



ORIGINAL ARTICLE

# Obstructive Sleep Apnea: Epidemiology and Portuguese patients profile



A.P. Rodrigues<sup>a,\*</sup>, P. Pinto<sup>b,c</sup>, B. Nunes<sup>a</sup>, C. Bárbara<sup>b,c</sup>

<sup>a</sup> Departamento de Epidemiologia, Instituto Nacional de Saúde Doutor Ricardo Jorge, Lisboa, Portugal

<sup>b</sup> Programa Nacional para as Doenças Respiratórias, Direção-Geral da Saúde, Serviço de Pneumologia, Centro Hospitalar Lisboa Norte, Lisboa, Portugal

<sup>c</sup> Instituto de Saúde Ambiental (ISAMB), Faculdade de Medicina, Universidade de Lisboa, Portugal

Received 18 July 2016; accepted 13 January 2017

## KEYWORDS

Sleep apnea;  
Public health;  
Prevalence;  
Portugal

## Abstract

**Introduction:** Obstructive Sleep Apnea (OSA) is characterized by recurrent episodes of apnea and hypopnea, secondary to collapse of the upper airways during sleep. OSA is frequently associated to cardiovascular complications. In Portugal, its magnitude is unknown.

**Methods:** In 2014 a cross-sectional study was performed using the Portuguese General Practitioner (GP) Sentinel Network (Rede Médicos Sentinela). Participants GP reported all OSA cases diagnosed and registered in their lists of users on the 31 December 2013.

Frequency of OSA has been estimated by sex and age. OSA patients were also characterized by method of diagnosis, treatment, and underlying conditions.

Association between risk factors and severe OSA (*odds ratio*) was calculated using a logistic regression model adjusting confounding.

**Results:** Prevalence of OSA on the population aged 25 years or more was 0.89% (95 CI: 0.80–1.00%); it was higher in males 1.47% (95 CI: 1.30–1.67%) and in those aged between 65 and 74 (2.35%). Most had severe OSA (48.4%). Hypertension (75.9%), obesity (74.2%) and diabetes mellitus (34.1%) were the most frequent comorbidities. Being a male (OR: 2.6; 95 CI: 1.2–5.8) and having obesity (OR: 4.0; 95 CI: 1.8–8.6) were associated with an increased risk of severe OSA.

**Conclusion:** Found frequency of OSA was lower than other countries estimates, which may be explained by differences on case definition but can also suggest underdiagnosis of this condition as reported by other authors.

© 2017 Sociedade Portuguesa de Pneumologia. Published by Elsevier España, S.L.U. This is an open access article under the CC BY-NC-ND license (<http://creativecommons.org/licenses/by-nc-nd/4.0/>).

\* Corresponding author.

E-mail address: [ana.rodrigues@insa.min-saude.pt](mailto:ana.rodrigues@insa.min-saude.pt) (A.P. Rodrigues).

## Introduction

The Obstructive Sleep Apnea (OSA) is characterized by recurrent episodes of apnea or hypopnea secondary to a collapse of the upper airways during sleep.

A wide variability in OSA prevalence is found between studies due to important differences in cases definition and study population.<sup>1</sup>

It is estimated that the prevalence of OSA (defined by the presence of episodes of hypopnea and apnea and frequent daytime sleepiness) in adult men vary between 1% and 5%.<sup>1</sup> Considering OSA definition currently used (occurrence of more than 5 episodes of apnea and hypopnea per hour), prevalence of OSA, accordingly sex and age group, can vary between 2% and 28%, half of which is classified as moderate or severe.<sup>2,3</sup> Prevalence of undiagnosed OSA may range between 0.3% and 5%.<sup>4</sup>

As OSA affects mainly middle-aged and obese males,<sup>5</sup> it is recognized that the increase in obesity may contribute to an increase in OSA prevalence.

