

Long-term CPAP Compliance in Women with Obstructive Sleep Apnoea

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ABSTRACT

Continuous positive airway pressure (CPAP) is the treatment of choice for obstructive sleep apnoea (OSA), but compliance and variables involved in long-term CPAP adherence in women with OSA are unknown.

We performed an observational study including all consecutive women diagnosed with OSA who started CPAP treatment in two Spanish teaching hospitals between 1999 and 2007 and were followed-up until December 2010. The Kaplan-Meier method was used to calculate the probability to continue on CPAP treatment and a multivariate Cox regression analysis was used to identify baseline predictors of CPAP dropout.

We analysed 708 women, median (IQR) age 60 (52-67) years and apnoea-hypopnoea index 43.0 (27.2-66.8). Women were followed for a median of 6.2 (4.2-7.7) years. The probability of still being on CPAP at 5 and 10 years was 82.8% and 79.9%, respectively. The median CPAP use was 6 (IQR 4-7) hours/day. In the multivariate analysis, independent baseline predictors of CPAP dropout were psychoactive medication (HR 1.47, 95%CI 1.03-2.08), age (HR 1.01, 95%CI 1.00-1.03) and CPAP pressure (HR 0.89, 95% CI 0.81 to 0.96).

Long-term CPAP adherence in women with OSA is good. Psychoactive medication and increasing age were independent predictors of CPAP dropout, whereas higher CPAP pressure was associated with continued treatment.

Keywords:

adherence, continuous positive airway pressure, compliance, gender, sleep apnoea syndromes, obstructive sleep apnoea, women.

INTRODUCTION

Obstructive sleep apnoea (OSA) affects around 2-3% of middle-aged women in the general population [1]. This sleep disorder has an important impact on women's quality of life, including a wide variety of symptoms such as insomnia [2–4], headache [2,4], depression [2,4,5], anxiety [5] and fatigue [2]. OSA has also recently been recognised as a risk factor for increased cardiovascular mortality in this population [6].

Continuous positive airway pressure (CPAP) is the treatment of choice for OSA patients [7]. Since CPAP is a chronic treatment and, in most cases must be used for life, good compliance is essential to achieve the beneficial effects of this therapy [8]. Although adherence to CPAP treatment has been extensively investigated in the literature [9–20], women have scarcely been represented in these series and no study to date has been specifically devoted to them. We therefore do not know how good adherence is in this population, and which variables can predict long-term compliance. Given that OSA features differ between men and women as regards prevalence [21], clinical presentation [2–4], severity [22] and pathophysiology [23,24], gender differences in adherence to treatment cannot be ruled out. In fact, the influence of gender on CPAP compliance has not been clarified and several studies have reported conflicting results [9,10,12,15,18]. Thus, the available evidence on this topic, mainly based on male populations, may not apply to women.

In order to try to answer these questions, we analysed long-term CPAP compliance and predictors of CPAP dropout in a large female cohort with a prolonged follow-up.

METHODS

Design and patients

All consecutive women diagnosed with OSA (apnoea-hypopnoea index [AHI] ≥ 10) who started CPAP treatment between December 1998 and December 2007 in the Sleep Units of the Valme (Seville, Spain) and Requena (Valencia, Spain) Hospitals were identified. This sample is part of a larger female cohort that was prospectively assessed for OSA-related cardiovascular outcomes and whose characteristics have been explained in detail elsewhere [6]. Exclusion criteria were as follows: age below 18 years, central sleep apnoea syndrome (more than 50% of apnoeic events were central), refusal to start CPAP therapy, and previous CPAP treatment. The ethics committee of both institutions approved the study.

Sleep study and CPAP treatment

We followed the Spanish Society of Pneumology and Thoracic Surgery guidelines for the diagnosis and treatment of OSA [25,26]. The diagnosis of OSA was always based on an overnight sleep study, either by full standard polysomnography (PSG) or respiratory polygraphy (RP), using a device previously validated against PSG. Every sleep study was manually scored by skilled staff, according to standard criteria [27]. PSG included the continuous recording of neurological variables: electroencephalogram, electrooculogram, and electromyogram. Breathing variables were scored on the basis of the flow tracing provided by an oro-nasal cannula and thermistor. Thoracoabdominal motion was measured with thoracic and abdominal bands. Oxygen saturation

(SaO₂) was recorded with a finger-pulse oximeter. An electrocardiogram was also recorded. RP included recording of the oro-nasal flow and pressure, respiratory movements, SaO₂, and electrocardiogram. Apnoea was defined as complete cessation of oro-nasal flow for >10 seconds and was classified as either obstructive or central, based on the presence or absence of respiratory efforts. Hypopnoea was defined as a 30-90% reduction in oro-nasal flow for >10 seconds followed by a $\geq 4\%$ decrease in SaO₂. The AHI was defined as the number of apnoeas plus hypopnoeas per hour of sleep (PSG) or recording (RP). Severe OSA was defined as an AHI ≥ 30 , and mild-moderate OSA as an AHI 10-29.9. CPAP treatment was offered to every woman with severe OSA irrespective of symptoms, and to those with OSA and daytime hypersomnolence (Epworth Sleepiness Scale, ESS>10) or cardiovascular risk [25,26]. CPAP was titrated on a second night in the sleep laboratory, with either full standard PSG or an auto-titrating CPAP device, in accordance with a validated protocol [25,26]. All the patients received education prior to the CPAP titration night.

Data collection

The following baseline variables were systematically recorded by prospectively using a standardized protocol and collected prior to the sleep study: age (years), body mass index (kg/m²) (BMI), excessive daytime somnolence (EDS) measured by the ESS, hospital of reference, smoking history of more than 20 packs-year, alcohol intake of more than 10 grams/day, systemic hypertension, diabetes mellitus, hyperlipidemia, use of psychoactive medication, documented history of previous stroke or ischemic heart disease, type of sleep study and

method of CPAP titration. Patients were classified as hypertensive, diabetic, or hyperlipidemic if any of these disorders had been previously diagnosed, they were undergoing specific treatment for them, or they had systolic or diastolic blood pressure $\geq 140/90$ mmHg on two or more different ambulatory readings, fasting glucose levels >7.0 mmol/l (125 mg/dl) on two or more determinations and fasting total cholesterol or triglycerides levels >5.17 mmol/l (200 mg/dl) on two or more determinations, respectively.

Follow-up

Once CPAP was started, patients were reviewed at 3-6 month intervals during the first year and every 12 months thereafter in the outpatient sleep clinic. During these appointments, a clinical assessment was made and patients were reinforced to use the device. In the case of side-effects or questions, patients could contact the Sleep Unit. CPAP machines were provided to the patients free of charge. Information regarding CPAP use was provided by the Home Care Provider in charge of the respiratory therapies and use was objectively assessed by reading the time-counter of the device. The data used in this study were the average cumulative CPAP compliance, from the start of treatment to the end of follow-up, death or censorship. The follow-up finished on 31 December 2010.

Endpoints

The endpoints of this study were continued use of a CPAP machine and baseline variables associated with CPAP compliance. Those women who stopped CPAP, and their reasons for doing so, were recorded on the basis of

the information provided by the Home Care Provider, medical records and computerized databases. For the purposes of this study, a CPAP dropout was registered whenever a patient abandoned the treatment, or whenever the device was reclaimed for bad compliance at the discretion of the supervising physician. Continued use of CPAP was considered to exist as long as a dropout did not occur. Those women who died, were lost to follow-up or who had CPAP withdrawn because their OSA was resolved were considered to be still on CPAP treatment up to that point, and they were not scored as a dropout.

Statistical analysis

The IBM SPSS 19.0 statistical package (SPSS Inc. Chicago, IL, USA) was used for data processing and analysis. Continuous variables are expressed as median (IQR), and qualitative variables as absolute values and percentages. Kaplan-Meier survival analyses were used to estimate the proportion of women still on CPAP treatment. The association between CPAP dropout and clinically relevant baseline factors (gender, age, BMI, ESS, hospital of reference, smoking and alcohol use, cardiovascular comorbidities, psychoactive medication, AHI, oximetric parameters of the sleep study, type of sleep study and type of CPAP titration) was tested using a univariate Cox regression analysis. Interactions between CPAP pressure and AHI, BMI and the titration method were also explored. To identify independent predictors of CPAP dropout, those variables found to be significant at a p-value ≤ 0.20 were entered into a multivariate Cox regression model. Variables thought to exert influence on adherence, such as age, ESS, psychoactive medication and the type of sleep study and titration method used, were forced as covariates into the

multivariate analysis irrespective of the results of the univariate analysis. The proportional hazards assumption was verified for each covariate model. A p value <0.05 was considered to be statistically significant.

RESULTS

Seven hundred and sixty-five women with OSA were prescribed CPAP during the study period. We excluded 10 women with central sleep apnoea, 2 younger than 18 years, 30 who refused CPAP therapy and did not even use the device for at least one day, and 15 who had been previously treated. Finally, a total of 708 women were studied. The baseline characteristics of the sample are depicted in Table 1. