Virginia Academy of Sleep Medicine

Arousal Threshold in Sleep Apnea Patients and Obesity

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Accreditation Statement

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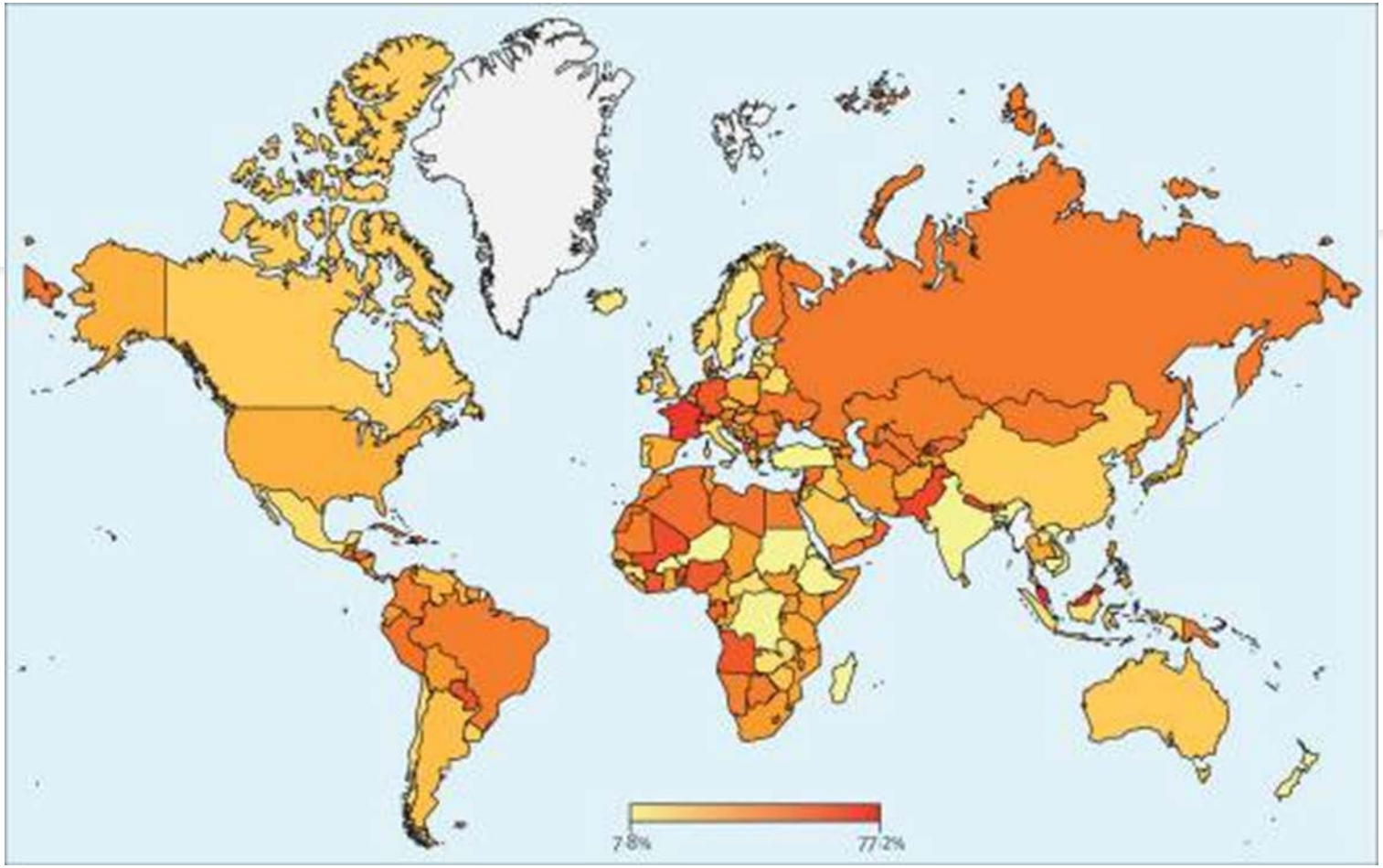
Introduction