In addition to its high magnitude, the clinical importance of OSA comes from its cardiovascular effects, consequences on morbidity and mortality<sup>6,7</sup> and also neuropsychological changes that increase the occurrence of occupational and traffic accidents.<sup>8</sup> OSA is a risk factor for hypertension and it is also known that high blood pressure risk increases with severity of OSA.<sup>9</sup> In fact, given the high frequency of OSA within individuals with hypertension,<sup>10</sup> the latest standard for hypertension diagnostic approach recommends performing OSA diagnosis in cases of high blood pressure which are resistant to treatment and have a non-dipper pattern on 24 h records of blood pressure.<sup>11,12</sup> It is also known that prevalence of sleep-disordered breathing among patients who had strokes is high, ranging between 44% and 74%,<sup>13</sup> emphasizing that the presence of OSA in these patients is associated with an increased risk of premature mortality.<sup>14</sup>

The association between Diabetes and OSA has recently been described and there is emerging evidence that OSA constitutes a risk factor for development of resistance to insulin<sup>15</sup> independently of obesity, which may be involved in metabolic syndrome development.<sup>16</sup>

Another aspect that reinforces the importance of the diagnosis of OSA is linked to the efficacy of nasal Continuous Positive Airway Pressure (CPAP) therapy in reversing neuropsychological disorders and reducing cardiovascular events.<sup>17</sup> As a consequence of CPAP treatment, reduction of excessive daytime sleepiness contributes to quality of life improvement and accident risk reduction but also the occurrence of high blood pressure is clearly lower in the short and long term.<sup>18</sup>

Although Portuguese prevalence of OSA is unknown, considering the high prevalence of adult obesity in Portugal<sup>19</sup> a high prevalence of OSA can be expected in the adult Portuguese population. Neither is the patient profile with OSA known, especially in terms of severity, treatment, comorbidities and use of health services.

As it is not currently feasible to implement a population based survey to estimate the Portuguese prevalence of OSA, the first approach to the subject is to estimate the frequency of OSA known within the population under observation of the General Practitioner (GP) Sentinel Network and to characterize OSA patients.

## Material and methods

A cross sectional study was performed within the GP Sentinel Network (known as *Rede Médicos Sentinela*), which has national distribution and 117 GP in 2013.

At the beginning of the study all Sentinel GP included in the *Rede Médicos Sentinela* in 2013 and also GPs that joined the network in the first trimester of 2014 (a total of 7) were invited to participate. Invitation was sent by email and renewed by phone call. The study protocol, questionnaire forms and detailed study instructions were sent to all doctors that accepted to take part in the study.

GP participation consisted in filling in a questionnaire for each and all of their patients diagnosed with OSA at 31st of December of 2013, using existing recorded information data to collect following data:

1. Sex and age.
2. Diagnostic, including: diagnostic date, overnight polysomnography or overnight respiratory polygraphy performance, apnea-hypopnea index, respiratory disturb index.
3. Comorbidities: diabetes, high blood pressure, obesity, coronary disease, stroke, acute myocardial infarction, arrhythmia, heart failure, occurrence of traffic accident (as driver).
4. Treatment: CPAP, specialized sleep medical appointment.

An OSA case was defined as someone having a previous diagnosis of OSA performed by a specialist and known by the patient's family doctor.

A Severe OSA was defined as someone having an apnea-hypopnea index or respiratory disturb index equal or higher than 30.

Proportion of OSA was estimated by sex and age group using the sum of users aged 25 years and more followed by each participating GP as denominator (total of 34,909 individuals that comprises the study sample).

95 Confidence intervals (95 CI) were computed using Wilson method.<sup>20</sup> No estimates were presented for age groups with less than 5 cases.

Mean (and 95 CI) and median were computed for numeric variables; proportions (and 95 CI) for categorical variables.

$\chi^2$  test was used to identify variables associated to severe OSA and a logistic regression model, using all variables in which  $\chi^2$  significant level was  $<0.20$ , was performed to estimate adjusted *Odds Ratio* (and 95 CI) of having severe OSA among all OSA patients.

