| Pressure                                      | 136 (68)     |
| BMI >35 kg/m²                                  | 68 (34)      |
| Age >50 years                                  | 112 (56)     |
| Neck girth >40 cm                              | 123 (61.5)   |
| Gender                                        | 137 (68.5)   |
| STOP-BANG Score n (%)                         | 137 (68.5)   |
| Obese (BMI ≥30 kg/m²)                         | 137 (68.5)   |
| Morbid obese (BMI ≥40 kg/m²)                  | 32 (16)      |
| Severity of OSA n (%)                         | Normal (2)   |
| Mild                                         | 16 (8)       |
| Moderate                                     | 36 (18)      |
| Severe                                       | 146 (73)     |
As shown in Table 2, women with higher BMI have more risk of OSA. Other variables are evenly distributed in both the sexes.

There were 68.5 % (n = 137) obese and 16% (n = 32) morbid obese individuals (Table 3). BMI ≥30 increases the risk of OSA without making a significant difference in obese and morbid obese individuals.

As shown in Table 4, the higher the STOP-BANG Score, the higher the chance of getting sleep apnea. STOP-BANG Score ≥3 is significantly raising suspicion of sleep disordered breathing (SDB).

### Table 2: Baseline characteristics of different gender groups

| Gender | Men (n = 137) | Women (n = 63) | p value |
|--------|---------------|----------------|---------|
| Age (years) | 50.80 ± 13.23 | 54.03 ± 13.61 | 0.11 |
| Weight (kg) | 86.46 ± 20.38 | 85.62 ± 19.06 | 0.78 |
| Height (cm) | 164.27 ± 9.69 | 156.73 ± 9.49 | <0.0001 |
| BMI (kg/m²) | 31.82 ± 6.30 | 34.88 ± 7.68 | 0.003 |
| Neck girth (cm) | 39.64 ± 6.19 | 39.17 ± 5.50 | 0.61 |
| ESS | 14.64 ± 3.88 | 14.13 ± 3.99 | 0.39 |
| STOP-BANG | 5.61 ± 1.62 | 4.76 ± 1.75 | 0.0009 |
| AHI | 49.89 ± 24.70 | 44.57 ± 23.96 | 0.15 |

| STOP-BANG | n (%) | n (%) | p value |
|------------|-------|-------|---------|
| Snoring | 123 (90) | 56 (89) | 0.85 |
| Tiredness | 122 (89) | 57 (90) | 0.76 |
| Observed choking | 101 (73) | 43 (68) | 0.42 |
| Pressure | 95 (69) | 41 (65) | 0.55 |
| BMI >35 kg/m² | 39 (29) | 29 (46) | 0.015 |
| Age >50 years | 70 (51) | 42 (67) | 0.04 |
| Neck girth >40 cm | 85 (62) | 38 (60) | 0.82 |
| Gender | 137 (100) | 0 (0) | NA |

| STOP-BANG Score | n (%) | n (%) | p value |
|------------------|-------|-------|---------|
| 0–2 | 7 (5) | 8 (13) | 0.06 |
| 3–4 | 23 (17) | 17 (27) | 0.09 |
| ≥5 | 107 (78) | 38 (60) | 0.0088 |

| Obesity | n (%) | n (%) | p value |
|---------|-------|-------|---------|
| Obese (BMI ≥30) | 88 (64) | 49 (78) | 0.055 |
| Morbid obese (BMI ≥40) | 15 (11) | 17 (27) | 0.004 |

| Severity of OSA | n (%) | n (%) | p value |
|------------------|-------|-------|---------|
| Normal | 1 (1) | 1 (2) | 0.57 |
| Mild | 11 (8) | 5 (8) | 0.98 |
| Moderate | 21 (15) | 15 (24) | 0.15 |
| Severe | 104 (76) | 42 (66) | 0.17 |

Bold digits interpreted as significance difference or correlation between two groups or variables.

### Table 3: Comparison between obese and morbid obese group

| Obese (n = 137) | Morbid obese (n = 32) | p value |
|-----------------|-----------------------|---------|
| (BMI ≥30kg/m²) | (BMI ≥40kg/m²) | |
| Age (years) | 52.71 ± 11.78 | 55.47 ± 10.79 | 0.28 |
| Weight (kg) | 95.07 ± 11.60 | 109.74 ± 16.28 | <0.0001 |
| Height (cm) | 162.29 ± 8.21 | 157.56 ± 9.99 | 0.0055 |
| BMI (kg/m²) | 36.14 ± 5.20 | 43.97 ± 3.75 | <0.0001 |
| Neck girth (cm) | 40.74 ± 5.17 | 42.03 ± 4.71 | 0.2 |
| ESS | 15.20 ± 3.68 | 14.78 ± 3.64 | 0.56 |
| STOP-BANG | 5.70 ± 1.60 | 6.16 ± 1.76 | 0.16 |
| AHI | 51.81 ± 24.93 | 46.53 ± 26.20 | 0.28 |

(Contd...)
### Table 3: (Contd...)

|                  | Obese (n = 137) | Morbid obese (n = 32) | p value |
|------------------|-----------------|-----------------------|---------|
| **BMI ≥30kg/m²** |                 |                       |         |
| Snoring          | 128 (93)        | 29 (90)               | 0.56    |
| Tiredness        | 127 (92)        | 29 (90)               | 0.69    |
| Observed choking | 102 (74)        | 25 (78)               | 0.67    |
| Pressure         | 101 (73)        | 24 (75)               | 0.88    |
| BMI >35 kg/m²    | 68 (49)         | 32 (100)              | NA      |
| Age >50 years    | 81 (59)         | 23 (71)               | 0.18    |
| Neck girth >40 cm| 95 (69)         | 26 (81)               | 0.18    |
| Gender           | 88 (64)         | 15 (47)               |         |
| **STOP-BANG Score** |                 |                       |         |
| 0–2              | 6 (4)           | 1 (3)                 | 0.75    |
| 3–4              | 23 (17)         | 4 (12)                | 0.55    |
| ≥5               | 108 (79)        | 27 (85)               | 0.48    |

**Severity of OSA**

|                  | Obese (n = 137) | Morbid obese (n = 32) | p value |
|------------------|-----------------|-----------------------|---------|
| Normal           | 2 (2)           | 2 (6)                 | 0.11    |
| Mild             | 6 (4)           | 2 (6)                 | 0.65    |
| Moderate         | 26 (19)         | 6 (19)                | 0.98    |
| Severe           | 103 (75)        | 22 (69)               | 0.56    |

Bold digits interpreted as significance difference or correlation between two groups or variables.

### Table 4: STOP-BANG Score profile

|                      | STOP-BANG Score |          |          |          |
|----------------------|-----------------|----------|----------|----------|
|                      | 0–2 (n = 15)    | 3–4 (n = 40) | ≥5 (n = 145) | p value |
| Age (years)          | 39.53 ± 15.78   | 46.9 ± 15.92 | 54.44 ± 11.22 |         |
| Weight (kg)          | 69.87 ± 27.74   | 79.38 ± 19.22 | 89.77 ± 17.90 |         |
| Height (cm)          | 157.67 ± 14.17  | 161.4 ± 10.69 | 162.47 ± 9.58 |         |
| BMI (kg/m²)          | 27.26 ± 8.56    | 30.54 ± 7.10  | 33.97 ± 6.25  |         |
| Neck girth (cm)      | 31.6 ± 6.75     | 35.28 ± 5.57  | 41.48 ± 4.59  |         |
| ESS                  | 9.80 ± 3.95     | 11.63 ± 3.00  | 15.74 ± 3.32  |         |
| STOP-BANG            | 1.80 ± 0.41     | 3.55 ± 0.50   | 6.20 ± 0.98   |         |
| AHI                  | 22.87 ± 24.91   | 30.53 ± 18.22 | 55.72 ± 21.70 |         |

**STOP-BANG Score**

|                      | Obese (n = 137) | Morbid obese (n = 32) | p value |
|----------------------|-----------------|-----------------------|---------|
| Snoring              | 3 (20)          | 32 (80)               | 144 (99) | <0.0001 |
| Tiredness            | 9 (60)          | 27 (67)               | 143 (98) | <0.0001 |
| Observed choking     | 4 (27)          | 17 (42)               | 123 (85) | <0.0001 |
| Pressure             | 3 (20)          | 10 (25)               | 123 (85) | <0.0001 |
| BMI >35 kg/m²        | 2 (13)          | 8 (20)                | 58 (40)  | 0.013   |
| Age >50 years        | 4 (27)          | 15 (37)               | 93 (64)  | <0.0001 |
| Neck girth >40 cm    | 2 (13)          | 10 (25)               | 111 (77) | <0.0001 |
| Gender               | 7 (47)          | 23 (57)               | 107 (74) | 0.024   |
| Obesity              |                 |                       |         |
| Obese (BMI ≥30 kg/m²)| 6 (40)          | 23 (57)               | 108 (74) | 0.0009  |
| Morbid obese (BMI ≥40 kg/m²)| 1 (7) | 4 (10) | 27 (17) | 0.25   |
| Severity of OSA      |                 |                       |         |
| Normal               | 0 (0)           | 1 (2.5)               | 1 (0.7)  | NA      |
| Mild                 | 8 (53)          | 5 (12)                | 3 (2)    | <0.0001 |
| Moderate             | 4 (27)          | 18 (45)               | 14 (10)  | <0.0001 |
| Severe               | 3 (20)          | 16 (40)               | 127 (88) | <0.0001 |