Obstructive sleep apnea (OSA) is a common sleep-related breathing disorder worldwide

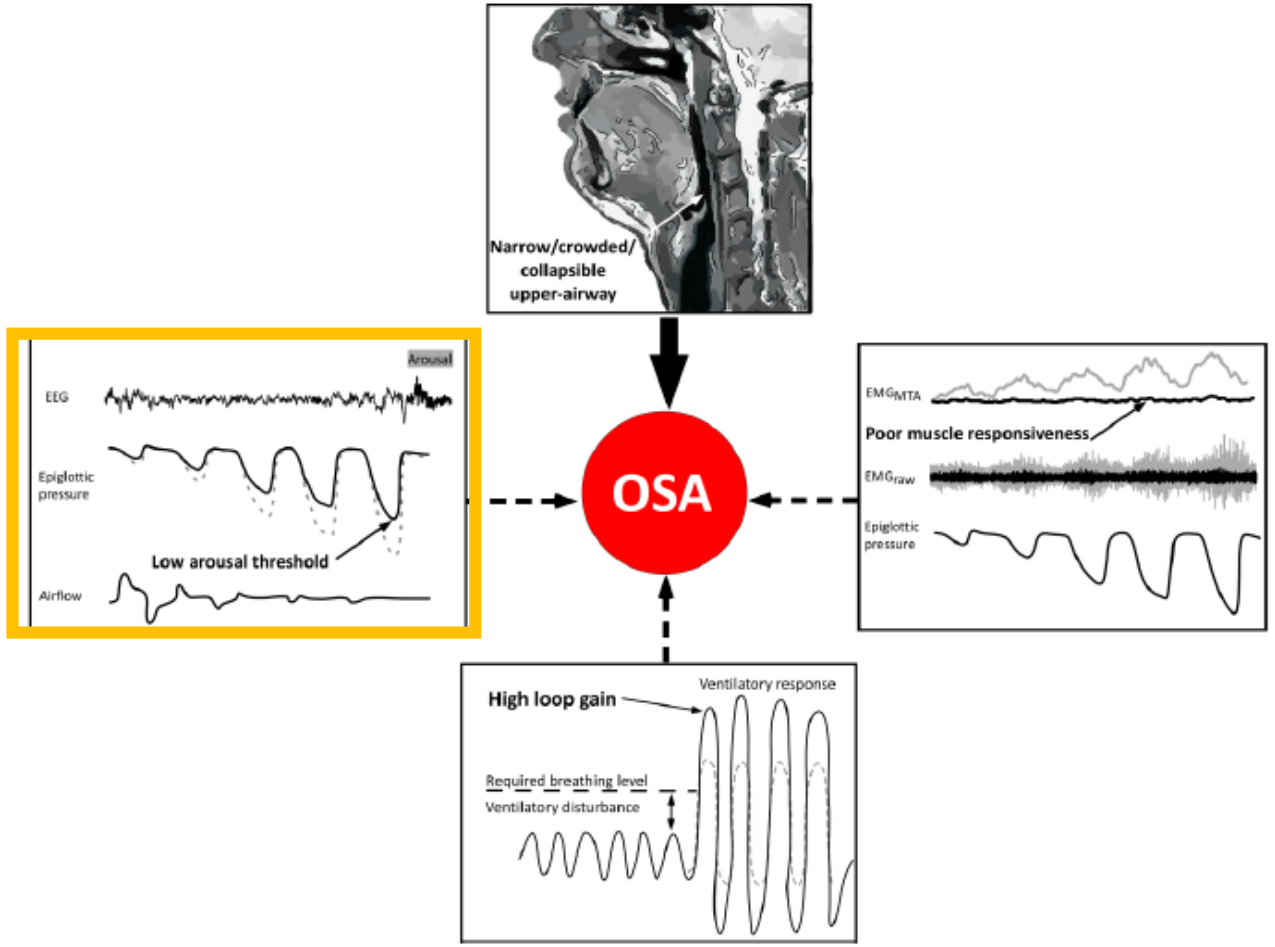


Global heat map of estimated prevalence of OSA (AHI ≥5 events/hr) for each country

