

## Search Strategies

### Pubmed

<i>Disease 1</i>	"Sleep Apnea Syndromes"[Mesh] OR "sleep apnea" OR "Sleep breathing disorder" OR "Sleep-disordered breathing" OR "Sleep disordered breathing" OR "Obstructive sleep apnea"
<i>Disease 2</i>	"Snoring"[Mesh] OR "snore" OR "snores"
<i>Intervention</i>	"Mobile Applications"[Mesh] OR "mobile applications" OR "mobile apps" OR "apps" OR "gadgets" OR "health trackers" OR "mhealth" OR "wearable device" OR "iphone" OR "android" OR "fitbit" OR "cell phones" OR "cellular phones" OR "mobile phones" OR "smartphones" OR "mobile" OR tablet OR "Commercial Accelerometer" OR "Commercial Actigraphy" OR "Wrist-Based" OR "Handheld device"
<i>Comparison</i>	-
<i>Outcome</i>	-
<i>String</i>	(Sleep Apnea Syndromes"[Mesh] OR "sleep apnea" OR "Sleep breathing disorder" OR "Sleep-disordered breathing" OR "Sleep disordered breathing" OR "Obstructive sleep apnea" OR "Snoring"[Mesh] OR "snore" OR "snores") AND (Mobile Applications"[Mesh] OR "mobile applications" OR "mobile apps" OR "apps" OR "gadgets" OR "health trackers" OR "mhealth" OR "wearable device" OR "iphone" OR "android" OR "fitbit" OR "cell phones" OR "cellular phones" OR "mobile phones" OR "smartphones" OR "mobile" OR tablet OR "Commercial Accelerometer" OR "Commercial Actigraphy" OR "Wrist-Based" OR "Handheld device")

### Embase [String]

'mobile application'/exp OR 'mobile application' OR 'mobile apps'/exp OR 'mobile apps' OR 'gadgets' OR 'mobile phone'/exp OR 'mobile phone' OR 'health tracker' OR 'mhealth'/exp OR mhealth OR 'wearable device'/exp OR 'wearable device' OR 'fitbit' OR 'iphone'/exp OR 'iphone' OR 'android'/exp OR android OR 'cell phones' OR 'cellular phones' OR 'smartphones' OR 'commecial accelerometer' OR ' commercial actigraphy' OR 'wrist-based' OR 'handheld device' AND ('sleep disordered breathing'/exp OR 'sleep disordered breathing' OR 'snoring'/exp OR snoring) AND [2007-2017/py

### Grey Literature: Google

("sleep apnea" OR snoring OR insomnia) AND ("mobile applications" OR "mobile apps" OR "cell phone" OR "mobile phone"); site:.org, site:.edu, site:.gov +.pdf

**Table S2.A.** Threshold of Index Interventions for OSA\* Diagnostics Studies using Laboratory PSG<sup>o</sup> as the Standard Comparison