Model assumptions of the final regression model were checked by residual analysis. *Hosmer and Lemeshow* test was used to check the goodness of the final regression model.

## Results

29 (of 124) GP agreed to participate, giving a population under observation of 34,909 individuals (Table 1). All the GP that accepted participating in the study sent information relating to OSA cases, which corresponds to a 100% participation rate. In relation to sex and age distribution, no

**Table 1** Study population by sex and age group.

Age group (years)	Male	%	Female	%	Total	%
25–34	2,967	48.5	3,154	51.5	6,121	17.5
35–44	3,426	47.1	3,847	52.9	7,273	20.8
45–54	3,065	47.3	3,419	52.7	6,484	18.6
55–64	2,726	46.6	3,119	53.4	5,845	16.7
65–74	2,189	45.9	2,582	54.1	4,771	13.7
≥75	1,699	38.5	2,716	61.5	4,415	12.6
Total	16,072	46.0	18,837	54.0	34,909	100.0

**Table 2** Distribution of Obstructive Sleep Apnea by sex and age.

Age group (years)	Male			Female			Total		
	F	%	95 CI	F	%	95 CI	F	%	95 CI
25–34	3	<sup>a</sup>	<sup>a</sup>	0	0	<sup>a</sup>	3	<sup>a</sup>	<sup>a</sup>
35–44	10	0.29	0.16–0.54	7	0.18	0.09–0.38	17	0.23	0.15–0.37
45–54	34	1.11	0.79–1.54	14	0.41	0.24–0.69	48	0.74	0.56–0.98
55–64	73	2.68	2.14–3.36	16	0.51	0.32–0.83	89	1.52	1.24–1.87
65–74	88	4.02	3.28–4.93	24	0.93	0.63–1.38	112	2.35	1.95–2.82
≥75	29	1.71	1.19–2.44	13	0.48	0.28–0.82	42	0.95	0.71–1.28
Total	237	1.47	1.30–1.67	74	0.39	0.31–0.49	311	0.89	0.80–1.00

Note: F – frequency, 95 CI – 95% confidence interval.

<sup>a</sup> Less than 5.

**Table 3** Comorbidities.

Comorbidities	N	F (%)	95 CI
Obesity	302	224 (74.2)	69.0–78.8
High blood pressure	303	230 (75.9)	70.8–80.4
Diabetes mellitus	305	104 (34.1)	29.0–39.6
Arrhythmia	294	35 (11.9)	8.7–16.1
Traffic accident	248	21 (8.5)	5.6–12.6
Coronary disease	294	33 (11.2)	8.1–15.3
Heart failure	295	28 (9.5)	6.6–13.4
Stroke	297	18 (6.1)	3.9–9.4
Acute myocardial infarction	295	19 (6.4)	4.2–9.8

Note: N – number of valid observations, F – frequency, 95 CI – 95% confidence interval.

differences were found between the study population and the Portuguese population (Supplementary material).

311 cases of OSA were identified in that population; the average age was 62.8 years (95 CI: 61.6–64.1) and no age difference was found between sexes.

Proportion of cases aged 25 years and more has been 0.89% (95 CI: 0.80–1.00). A higher proportion of OSA was found in males, namely between 65 and 74 years (4.02%; 95 CI: 3.28–4.93) (see Table 2).

97.3% (95 CI: 94.5–98.7) of all cases had undergone sleep study and of those 56.2% had undergone polysomnography. 48.4% (95 CI: 40.8–56.1) had a severe disease (AHI or RDI ≥ 30) and only 17.6% (95 CI: 12.5–24.3) had a mild disease [5 ≤ (AHI or RDI) < 15].

More than half of the cases (59.5%; 95 CI: 53.8–65.0) were followed through specialized medical appointments.

Continuous positive airway pressure treatment was prescribed to 89.6% of all patients (95 CI: 85.7–92.6), being this proportion higher (96.1%) for those who had a severe clinical condition.

High blood pressure (75.9%), obesity (74.2%) and diabetes mellitus (34.1%) were the most frequent comorbidities in OSA patients (Table 3).

In relation to OSA severity, it was found that being male (OR: 2.6; 95 CI: 1.2–5.8) and obese (OR: 4.0; 95 CI: 1.8–8.6) showed an association to a higher risk of having severe disease among all OSA patients (Table 4).

## Discussion

### Prevalence of Obstructive Sleep Apnea

Although this study focused only on diagnosed OSA cases by family doctors, the low prevalence of OSA (0.89%) found suggests that like other studies<sup>2–4,8,21</sup> this clinical condition is actually underdiagnosed. Nevertheless, as case identification was performed using medical registries that use the second version of the International Classification for Primary

**Table 4** Risk factors of Severe Obstructive Sleep Apnea.

	OR (adjusted)	95 CI	p-value
Male	2.6	1.2–5.8	0.017
Obesity	4.0	1.8–8.6	<0.001

Note: OR adjusted by sex, obesity. OR – odds ratio, 95 CI – 95% confidence interval.

Hosmer and Lemeshow p-value: 0.544.

**Table 5** Proportion of severe cases.

Study	Severe cases (%)	
	Male	Female
Young et al. <sup>a</sup>	37.9	44.4
Durán et al.	26.0	10.4

Note: Proportions computed from prevalence values of OSA.

<sup>a</sup> Includes moderate and severe cases (AHI  $\geq$  15).

Care (ICPC2) we cannot exclude the effect of the registries' characteristics during the case identification process.

On the other hand, compared to other countries<sup>2,3</sup> (Table 5) a higher proportion of severe cases was found on our study (48.4%), which suggests that OSA patients known in primary health care setting are those with a severe clinical presentation. The legal requirement for a treatment prescription performed by a medical doctor within the National Health System is probably favors a better knowledge of severe cases.

Considering the hypothesis of underdiagnosis and accepting the fact that severe cases represents 20% of all OSA cases (a similar value was found in Spain<sup>3</sup>), OSA prevalence at population level (aged 25 years and more) could be around 2.2%, which is still lower than that found in USA<sup>2</sup> (4% male, 2% female) and Spain<sup>3</sup> (26.2% male, 28.0% female). Several methodological differences between studies were found (namely in sampling framework, age groups, case selection and case definition<sup>1-3,21</sup>) that limit data comparability. Nevertheless, as case definition used in Young et al. study<sup>2</sup> includes the presence of symptoms of OSA and an AHI  $\geq$  5, we considered that it can be closer to the case definition used in this study than that used by Durán et al.<sup>3</sup> However, given our case definition (previous diagnosis performed by a specialist and known by the patient's family doctor), a selection bias cannot be excluded if OSA diagnosis had been more frequently made in male patients, which may explain a higher sex ratio estimate (3.8 male:1.0 female) than that observed by Young et al.<sup>2</sup> (3:1).

The highest prevalence of OSA for both sexes found between 65 and 74 years of age can indicate a late diagnosis of OSA when compared to other study which show that the highest prevalence in men was observed between the 5th and 6th decades of life.<sup>22</sup> These results highlight the hypothesis of underdiagnosis of OSA, namely among young and less health care consumer population.

### Comorbidities

The underlying conditions observed in our OSA patients were those frequently associated to OSA as risk factors (obesity) or as complications (DM and high blood pressure).<sup>3,8,10,15,23-25</sup> As expected, the proportion of OSA patients suffering high blood pressure (75.9%) is higher than the prevalence of high blood pressure observed in the adult Portuguese population (42%).<sup>26</sup> Nevertheless, contrary to what has been suggested by other studies,<sup>10,23,24</sup> no association between high blood pressure and OSA severity was found which can be explained by the high proportion of cases with high blood pressure and the reduced number of cases ( $n=311$ ). Also the high proportion of obesity in our sample<sup>27</sup> and the old age of the

participants could contribute to this null association as high blood pressure is less associated to severe OSA within older and obese patients.<sup>8</sup>

The association of male sex, obesity and severe OSA found is compatible with the role of these factors in the pathogenesis of the disease described elsewhere.<sup>2</sup>

### Limitations

As a limitation, it is important to mention that the study setting and case definition used only permitted us to estimate the proportion of users of primary care suffering from OSA instead of an estimate of the real prevalence of OSA. Despite the large sample size used and its similar demographic structure, when compared to the Portuguese population, the distribution of participating GP does not guarantee a national representativeness of the sample.

### Conclusions

As far as we know, this was the first approach to working out the burden of this disease on the Portuguese population. Our research found a low prevalence of OSA within the Portuguese population aged 25 years and more, which may indicate an underdiagnosis of this health condition.

### Ethical disclosures

**Protection of human and animal subjects.** The authors declare that no experiments were performed on humans or animals for this study.

**Confidentiality of data.** The authors declare that they have followed the protocols of their work center on the publication of patient data. All data analyzed by the research team are anonymized and did not permit to identify any patient.

**Right to privacy and informed consent.** As only secondary data used in this research, it was not possible to collect write informed consent. Only anonymized data were used and no individual patient data appear in this article.

### Conflicts of interest

The authors have no conflicts of interest to declare.

### Acknowledgement

To all the Primary Health Care doctors that participated on this survey.

To Inês Batista for the administrative support needed to realize this study.

### Appendix A. Supplementary material

Supplementary material associated with this article can be found in the online version available at [doi:10.1016/j.rppnen.2017.01.002](https://doi.org/10.1016/j.rppnen.2017.01.002).

## References

- Davies RJO, Stradling JR. The epidemiology of sleep apnoea. *Thorax*. 1996;51:565–70.
- Young T, Palta M, Dempsey J, Skatrud J, Weber S, Badr S. The occurrence of sleep-disordered breathing among middle-aged adults. *N Engl J Med*. 1993;328:230–235.
- Durán J, Esnaola S, Rubio R, Iztueta A. Obstructive sleep apnea–hypopnea and related clinical features in a population-base sample of subjects aged 30 to 70 years. *Am J Respir Crit Care Med*. 2001;163 Pt 1:685–9.
- Lindberg E, Gislason T. Epidemiology of sleep-related obstructive breathing. *Sleep Med Rev*. 2000;4:411–33.
- Chung F, Subramanyam R, Liao P, Sasaki E, Shapiro C, Sun Y. High STOP\_BANG score indicates a high probability of obstructive sleep apnea. *Br J Anaesth*. 2012;108:768–75.
- Lopez-Jimenez F, Kuniyoshi FHS, Gami A, Somers VK. Obstructive sleep apnea: implications for cardiac and vascular disease. *Chest*. 2008;133:793–804.
- Shahar E, Whitney CW, Redline S, Lee ET, Newman AB, Nieto FJ, et al. Sleep-disordered breathing and cardiovascular disease: cross-sectional results of the Sleep Heart Health Study. *Am J Respir Crit Care Med*. 2001;163:19–25.
- Young T, Peppard PE, Gottlieb DJ. Epidemiology of obstructive sleep apnea. *Am J Respir Crit Care Med*. 2002;165:1217–39.
- Durán-Cantolla J, Aizpuru F, Martínez-Null C, Barbé F. Obstructive sleep apnea/hypopnea and systemic hypertension. *Sleep Med Rev*. 2009;13:323–31.
- Lavie P, Herer P, Hoffstein V. Obstructive sleep apnea syndrome as a risk factor for hypertension: population study. *BMJ*. 2000;320:479–82.
- American Heart Association. A scientific statement from the American Heart Association Professional Education Committee of the Council for High Blood Pressure Research. Resistant Hypertension: diagnosis, evaluation and treatment. *Hypertension*. 2008;51:1403–19.
- European Society of Hypertension, European Society of Cardiology. The Task Force for the Management of Arterial Hypertension of the European Society of Hypertension (ESH) and of the European Society of Cardiology (ESC). 2007 guidelines for the management of arterial hypertension. *J Hypertens*. 2007;25:1105–87.
- Parra O, Arboix A, Bechich S, García-Eroles L, Montserrat JM, López JA, et al. Time course of sleep related breathing disorders in first-ever stroke or transient ischemic attack. *Am J Respir Crit Care Med*. 2000;161:375–80.
- Sahlin C, Sandberg O, Gustafson Y, Bucht G, Carlberg B, Stenlund H, et al. Obstructive sleep apnea is a risk factor for death in patients with stroke. A 10-year follow-up. *Arch Intern Med*. 2008;168:297–301.
- Punjabi NM, Sorkin JD, Katzel LI, Goldberg AP, Schwartz AR, Smith PL. Sleep-disordered breathing and insulin resistance in middle-aged and overweight men. *Am J Respir Crit Care Med*. 2002;165:677–82.
- Kono M, Tatsumi K, Saibara T, Nakamura A, Tanabe N, Takiguchi Y, et al. Obstructive sleep apnea syndrome is associated with some components of metabolic syndrome. *Chest*. 2007;131:1387–92.
- Pinto P, Cristina Bárbara C, Montserrat JM, Patarrão RS, Guarino MP, Carmo MM, et al. Effects of CPAP on nitrate and norepinephrine levels in severe and mild–moderate sleep apnea. *BMC Pulm Med*. 2013;13:1–7.
- Haentjens P, Van Meerhaeghe A, Moscariello A, Weerdt S, Poppe K, Dupont A, et al. The impact of continuous positive airway pressure on blood pressure in patients with obstructive sleep apnea syndrome. Evidence from a meta-analysis of placebo-controlled randomized trials. *Arch Intern Med*. 2007;167:757–65.
- World Health Organization (WHO). Obesity: situation and trends. WHO; 2014 [Online]. Available in: <http://apps.who.int/gho/data/node.main.A900> [accessed 30.11.14].
- Domenech JM, Granero R. Macro !CIP for SPSS statistics. Confidence intervals for proportions [programa informático] V2012.07.13. Bellaterra: Universitat Autònoma de Barcelona; 2012. Available in: <http://www.metodo.uab.cat/macros.htm>
- Zamarrón C, Gude F, Otero Y, Alvarez JM, Golpe A, Rodríguez JR. Prevalence of sleep disordered breathing and sleep apnea in 50- to 70-year old individuals. *Respiration*. 1999;66:317–22.
- Bixler EO, Vgontzas AN, HAVe TT, Tyson K, Kales A. Effects of age on sleep apnea in men. *Am J Respir Crit Care Med*. 1998;157:144–8.
- Young T, Peppard P, Palta M, Hla KM, Finn L, Morgan B, et al. Population-based study of sleep-disordered breathing as a risk factor for hypertension. *Arch Intern Med*. 1997;157:1746–52.
- Peppard PE, Young T, Palta M, Skatrud J. Prospective study of the association between sleep-disordered breathing and hypertension. *N Engl J Med*. 2000;342:1378–84.
- Nieto FJ, Young TB, Lind BK, Shahar E, Samet JM, Redline S, et al. Association of sleep-disordered breathing, sleep apnea, and hypertension in a large community-based study: Sleep Heart Health Study. *JAMA*. 2000;283:1829–36.
- Polónia J, Martins L, Pinto F, Nazare J. Prevalence awareness, treatment and control of hypertension and salt intake in Portugal: changes over a decade. The PHYSA study. *J Hypertension*. 2014;32:1211–21.
- Carmo I, Santos O, Camolas J, Vieira J, Carreira M, Medina L, et al. Overweight and obesity in Portugal: national prevalence in 2003–2005. *Obes Rev*. 2007;9:11–9. World of obesity, 2014 [Online]. Available in: <http://www.worldobesity.org/aboutobesity/world-map-obesity/> [accessed 18.08.14].