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Incorporating Body-Type (Apple vs. Pear) in STOP-BANG Questionnaire Improves Its Validity to Detect OSA

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Abstract

Study Objective—The aim of this study is to evaluate whether adding the item of “apple body type” to the STOP-BANG questionnaire enhances diagnostic performance of the questionnaire for detecting obstructive sleep apnea (OSA).

Design—Cross-sectional study

Setting—Sleep center setting

Patients—Two hundred and eight subjects who were referred for an evaluation of possible OSA at Tulane Comprehensive Sleep Center. The exclusion criteria were age < 18 years old, incomplete or absent questionnaire, incomplete body type identification, polysomnography (PSG) refusal, and pregnant women.

Interventions—STOP-BANG items and body type data were collected on the initial clinic visit. An overnight PSG was performed on every participant.

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Conflicts of interest

None of the authors have any financial conflicts of interest to declare as it relates to the contents of this manuscript.

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Measurements—Descriptive analyses of the demographic data and PSG variables were performed. The predictive parameters of STOP and STOP-BANG without and with body type score (STOP-Apple and STOPBANG-Apple) were compared.

Main results—The STOP questionnaire's sensitivity/specificity/positive likelihood ratio (+LR) (cut-off = 2) was 96%/11%/1.1, respectively whereas the STOP-Apple questionnaire (cut-off = 3) was 88%/39%/1.5. The STOP-BANG's sensitivity/specificity/+LR (cut-off = 3) was 96%/19%/1.2, respectively whereas the STOP-BANG-Apple questionnaire (cut-off = 4) was 90%/39%/1.5. The area under the Receiver Operating Characteristic (ROC) curve of STOP-Apple was comparable to the STOP-BANG ($P = 0.25$). The addition of the apple body type item to the STOP-BANG questionnaire in participants with a score ≥ 3 led to increased specificity (67.4%), increased the odds ratio of having OSA of 2.5 (95% CI, 1.2–5.3) and odds ratio of having moderate-severe OSA of 4.7 (95% CI, 2.5–8.7).

Conclusion—In the sleep center setting, adding the body type item to the STOP-BANG questionnaire improves not only clinical prediction for PSG confirmed OSA but also predicts moderate to severe of OSA.

Keywords

STOP-BANG questionnaire; Body type; Obstructive sleep apnea

1. Introduction

The STOP-BANG questionnaire is a validated screening tool for obstructive sleep apnea (OSA). It is an 8-item questionnaire that looks at **S**nororing, **T**iredness during day time, **O**bserved apnea during sleep, high blood **P**ressure, **B**MI (Body Mass Index) $> 35 \text{ kg/m}^2$, **A**ge > 50 , **N**eck circumference $> 40 \text{ cm}$, and male **G**ender (Appendix 1). Literature shows it has a high sensitivity of 83–96.2% and low specificity of 13.9–56% in a preoperative setting^(1, 2). Moreover, its ability to detect OSA maybe limited among certain populations including patients undergoing bariatric surgery and pregnant woman who are predominantly younger females^(3, 4).

It is also known that OSA is highly prevalent among individuals with obesity. Obesity can be defined according to different types of body fat distribution, central (i.e. apple) or peripheral (i.e. pear)⁽⁵⁾. Each type has reportedly different health consequences⁽⁶⁾. An “apple” body type is associated with the presence⁽⁷⁾ and severity of OSA⁽⁸⁾. An increased BMI alone does not identify fat distribution type⁽⁹⁾. Moreover, some components of STOP-BANG questionnaire (e.g. BMI⁽¹⁰⁾, age⁽¹¹⁾, and gender⁽¹²⁾) are associated with different body types.

We aimed to investigate the effect of using the presence (or absence) of an apple body type, in addition to BMI, on diagnostic performance of the STOP-BANG questionnaire for OSA.

2. Materials and Methods

2.1 Patient Population of the Study

After IRB approval 208 participants undergoing OSA evaluation with polysomnography (PSG) were recruited between December 2013 and March 2015. Exclusion criteria included

age < 18 years old, incomplete or absent questionnaire, incomplete body type identification, PSG refusal, and pregnant women.

2.2 STOP-BANG questionnaire and Body type determination

The patients who met the inclusion criteria were included in the study. A STOP-BANG questionnaire was administered during the initial clinical evaluation and a score greater than or equal to 3 was determined as “high risk” for OSA. Other data obtained included a participant’s clinical history, demographic data, anthropometric measurement (waist and hip), and fat distribution type (apple, pear, or indeterminate).

Apple and pear body type is defined as excess upper body fat and lower body fat, respectively (Figure 1). Indeterminate body type refers to fat distribution type that cannot categorize as apple or pear such as a patient with low body fat or generalized distribution of excess body fat. Fat distribution type was determined by subjective visual inspection (i.e. eye-ball test). Alternative methods of measuring fat distribution may be considered more precise. However in clinical practice subjective visual inspection is routinely used in our institution.

According to the 2008 WHO guideline, central obesity defined as waist-hip ratio (WHR) more than or equal to 0.9 and 0.85 for male and female⁽¹³⁾, respectively. Although, this cut off is used to identify the risk of metabolic complications but the criteria should also be applicable to our study. Since OSA is associated with metabolic syndrome and there is certainly no standard measurement for the diagnosis of central obesity. We also compared results between visual inspection and WHR based on this WHO cut-off for central obesity.

To calculate the score of the questionnaires, the presence of apple body type received 1 point whereas its absence and the indeterminate type receive 0 points. We add the body type scores to the corresponding questionnaire scores and made the total STOP-Apple and STOP-BANG-Apple scores.

2.3 Polysomnographic study

A gold standard, overnight laboratory PSG was conducted in all participants. Sleep staging was monitored using electroencephalogram (F3-M2, F4-M1, C3-M2, C4-M1 and O1-M2, and O2-M1), bilateral electrooculograms (E1-M2, E2-M1), and a surface submental electromyogram (EMG). Respiratory parameters were monitored using pulse oximetry, snoring microphone, nasal thermistors and pressure transducer, and thoracic and abdominal inductance plethysmograms. The heart rate was continuously monitored using an electrocardiogram. Bilateral tibialis EMG leads were placed to detect periodic limb movements.

A registered PSG technologist under the supervision of the sleep physician visually scored all studies. The technologist was blinded to clinical information and the results of STOP-BANG-Apple scores.

Using the 2012 American Academy of Sleep Medicine Manual for Scoring of Sleep and Associated Events⁽¹⁴⁾; apnea was defined as cessation of the airflow 90% detected through

the nasal thermistor sensor for at least 10 seconds. Hypopnea was defined by a peak airflow signal excursion drop of $\geq 30\%$ using nasal pressure, with $\geq 3\%$ oxygen desaturation or associated arousal. The diagnosis of OSA was defined as an Apnea Hypopnea Index (AHI) of greater than 5 events per hour. The determination of OSA severity was categorized by the AHI values: $> 5-15$ as mild, $> 15-30$ as moderate, and > 30 as severe OSA.

2.4 Data Analysis and Statistics

Sample Size Estimation—The sample size calculation was performed based on pre-determined sensitivity of 90%^(15, 16); the prevalence of OSA in sleep clinic setting that were reported around 75%^(15, 16); the confidence level $(1 - \alpha)$ for statistical judgment where α is 0.05. The required sample sizes were 186 participants.

2.5 Data Analysis

Statistical analyses were performed using SPSS software version 20.0 (SPSS, Chicago, IL). Patient characteristic data were presented with descriptive statistics; mean $\pm$ standard error (SE), median and interquartile range (IQR), frequency or percentage. For pair-wise relationships, two-sample *t*-test or Mann-Whitney test were used to compare the mean value of the continuous outcome measures; and chi-square test were used to compare the proportion of positive signals for binary outcomes. $P < 0.05$ was defined as significant.

The predictive performance of the STOP, STOP-BANG, STOP-Apple, and STOP-BANG-Apple questionnaire: sensitivity, specificity, positive predictive values (PPVs), negative predictive values (NPVs), positive likelihood ratios (LR+), and negative likelihood ratios (LR-) were calculated and compared for each score. The receiver operating characteristic curve (ROC) was performed to compare the diagnostic ability of STOP, STOP-BANG, STOP-Apple and STOP-BANG-Apple.

To evaluate the ability of adding apple body type as a sequential test follow by the STOP-BANG questionnaire, the net-sensitivity and net-specificity were calculated to identify more true positive results and the reduction of the false positive rate.

For patients at high risk of OSA based on a STOP-BANG score (≥ 3); we then included the apple body type item and compared odd ratio (ORs) outcomes of having mild, moderate, or severe OSA (AHI values: $> 5-15$, $> 15-30$, and > 30 , respectively). Logistic regression was used to calculate the adjusted ORs.

The Kappa statistic was used to measure the agreement between subjective visual inspection (eye-ball test) and WHR, to identify central obesity.

3. Results

3.1 Patient characteristics and demographics

A total of 208 patients were included in the study. Participant demographic data, which included age, sex, Body Mass Index (BMI), and co-morbidities, are shown in Table 1. The patients were predominantly female (64%). The average age, BMI, and neck circumference was 52.9 (± 0.9) years, 36.9 (± 0.7) kg/m², and 40.6 (± 0.4) cm, respectively. A total of 119

(57%) and 45 (22%) patients were classified as apple and pear body type respectively, and 44 (21%) patients were classified as indeterminate body type. The apple body type group had significantly greater neck circumference [42.6 (± 0.4) vs. 37.9 (± 0.6) cm, $p < 0.01$], BMI [39.9 (± 0.7) vs. 32.8 (± 1.2), $p < 0.01$] and WHR [0.97 (± 0.07) vs. 0.87 (± 0.05), $p < 0.01$] compared to non-apple body type group. Descriptive summary statistics are displayed on Table 1.

The prevalence of OSA based on PSG (AHI > 5) in the study sample were 78% (162 patients), with the median AHI (IQR) of 19 (12 – 49.9). The prevalence of mild OSA (AHI > 5 –15), moderate OSA (AHI > 15 –30), and severe OSA (AHI > 30) was 30%, 19%, and 29%, respectively.

3.2 Prediction of OSA from STOP-BANG Questionnaire and Body Type

A total of 198 (95.2%) and 193 patients (92.8%) had a STOP and STOP-BANG score 2 and 3, respectively. Most patients had a STOP-BANG score of 4 (24.5%), 5 (20.2%), and 6 (20.2%) while STOP-BANG-Apple score were 5 (18.8%), 6 (18.8%), and 7 (17.8%).

The operating characteristics of the STOP, STOP-Apple, STOP-BANG, as well as, the STOP-BANG-Apple at different AHI severity are displayed in Figure 2. Using ROC analysis, the cut-off with the highest accuracy to determine the PSG-confirmed OSA for STOP-Apple and STOP-BANG-Apple was 3 and 4, respectively. Based on comparisons among their areas under the curve (AUC), a global measure of diagnostic accuracy, STOP-Apple had a significantly higher AUC than STOP questionnaire [STOP-Apple AUC = 0.68 (95% CI, 0.73–0.87) vs. STOP AUC = 0.63 (95% CI, 0.54–0.72), $p = 0.016$] and was comparable to STOP-BANG [AUC = 0.78 (95% CI, 0.70–0.85), $p = 0.24$], as there were no statistical difference in AUC (Figure 2).

The predictive performance of STOP vs. STOP-Apple and STOP-BANG vs. STOP-BANG-Apple at mild (AHI > 5), moderate (AHI > 15), and severe (AHI > 30) levels of OSA are displayed in Table 2. The high sensitivity of STOP-BANG makes its useful as a screening tool for OSA. However, the modest specificity will yield a high false positive rate. Higher specificity was achieved by adding the apple body item to the STOP-BANG questionnaire [STOP-BANG-Apple's specificity = 39.1% vs. STOP-BANG's specificity = 19.6%]. Addition of apple body type item achieved a net specificity of 67.4% in participants scoring 3 in STOP-BANG questionnaire (Figure 3).

3.3 Prediction of OSA severity from STOP-BANG Questionnaire and Body Type

In participants with a STOP-BANG 3, the presence of apple body type increased the probability of having PSG confirmed OSA (AHI > 5), as well as, predicting moderate/severe OSA (AHI > 15) with ORs of 2.5 (95% CI, 1.2–5.3) and 4.7 (95% CI, 2.5–8.7), respectively. After adjustment for BMI, the associations between apple body type and the severity of OSA remained consistent.

Review of PSG data in participants with an AHI > 5 ($n=162$), the apple body type was associated with significantly greater AHI, supine AHI and REM AHI, while the nadir oxygen saturation was significantly lower. However, there was no statistical difference in the

mean oxygen saturation and the percentage of time with oxygen saturation less than 90%. (Table 3)

In participants with apple body type, the AHI was significantly greater than non-apple group as the STOP-BANG score increased. At STOP-BANG score cut-off of 3, 4, 5, and 6, the median AHI of apple and non-apple body group were 20.1 (12–56.8) vs. 10 (3.8–17.7), 21 (12–61.2) vs. 11.2 (5.8–17.9), 28.1 (15.1–68.8) vs. 11.9 (7.5–21.1), and 41.5 (16–76) vs. 11.9 (6–21.6), respectively.

3.4 Waist-hip ratio vs. Visual inspection

There was a moderate agreement between WHR and subjective visual inspection ($K = 0.54$, $p < 0.01$). The presence of apple body type increases the probability of having central obesity based on WHR with ORs of 28 (95% CI, 2.5–317).

4. Discussion

The STOP-BANG questionnaire is a validated screening tool for predicting the risk of OSA in general surgical population. It has a high sensitivity but low specificity leading to a high false positive rate⁽¹⁾.

The STOP-BANG tool does not include patient body type as an item. Our study shows that specificity of the STOP and STOP-BANG screening tools increases after addition of this item in patients scoring 2 and 3, respectively; i.e. high risk for OSA. Addition of the apple body type item to the STOP questionnaire not only improves its specificity but also makes this OSA screening tool, STOP-Apple, as effective as STOP-BANG alone. In a busy pre-operative clinical setting, the addition of the apple body type item is simpler than acquiring a patient's neck circumference measurement, which is often omitted, and open to inter-rater variable. Addition of the apple body type item to participants at high risk for OSA (STOP-BANG 3) were at increased risk of having OSA (ORs 2.5) and moderate to severe OSA (ORs 4.7). The apple body type group has significantly higher AHI than the non-apple body group, making apple body type a predictor of OSA.

The relationship between body type and OSA has been extensively studied. A study by Martinez-Rivera et al. reported central obesity to be a factor in PSG-confirmed OSA (ORs 2.6)⁽⁷⁾ which is consistent with our results. Several mechanisms have been proposed to explain this pathogenic linkage. As central obesity is characterized by a high waist hip ratio or increased neck circumference⁽¹⁷⁾, it may be associated with increased adipose tissue around the upper airway as well as increased upper airway collapse as a result of attenuated tracheal traction from lower lung volume⁽¹⁸⁾.

Currently, the gold standard diagnostic test for OSA is PSG, which is often limited by cost and availability. Diagnostic sleep testing for all patients with STOP-BANG 3 utilize tremendous healthcare resource and maybe unjustifiable. In 2014, the American Society of Anesthesiologists practice guideline for the perioperative management of OSA patient addressed "OSA severity" as one of the predictive parameters for OSA related complications⁽¹⁹⁾. Therefore, moderate and severe OSA should be first identified and treated

properly prior to the surgery. This is potentially useful in our clinical practice especially the perioperative setting.

In a perioperative setting, the presence of an apple body type in a patient with a STOP-BANG score 3 may assist the clinical provider by stratifying the patient's OSA risk to moderate-severe. Through recognition of the OSA risk, an OSA-friendly anesthetic would be delivered i.e. preparing for a difficult airway problem, using short acting anesthetic drugs, avoidance of respiratory depressants, increased use of regional anesthetic techniques or applying positive airway pressure (PAP) during the postoperative period.

The major strength of this study is that all patients underwent an in-laboratory PSG that made the analyses of predictive parameters more precise. In addition, the sample size was higher than the calculated study power. Limitations of this study include the study population, which represented an unselected population randomly referred to a tertiary center sleep facility. Further studies would be required to assess if outcomes could be reproduced in a different study population. Another limitation centers around how the apple body type was determined i.e. visual inspection as opposed to other quantitative fat distribution measurements. However, the study's visual inspection test was in moderate agreement with the WHR measurement. Furthermore, body type determination by visual inspection meets basic requirements as a good screening tool; including its safety, ease of use, acceptable sensitivity, wide availability, and cost saving. Therefore, body type determination by visual inspection would justify using in clinical practice. Finally, we did not assess inter-rater reliability (between two investigators) in identification of the apple body type with may have affected the apple body type selection process.

5. Conclusion

In a sleep center setting, inclusion of apple body type in participants with STOP-BANG score 3 improves the specificity of the screening tool in detecting OSA as determined by PSG as well as stratifying the severity of the OSA i.e. moderate-severe.

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Appendix 1

The STOP-BANG questionnaire(1)

1. **Snororing:** Do you snore loudly? (Louder than talking or loud enough to be heard through closed doors)
Yes No
2. **Tired:** Do you often feel tired or sleepy during daytime?
Yes No

3. **Observed:** Has anyone observed you stop breathing during your sleep?
Yes No
4. **Blood Pressure:** Do you have or are you being treated for high blood pressure?
Yes No
5. **BMI:** BMI more than 35 kg/m²?
Yes No
6. **Age:** Over than 50 years old?
Yes No
7. **Neck Circumference:** Greater than 40 cm
Yes No
8. **Gender:** Male gender?
Yes No

High risk of OSA: answering yes to three or more items

Low risk of OSA: answering yes to less than three items

Highlights

- Applying apple body type to the STOP-BANG questionnaire improves the ability to identify a PSG-confirmed diagnosis and indicates the severity of OSA.
- In clinical practice, patients who have STOP-BANG 3 with apple body type would have a greater probability to detect moderate to severe OSA.
- This may help clinician to triage patients who require comprehensive care, as well as trigger practitioners to undertake perioperative precautions and minimize the OSA related complication.

Figure 1.
Apple and Pear Body types (By permission of Mayo Foundation for Medical and Research.
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Figure 2.
The ROC curves for each questionnaire

All subjects				High risk of OSA (STOP-BANG ≥ 3)			
	OSA+	OSA-			OSA+	OSA-	
Apple				Apple	99	15	114
Non-apple				Non-apple	57	22	79
STOP-BANG ≥ 3	156	37	193		156	37	193
STOP-BANG < 3	6	9	15				
	162	46	208				

Net Specificity = 67.4% ((9+22)/46 x 100)

Specificity = 19% (9/46 x 100)

Figure 3.

Two-stage screening: Applying body type sequentially to the STOP-BANG questionnaire (cut-off = 3)

Table 1

Participant demographic data with and without apple body type.

	Total (<i>n</i> = 208)	Apple (<i>n</i> = 119)	Non-Apple (<i>n</i> = 89)	<i>P</i> -value
Gender, Male/Female, <i>n</i> (%)	75/113 (36/64)	47/72 (39/61)	28/61 (32/68)	
Race, <i>n</i> (%)				
White	58 (28)	31 (26)	27 (30)	
African American	143 (69)	86 (72)	57 (64)	
Hispanic	1 (0.5)	1 (0.8)	0	
Age, years	52 (0.9)	52.4 (1.2)	53.8 (1.5)	0.46
BMI, kg/m ²	36.9 (0.7)	39.9 (0.7)	32.8 (1.2)	<0.01
Neck, cm	40.6 (0.4)	42.6 (0.4)	37.9 (0.6)	<0.01
Waist-Hip ratio	0.95 (0.01)	0.97 (0.07)	0.87 (0.05)	<0.01
Co-morbidities, <i>n</i> (%)				
HT	144 (69)	88 (74)	56 (63)	0.08
DM	58 (28)	40 (34)	18 (20)	0.03
GERD	41 (20)	22 (19)	19 (21)	0.6
CAD	22 (10)	16 (13)	6 (7)	0.16
AHI, Median (IQR)	14.05 (6–35.7)	20 (10.7–56)	9 (3.2–17.2)	<0.01
OSA Diagnosis, <i>n</i> (%)				<i>p</i> <0.0001
Non-OSA	46 (22)	18 (15)	28 (31)	0.1839
Mild OSA	62 (30)	25 (21)	37 (42)	0.1619
Moderate OSA	40 (19)	27 (23)	13 (15)	0.0385
Severe OSA	60 (29)	49 (41)	11 (12)	<0.0001

AHI: Apnea-Hypopnea-Index; BMI: Body Mass Index; CAD: Coronary Artery Disease; DM: Diabetes; GERD: Gastroesophageal reflux; HT: Hypertension; IQR: Interquartile range, P25 to P75 (25th to 75th percentile); OSA: Obstructive sleep apnea; SE: Standard Error. Data in cells represent number (%) or mean (Standard Error), except AHI is represented by Median (IQR). *P*-value compares between apple and non-apple body type. Diagnosed OSA defined as AHI >5 events/hour. The determination of OSA severity defined by the AHI values: 5–15 as mild; 15–30 as moderate, and > 30 as severe OSA.

Table 2Predictive parameters for STOP, STOP-BANG and STOP-BANG-Apple questionnaires, $n = 208$

	OSA diagnosis AHI > 5 (n =162)	Moderate-Severe OSA AHI > 15 (n = 100)	Severe OSA AHI > 30 (n = 60)
STOP (Cut off score =2)			
• Sensitivity, %	96.9	98	98.3
• Specificity, %	10.9	7.4	60
• PPV, %	79.3 (74–84)	49.5 (42.5–56.5)	29.3 (22.9–35.6)
• NPV, %	50 (19–81)	80 (55.2–104.8)	90 (71.4–108.6)
• +LR	1.1 (0.98–1.2)	1.1 (0.99–1.1)	1.0 (0.99–1.1)
• –LR	0.28 (0.08–0.9)	0.27 (0.05–1.2)	0.28 (0.04–2.1)
STOP-Apple (Cut off score 3)			
• Sensitivity	88.3	96	96.6
• Specificity	39.1	30.6	23.5
• PPV	83.6 (78.1–89.2)	56.1 (48.7–63.6)	33.3 (26.3–40.4)
• NPV	48.6 (32.5–64.8)	89.2 (79.2–99.2)	94.6 (87.3–101.9)
• +LR	1.5 (1.1–1.8)	1.4 (1.2–1.6)	1.3 (1.1–1.4)
• –LR	0.3 (0.17–0.5)	0.13 (0.05–0.35)	0.14 (0.04–0.6)
STOP-BANG (Cut off score = 3)			
• Sensitivity	96.3	98	98.3
• Specificity	19.6	12	9.4
• PPV	81 (75.3–86.4)	50.1 (43.7–57.8)	30 (23.6–36.5)
• NPV	60 (35.2–84.8)	86.7 (69.5–103.9)	93.3 (80.7–105.9)
• +LR	1.2 (1.0–1.4)	1.1 (1.03–1.2)	1.1 (1.02–1.15)
• –LR	0.19 (0.07–0.5)	0.17 (0.04–0.72)	0.18 (0.02–1.3)
STOP-BANG-Apple (Cut off score =4)			
• Sensitivity	90.1	95	93.2
• Specificity	39.1	27	20.1
• PPV	84 (78.5–89.4)	54.6 (47.2–62)	32 (24.7–38.5)
• NPV	53 (36.1–69.7)	85.3 (73.4–97.2)	88 (77.4–99.1)
• +LR	1.5 (1.2–1.87)	1.3 (1.1–1.5)	1.2 (1.04–1.3)
• –LR	0.25 (0.14–0.45)	0.19 (0.07–0.46)	0.34 (0.12–0.9)

AHI: Apnea Hypopnea Index; NPV: Negative predictive value; ORs: Odds ratio; 95% CI: 95% confidence interval; +LR: Positive likelihood ratio; NPV: Negative predictive value; PPV: Positive predictive value. Data in cells represents absolute value.

Table 3

The polysomnogram parameters among diagnosed OSA patients

	Total (<i>n</i> = 162)	Apple (<i>n</i> = 101)	Non-Apple (<i>n</i> = 61)	<i>P</i>-value
Total sleep time (TST)	351.5 (304 – 388)	349 (299 – 391)	356 (318 – 384.5)	0.55
Sleep efficiency, %	79.3 (69 – 84.4)	79.6 (69 – 84)	79 (67.6 – 84.9)	0.98
AHI	19 (12 – 49.9)	28.1 (14.9 – 63)	12 (9 – 22.4)	<0.01
Nadir O ₂ , %	82 (75 – 87)	81 (74 – 85)	85 (79.5 – 87)	<0.01
Supine AHI	21.5 (5.9 – 53.3)	31.5 (14 – 72.8)	10.8 (1.7 – 25.5)	<0.01
REM AHI	22.5 (6.7 – 36.3)	30 (12.9 – 43)	10.4 (4 – 29.2)	<0.01
Mean O ₂ saturation	95 (93 – 96)	95 (93 – 96)	95 (93 – 96)	0.69
Percentage of TST with O ₂ saturation < 90%	0.8 (0 – 2.8)	0.6 (0.05 – 9.1)	0.95 (0 – 2.5)	0.61

AHI: Apnea-Hypopnea-Index; Nadir O₂: Nadir Oxygen; REM: Rapid Eye Movement; TST: Total Sleep Time. Data in cells represent Median and Interquartile range (IQR) except the total sleep time and sleep efficiency which represent in Mean and standard error. *P*-value compares between apple and non-apple body type