Study	Threshold (AHI <sup>o</sup> )	OSA* (n)	Non-OSA* (n)	Prevalence (%)	True Positive	False Positive	False Negative	True Negative
<b>Studies with Bed/Mattress based-sensors</b>								
Agatsuma (2009)	≥5	162	39	80.60	162	26	0	13
	≥15	127	74	63.20	123	30	4	44
	≥30	89	112	44.30	72	22	17	90
Beattie (2013)	≥5	31	14	68.90	26	3	5	11
	≥15	15	30	33.30	13	1	2	29
	≥30	12	33	26.70	12	1	0	30
Norman (2014)	≥5	47	13	80.00	44	3	3	10
	≥15	25	35	41.67	22	3	3	32
	≥30	10	50	16.67	10	2	0	48
Takasaki (2008)	≥5	45	7	86.50	45	7	0	0
	≥10	40	12	76.90	40	7	0	5
	≥15	33	19	63.50	33	7	0	12
	≥20	31	21	59.60	29	5	2	16
	≥30	27	25	51.90	24	2	3	23
	≥40	24	28	46.20	18	0	6	28
Tenhunem (2013)	≥5	110	47	70.10	36	21	11	89
	≥15	61	96	38.85	91	5	5	56
	≥30	34	123	21.66	115	6	8	28
Tsukahara (2014)	≥5	-	-	-	-	-	-	-
	≥20	-	-	-	-	-	-	-
<b>Contactless Devices (Other than Bed/Mattress based sensors)</b>								
Abad Capa (2016)	≥5	44	6	88.00	44	1	0	5
	≥15	34	16	68.00	30	3	4	13
	≥30	23	27	46.00	19	1	4	26
Davidovich (2016)	≥15	34	62	35.40	30	7	4	55
Espinoza-Cuadros (2015)	≥5	239	46	83.90	238	44	1	2
	≥10	203	82	71.20	175	64	18	28
	≥15	154	131	54.00	98	43	56	88
	≥30	23	262	8.10	17	12	6	196
Nandakumar (2015)	≥5	26	11	70.30	22	1	4	10
	≥15	15	22	40.50	15	0	0	22
	≥30	7	30	18.90	7	0	0	30
Zaffaroni (2013)	≥5	57	17	77.00	56	9	1	8
	≥15	38	36	51.40	34	3	4	33
	≥30	19	55	25.68	16	6	3	49
Weinreich (2014)	≥5	41	11	78.85	41	5	0	5
	≥10	36	16	69.23	33	4	3	12
	≥15	28	24	53.85	27	3	1	21
<b>Contact Devices with at least three sensors</b>								
Al-Mardini M 2014	≥5	8	7	53.30	8	1	0	6
	≥15	6	9	40.00	6	0	0	9
	≥30	4	11	26.70	3	0	1	11
Benistant (2016)	≥5	4	5	44.40	2	0	2	5
	≥15	0	9	0.00	0	0	0	9
	≥30	0	9	0.00	0	0	0	9
Rofouei (2011)	≥5	1	0	-	-	-	-	-

<b>Contact Devices with less than 3 sensors</b>								
Dinç (2014)	$\geq 5$	26	5	83.90	14	0	12	5
	$\geq 15$	16	15	51.60	7	0	9	15
	$\geq 30$	9	22	29.00	4	0	5	22
Levendowski (2015) Study A	$\geq 5$	14	6	70.00	11	0	3	6
	$\geq 15$	13	7	65.00	11	1	2	6
	$\geq 30$	12	8	60.00	10	1	2	7
Ozmen (2011)	$\geq 15$	30	34	46.88	25	8	5	26
	$\geq 25$	25	39	39.06	20	8	5	31
	$\geq 40$	18	46	28.13	17	3	1	43
Selvaraj (2014) <sup>§</sup>	$\geq 15$	15	38	28.30	11	4	4	34
Nakano (2014)	$\geq 15$	23	17	57.50	-	-	-	-
	$\geq 30$	-	-	-	-	-	-	-

\*OSA: Obstructive sleep apnea

<sup>o</sup>PSG: Polysomnogram

<sup>o</sup>AHI: Apnea hypopnea index

<sup>§</sup> The study participants were tested with the sensors positioned in three different locations of their chest. The prevalence, sensitivity and specificity results of the three different location results were averaged.

**Table S2.A.** Shows the total number of participants diagnosed with OSA with the standard laboratory diagnosis PSG, and the number of true positives, true negatives, false positives and false negatives of the index test for each AHI threshold evaluated in the included studies

**Table S2.B.** Threshold of Index Interventions for OSA\* Diagnostics Studies with Home PSG<sup>‡</sup> as Standard Comparison

Study	Threshold (AHI <sup>§</sup> )	OSA* (n)	Non-OSA* (n)	Prevalence (%)	True Positive	False Positive	False Negative	True Negative
<i>Contactless Devices with less than 3 sensors</i>								
Levendowski (2015) - B	>=5	16	8	66.70%	11	2	5	6
	>=10	11	13	45.83%	10	3	1	10
	>=15	9	15	37.50%	9	4	0	11

\*OSA: Obstructive sleep apnea

‡PSG: Polysomnogram

§AHI: Apnea hypopnea index

**Table S2.B.** Shows the total number of participants diagnosed with OSA with the standard home-based diagnostic PSG, and the number of true positives, true negatives, false positives and false negatives of the index test for each AHI threshold evaluated in the included study

**Table S2.C.** Threshold of Index Interventions for Snoring Diagnosis

Study	Threshold (AHI <sup>®</sup> )	OSA* (n)	Non-OSA* (n)	Prevalence (%)	True Positive	False Positive	False Negative	True Negative
Kreivi (2013)	5% of total sleep time snoring	148	52	74%	136	21	12	31
Camacho (patient 1)	53dB	1	0	Number of snorers: 380	363	15	17	-
Camacho (patient 2)	53dB	1	0	Number of snorers: 1158	737	53	421	-

<sup>®</sup>AHI: *Apnea hypopnea index*

**Table S2.C.** Shows the total number of participants diagnosed as snorers with the standard diagnostic PSG, and the number of true positives, true negatives, false positives and false negatives of the index test for each threshold used in the included studies

**Table S3.** Characteristics of the excluded studies

<b>Study</b>	<b>Reason for Excluding Study</b>
<b>Abdelnasser (2015)</b>	Measuring apnea in normal individuals simulating apneas. No comparison to gold standard
<b>Abeyratne (2015)</b>	Used pre-existing polysomnogram sensor in isolation. No wearable/device
<b>Baharav (2013)</b>	No comparison to gold standard
<b>Barak-Shinar (2013)</b>	Used pre-existing polysomnogram sensor in isolation. No wearable/device
<b>Ben-Israel (2012)</b>	Used pre-existing polysomnogram sensor in isolation. No wearable/device
<b>Bhat et al (2015)</b>	Does not measure AHI or RDI. Compare sleep time only.
<b>Blackwell et al (2011)</b>	Does not measure AHI or RDI. Compare sleep time only.
<b>Bsoul et al (2011)</b>	Used pre-existing polysomnogram sensor in isolation. No wearable/device
<b>Cao et al (2012)</b>	Measuring apnea in normal individuals simulating apneas. No comparison to gold standard
<b>Chen et al (2013)</b>	No comparison to gold standard
<b>De Silva et al (2011)</b>	No use of device
<b>Durán-Cantolla et al (2017)</b>	Use of class III medical device as index test
<b>Emoto et al (2014)</b>	Used pre-existing polysomnogram sensor in isolation. No wearable/device
<b>Fischer et al (2016)</b>	No comparison to gold standard
<b>Fiz et al (2010)</b>	Used pre-existing polysomnogram sensor in isolation. No wearable/device
<b>Hassan et al (2016)</b>	Used pre-existing polysomnogram sensor in isolation. No wearable/device
<b>Iovanovici et al (2015)</b>	Use of class II medical device as index test
<b>Kagawa et al (2013)</b>	Did not measure sensitivity and specificity of OSA diagnosis
<b>Kim et al (2016)</b>	Used pre-existing polysomnogram sensor in isolation. No wearable/device
<b>Lee et al (2013)</b>	Used pre-existing polysomnogram sensor in isolation. No wearable/device
<b>Liu et al (2016)</b>	Measuring apnea in normal individuals simulating apneas
<b>Michael et al (2007)</b>	Used pre-existing polysomnogram sensor in isolation. No wearable/device
<b>Mlynczak et al (2016)</b>	No comparison to gold standard
<b>Nasu et al (2011)</b>	No comparison to gold standard
<b>Ng et al (2009)</b>	Used pre-existing polysomnogram sensor in isolation. No wearable/device
<b>O'Hare et al (2015)</b>	Only measured sleep efficiency and total sleep time
<b>Oliver et al (2007)</b>	No comparison to gold standard
<b>Pan et al (2016)</b>	Use of class II medical device as index test
<b>Ren et al (2015)</b>	No comparison to gold standard
<b>Romen et al (2014)</b>	Use of class II medical device as index test
<b>Seren et al (2014)</b>	No comparison to gold standard
<b>Shin et al (2014)</b>	No comparison to gold standard
<b>Tseng (2012)</b>	Used pre-existing polysomnogram data
<b>Weinmin et al (2013)</b>	Tested index is a FDA approved medical device
<b>Xu et al (2015)</b>	Used pre-existing polysomnogram sensor in isolation. No wearable/device