Bold digits interpreted as significance difference or correlation between two groups or variables.
DISCUSSION

Snoring is the most common symptom in our study. Snoring is present in all spectrum of excessive daytime sleepiness (EDS)—in ascending order of severity—including primary snoring, upper airway resistance syndrome (UARS), OSA, central sleep apnea, complex sleep apnea, and obesity hypoventilation syndrome. BMI >30kg/m² with neck girth >40 cm is associated with high ESS and severity of sleep apnea. There is a positive correlation between variables like neck girth, ESS, and STOP-BANG Score with AHI as is depicted in Figure 1 (Tables 5 and 6).

A study to predict associated sleep apnea activity with high sensitivity and an AHI of 15 or higher confirmed four terms observed by bed partners: apnea, hypertension, BMI, and age. The advantage of the ESS is that it shows an average sleep tendency. The average ESS score of 30 normal men and women mean ± SD was 5.9 ± 2.2.

Snoring is very common. In the United Kingdom, a telephonic survey found out that 40% of the full populace who’ve loud breathing with an elevated incidence in men. The snoring is one of the most common symptoms of OSA and occurs in up to 70–95% of patients with the syndrome. On the contrary, the likelihood of OSA is much lower due to the absence of snoring, with only 3–6% reporting if not habitually snores.

Considering the severity of symptoms, the probability of indicating apnea activity gradually increased. For example, light snoring had an odds ratio of 2.1 and very severe snoring was 21.1 compared to those without snoring. Additionally, data on BMI and gender showed a 10% improvement in predictive power.

Patients experiencing tiredness, malaise, or fatigue may feel lethargic, but not necessarily hypersomnolent. Conditions such as anemia, congestive heart failure (CHF), depression, and hypothyroidism can accompany fatigue. Distinguishing between drowsiness and fatigue can eventually lead to a different diagnosis. However, sufferers with OSA use phrases consisting of fatigue, tiredness, or loss of power to explain their personal signs and symptoms of sleepiness.

Some patients report that they stopped breathing or became awake during sleep or that the patient was choking or feeling severe panic in the middle of the night. However, the combination of these symptoms, such as snoring and observed choking/apnea, better predicts OSA.

To date, hypertension (pressure) is the most well-documented and well-studied result of OSA. The greater the severity of OSA as measured by the Respiratory Disorder Index (RDI), the greater the risk of systemic hypertension.

A 4-year follow-up study in the Wisconsin Sleep Cohort shows a dose–response relationship...
### Table 5: Epworth sleepiness scale score profile

| ESS | Normal group (ESS ≤10) | Mild (11–14) (n = 61) | Moderate (15–17) (n = 45) | Severe (18–24) (n = 56) |
|-----|------------------------|-----------------------|---------------------------|------------------------|
| Age (years) | 49.84 ± 16.82 | 52.1 ± 11.90 | 51.4 ± 15.11 | 53.18 ± 10.85 |
| Weight (kg) | 78 ± 22.35 | 82.33 ± 18.18 | 90.56 ± 21.97 | 92.46 ± 15.36 |
| Height (cm) | 161.5 ± 10.55 | 160.8 ± 10.72 | 161.6 ± 11.38 | 163.59 ± 8.37 |
| BMI (kg/m²) | 29.88 ± 8.30 | 31.73 ± 6.14 | 34.40 ± 7.21 | 34.60 ± 5.53 |
| Neck girth (cm) | 33.03 ± 5.17 | 37.56 ± 5.43 | 42.62 ± 3.71 | 43.48 ± 3.25 |
| ESS | 8.68 ± 1.38 | 12.69 ± 1.18 | 16.02 ± 0.75 | 19.11 ± 1.26 |
| STOP-BANG | 3.61 ± 1.53 | 5.05 ± 1.47 | 6.04 ± 1.31 | 6.27 ± 1.30 |