Benjafield AV et. al. Am J Respir Crit Care Med. 2013 Oct 15;188(8):996-1004

Introduction

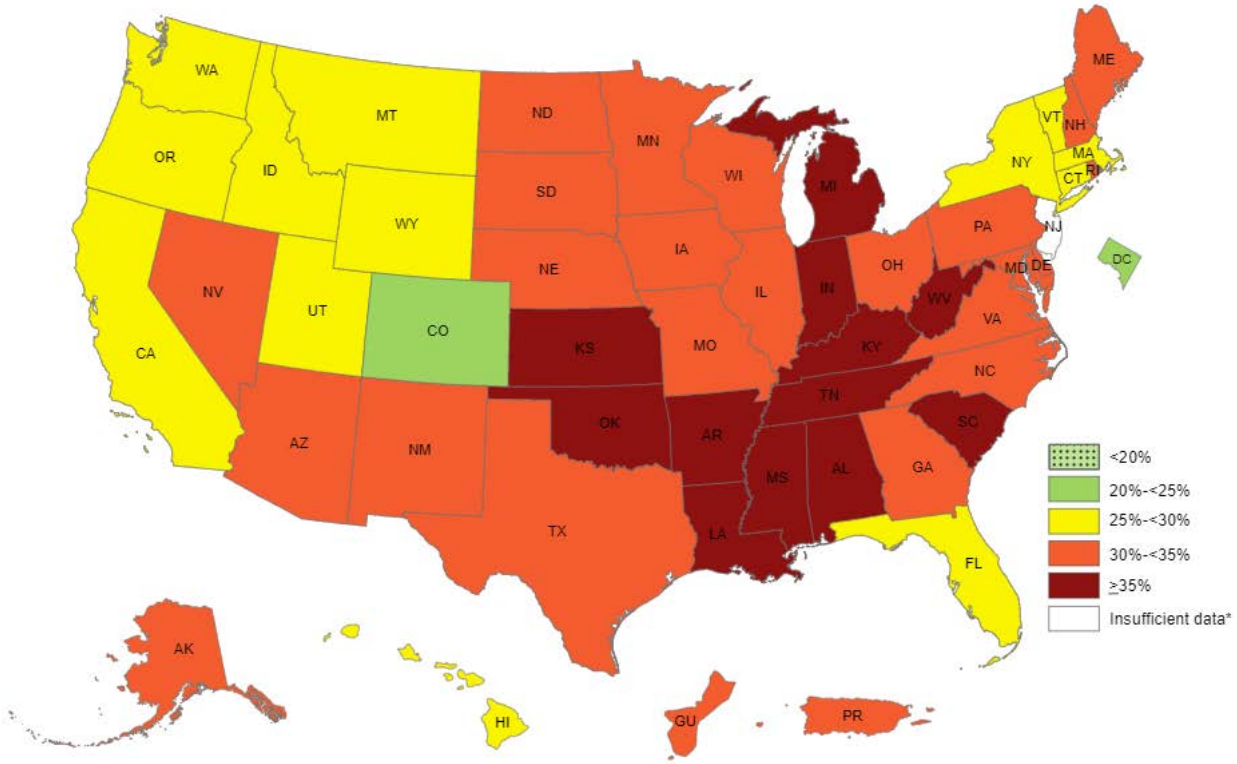
- **Low respiratory arousal threshold(ArTH) can contribute to OSA by causing sleep fragmentation and preventing recruitment of upper airway muscle leading to increasing hypopneas**



Schematic of the phenotypic traits that cause OSA. Some degree of "impaired'" upper airway anatomy is a prerequisite for OSA (narrow/ crowded/collapsible upper airway) indicated by the thick solid arrow and MRI schematic. Impairment in the nonanatomical traits (ie, low arousal threshold, poor muscle responsiveness, high loop gain) also importantly contributes to the pathogenesis of OSA in the majority of patients (dashed arrows). Schematic representation of impairment in each of the nonanatomical traits (solid black lines with adjacent arrows) is given, along with a more desirable response for each nonanatomical trait (gray lines). EMG ¼ genioglossus electromyographic activity; MTA ¼ moving time average (100 ms) of the rectified EMG signal.

Eckert DJ et. al. Am J Respir Crit Care Med. 2013;188(8):996-1004
Carberry JC et. al. Chest. 2018 Mar;153(3):744-755

Introduction



- **Prevalence of self-reported obesity among U.S. adults in 2019**
- **The major risk factor for OSA is obesity**

Young T et. al. JAMA. 2004;291(16):2013–2016
https://www.cdc.gov/obesity/data/prevalence-maps.html

Introduction

- **Low ArTH was found in 60% of obese patients with OSA.**
- **The association of a low arousal threshold and obesity severity is still unknown.**

Gray EL et. al. J Clin Sleep Med. 2017 Jan 15; 13(1): 81–88

Objective

- **To determine the association of arousal threshold between obesity vs morbid obesity in patients with OSA.**

Method

- A retrospective chart review
- Adult patients who underwent in-lab full night PSG in Torr Sleep Center (Corpus Christi, TX) between 2/2007-4/2008
- Inclusion: Patients with the diagnosis of OSA and obesity

Method

Definition

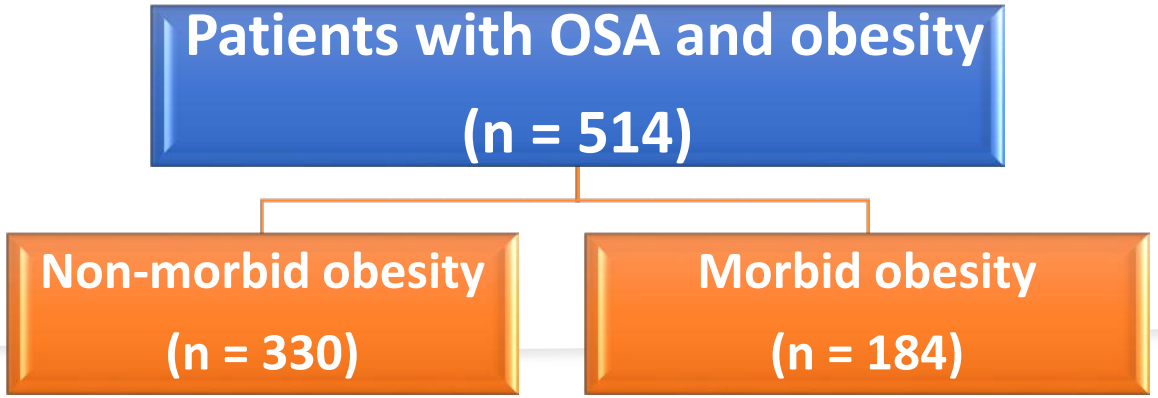
- **Obesity**
  - **Class 1: BMI 30-34.9 kg/m^2**
  - **Class 2: BMI 35-39.9 kg/m^2**
  - **Class 3 (Morbid obesity): BMI ≥ 40 kg/m^2**
- **OSA: Apnea-Hypopnea index (AHI) > 5**
- **The low ArTh score ≥ 2 is considered as low arousal threshold phenotype**

Low ArTH score = (AHI < 30events/hr) + (nadir SpO2 > 82.5%) + (Fhypopneas > 58.3%)

(Edwards BA et. al. Am J Respir Crit Care Med. 2014 Dec 1;190(11):1293-300)

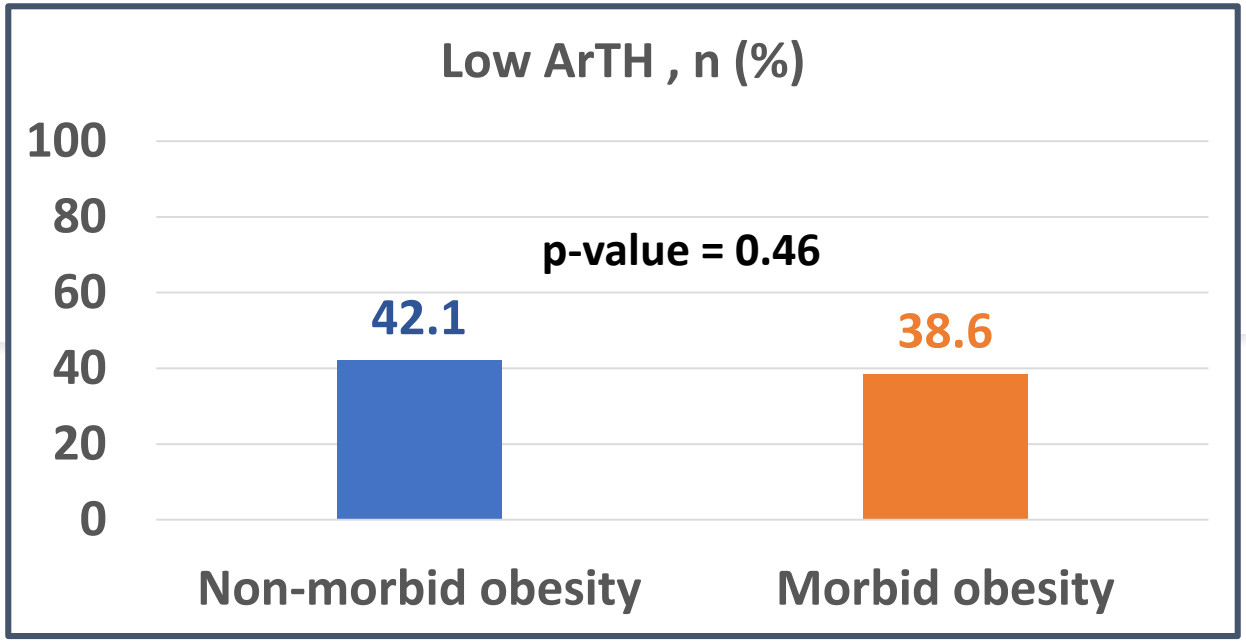
Logistic regression analysis

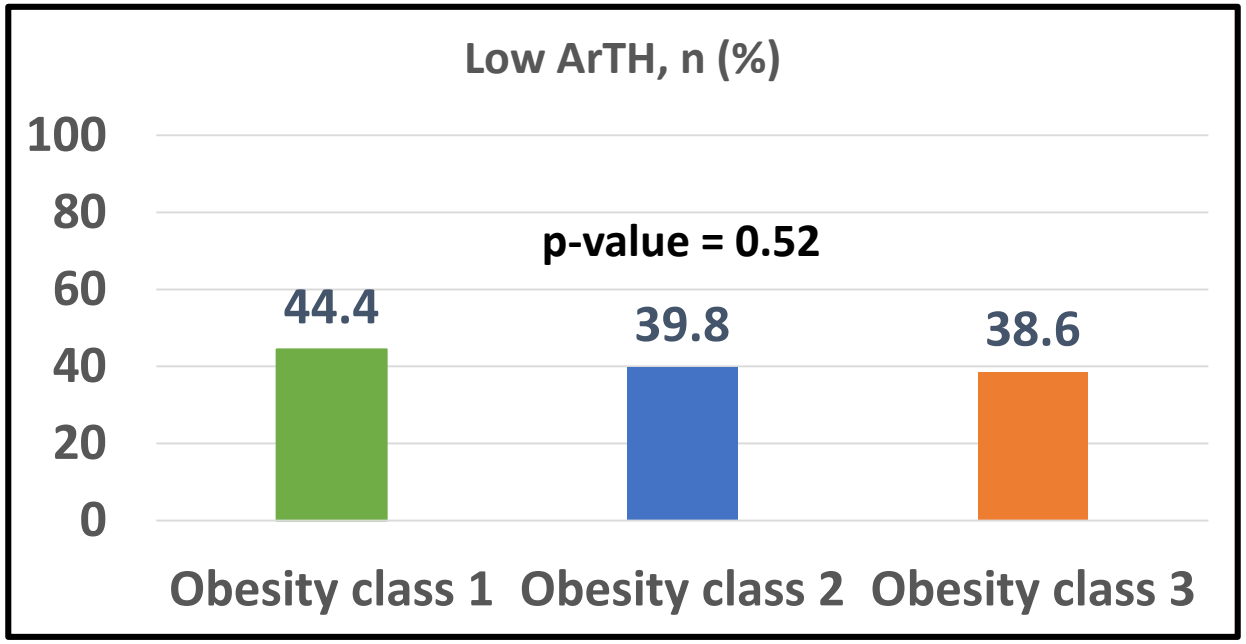
Results



	Non-morbid obesity	Morbid obesity	Total	P-value
Age, years	55 (19)	49 (18)	53 (18)	<0.001
Male, n (%)	229 (69.6)	99 (53.8)	328 (63.9)	<0.001
Race, n (%)				0.37
White	155 (47.0)	81 (44.0)	236 (45.9)	
Hispanic	170 (51.5)	97 (52.7)	267 (52.0)	
African American	5 (1.5)	6 (3.3)	11 (2.1)	
BMI, kg/m2	35 (4.5)	45 (8.4)	38 (9.1)	<0.001
Neck circumference, inches	17.0 (2.0)	18.0 (2.8)	17.5 (2.8)	<0.001
Modified Friedman	3 (2)	3 (2)	3 (2)	0.19
ESS	11 (9)	11 (8)	11 (8)	0.14

Results


Low ArTH , n (%)
100
80
60
40
20
0
p-value = 0.46
42.1
38.6
Non-morbid obesity
Morbid obesity


Low ArTH, n (%)
100
80
60
40
20
0
p-value = 0.52
44.4
39.8
38.6
Obesity class 1
Obesity class 2
Obesity class 3

Results

	Non-morbid obesity	Morbid obesity	Total
TST, minutes*	370 (95)	352 (101)	365 (100)