**Table S3** Shows the reason for excluding the 35 studies for which the full-texts were obtained

**Table S4.** QUADAS-2 Summary Description

Study	Domain 1. Patient Selection					Domain 2. Index Test					Domain 3. Standard test				Domain 4. Flow and Timing					
	Risk of Bias			Applicability		Risk of bias			Applicability		Risk of Bias		Applicability		Risk of Bias					
	Was a consecutive or random sample of patients enrolled?	Was a case-control design avoided?	Did the study avoid inappropriate exclusions?	Result	Are there concerns that the included patients and setting do not match the review question? (accuracy of non-PSG test for snoring/OSA diagnosis for adults with symptoms)	Result	Were the index test results interpreted without knowledge of the results of the reference standard?	If a threshold was used, was it pre-specified?	Result	Are there concerns that the index test, its conduct, or interpretation differ from the review question?	Result	Is the reference standard likely to correctly classify the target condition?	Were the reference standard results interpreted without the knowledge of the results of the index test?	Result	Are there concerns that the target condition as defined by the reference standard does not match the question?	Result	Was there an appropriate interval between test and reference standard?	Did all patients receive the same reference standard?	Were all patients included in the analysis?	Result
Al-Mardini (2013;2014)	U	No	U	U	Yes	High	Yes	Yes	Low	No	Low	U	U	U	No	Low	No	U	Yes	High
Benistant (2016)	Yes	Yes	Yes	Low	No	Low	Yes	Yes	Low	No	Low	Yes	Yes	Low	No	Low	Yes	Yes	No	Low
Norman (2014)	U	No	Yes	High	Yes	High	Yes	Yes	Low	No	Low	Yes	Yes	Low	No	Low	Yes	No	No	High
Tsukahara (2014)	Yes	Yes	Yes	low	No	low	Yes	U	U	No	low	Yes	Yes	low	No	Low	Yes	Yes	Yes	low
Beattie (2013)	U	Yes	Yes	U	No	low	Yes	Yes	low	No	low	Yes	Yes	low	No	low	Yes	Yes	U	low
Agatsuma (2009)	Yes	Yes	Yes	low	Yes	U	Yes	Yes	low	No	low	Yes	Yes	low	No	low	Yes	Yes	No	low
Rofouei (2011)	U	Yes	U	High	Yes	high	U	Yes	high	No	low	Yes	U	high	No	low	No	Yes	Yes	high
Takasaki (2008)	Yes	Yes	Yes	low	No	low	Yes	Yes	low	No	low	Yes	Yes	low	No	low	Yes	Yes	Yes	low
Tenhunem (2013)	Yes	Yes	Yes	low	U	U	U	No	high	no	low	Yes	U	U	No	low	Yes	Yes	No	high
Nandakumar (2015)	Yes	Yes	Yes	low	U	U	Yes	Yes	low	No	low	Yes	Yes	low	No	low	Yes	Yes	Yes	low
Weinreich (2014)	Yes	Yes	Yes	low	No	low	U	Yes	U	No	low	Yes	U	U	No	low	Yes	Yes	Yes	low
Zaffaroni (2013)	Yes	Yes	Yes	low	No	low	U	Yes	low	No	low	Yes	U	U	No	low	Yes	Yes	Yes	low
Davidovich (2016)	Yes	Yes	Yes	low	No	low	U	Yes	low	No	low	Yes	Yes	low	No	low	Yes	Yes	Yes	low

<b>Levendowski (2015)</b>	Yes	Yes	Yes	low	U	U	U	Yes	U	No	low	Yes.	U	U	U	U	Yes	Yes	No	low
<b>Abad Capa (2016)</b>	Yes	Yes	No	U	No	low	Yes	No	high	No	low	Yes	Yes	low	No	low	Yes	Yes	No	U
<b>Espinoza-Cuadros (2015)</b>	Yes	yes	Yes	low	No	low	Yes	Yes	low	Yes	high	Yes	Yes	low	Yes	high	U	Yes	Yes	U
<b>Selvaraj (2014)</b>	U	No	U	high	U	U	U	U	U	No	low	Yes	U	U	No	low	Yes	Yes	Yes	low
<b>Nakano (2014)</b>	U	U	U	high	Yes	U	U	Yes	low	No	low	yes	U	U	No	low	Yes	Yes	No	low
<b>Dinç, A.E. (2014)</b>	Yes	Yes	U	low	No	low	Yes	yes	low	no	low	Yes	Yes	low	No	low	No	Yes	No	high
<b>Ozmen (2011)</b>	Yes	Yes	Yes	low	No	low	Yes	Yes	Low	Yes	high	Yes	Yes	Low	No	Low	No	Yes	No	high
<b>Camacho (2015)</b>	U	U	U	U	no	low	U	No	high	no	low	Yes	U	U	No	low	Yes	Yes	Yes	low
<b>Kreivi (2013)</b>	Yes	Yes	Yes	low	No	low	U	Yes	U	No	low	Yes	U	U	No	low	Yes	Yes	Yes	low