#### STOP-BANG Score

| STOP-BANG | n (%) | n (%) | n (%) | n (%) | p value |
|-----------|-------|-------|-------|-------|---------|
| Snoring | 23 (61) | 56 (92) | 44 (98) | 56 (100) | NA |
| Tiredness | 29 (76) | 52 (85) | 44 (98) | 54 (96) | <0.0001 |
| Observed choking | 11 (29) | 41 (67) | 40 (89) | 52 (93) | <0.0001 |
| Pressure | 15 (39) | 40 (66) | 36 (80) | 45 (80) | 0.0013 |
| BMI >35 kg/m² | 9 (24) | 15 (25) | 16 (36) | 28 (50) | 0.57 |
| Age >50 years | 19 (50) | 38 (62) | 23 (51) | 32 (57) | <0.0001 |
| Neck girth >40 cm | 6 (16) | 36 (59) | 39 (87) | 52 (93) | <0.0001 |
| Gender | 24 (63) | 41 (67) | 33 (73) | 39 (70) | 0.78 |

#### Obesity

| Obesity | n (%) | n (%) | n (%) | n (%) | p value |
|---------|-------|-------|-------|-------|---------|
| Obese (BMI ≥30 kg/m²) | 21 (55) | 35 (57) | 35 (33) | 46 (82) | 0.0042 |
| Morbid obese (BMI ≥40 kg/m²) | 6 (16) | 7 (2) | 10 (22) | 9 (20) | 0.53 |

#### Severity of OSA

| Severity of OSA | n (%) | n (%) | n (%) | n (%) | p value |
|-----------------|-------|-------|-------|-------|---------|
| Normal | 2 (5) | 0 (0) | 0 (0) | 0 (0) | NA |
| Mild | 10 (26) | 4 (7) | 1 (2) | 1 (2) | <0.0001 |
| Moderate | 14 (37) | 16 (26) | 5 (11) | 1 (2) | <0.0001 |
| Severe | 12 (32) | 41 (67) | 39 (87) | 54 (96) | <0.0001 |

Bold digits interpreted as significance difference or correlation between two groups or variables.

### Table 6: Severity of sleep apnea details

| AHI severity | Mild (n = 16) | Moderate (n = 36) | Severe (n = 146) |
|-------------|--------------|-------------------|------------------|
| Age (years) | 46.5 ± 14.83 | 51.22 ± 15.38 | 52.49 ± 12.75 |
| Weight (kg) | 75.00 ± 26.41 | 86.25 ± 20.25 | 87.01 ± 18.53 |
| Height (cm) | 161.56 ± 15.29 | 161.33 ± 11.26 | 162.14 ± 9.37 |
| BMI (kg/m²) | 28.34 ± 8.47 | 33.02 ± 6.66 | 33.02 ± 6.49 |
| Neck girth (cm) | 32.81 ± 6.25 | 34.00 ± 5.76 | 41.06 ± 4.45 |
| ESS | 9.88 ± 4.10 | 11.61 ± 2.72 | 15.77 ± 3.29 |
| STOP-BANG | 3.00 ± 1.59 | 4.19 ± 1.43 | 5.89 ± 1.40 |
| AHI | 8.19 ± 2.69 | 22.69 ± 3.89 | 59.50 ± 18.11 |
between AHI and hypertension. A risk ratio of 4.54 for hypertension was associated with more than 15 AHI events per hour.\(^\text{31}\) Patients with refractory hypertension (requires at least three pressures) may be particularly at risk for OSA.\(^\text{42}\)

There is a clear correlation between OSAS and overweight. A Wisconsin Sleep Cohort shows that patients with mild OSAS have a sixfold risk of developing moderate or severe OSAS when they gain only 10% of their body weight. Among the cohort of morbid obese (BMI >40 kg/m\(^2\)), 70% of individuals suffer from OSAS.

There are several large cohort studies that have been shown to increase the prevalence of sleep apnea among men and women aged 60 years and older by two to three times that of the middle-aged population.\(^\text{33–48}\)

The study shows that the neck circumference is a strong predictor of OSAS,\(^\text{49}\) as there is an increase in excess fat in the anterior and lateral regions of the upper airways in both obese and non-obese patients.\(^\text{50}\) If the neck circumference is larger than 48 cm, the risk of OSAS is high, and if the circumference is less than 37 cm, the risk of OSAS is low. Male gender is an important risk factor.\(^\text{22}\) In a Wisconsin Sleep Cohort study, postmenopausal women were more than three times more likely to have a moderate-to-severe OSAS than premenopausal women with age-matched BMI.\(^\text{51}\)

**Conclusion**

In outpatients, STOP-BANG Score and ESS are simple and easy measures for suspicion and diagnosis of OSAS. STOP-BANG Score ≥3 and ESS >10 increase the probability of OSAS.

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