SE*	82.9 (17.6)	79.5 (18.8)	81.6 (18.0)
REM %*	16.3 (11.8)	13.6 (12.9)	15.2 (12.5)
REM AHI	34.8 (40.0)	39.9 (45.1)	35.7 (42.3)
NREM AHI*	24.6 (37.5)	35.7 (50.6)	29 (41.1)
Supine AHI	33.3 (42.9)	35.2 (48.6)	33.8 (46.2)
Arousal index*	39.5 (33.6)	46.6 (41.3)	41.9 (37.1)
SaO2 Nadir*	78 (11)	76 (14)	77 (12)
AHI*	27.7 (35.0)	36.7 (45.4)	31.2 (36.9)

* p-value < 0.05

Results

	Multivariate analysis		
	OR	95%CI	p-value
morbid obesity	1.19	0.68-2.10	0.54
Age	0.97	0.95-0.99	<0.01
Female	1.68	0.90-3.15	0.10
Neck circumferences	0.96	0.82-1.13	0.66
TST	0.996	0.99-1.00	0.22
SE	1.00	0.97-1.03	0.97
REM %	0.97	0.94-1.01	0.11
Arousal index	0.96	0.95-0.97	<0.001
SaO2 Nadir	1.21	1.16-1.27	<0.001
AHI	0.999	0.998-1.001	0.26

Conclusion

- A low ArTH phenotype of OSA is found in approximately 40 % of patient with obesity.
- Our data shows that severity of obesity is not associated with low arousal threshold phenotype in patients with OSA.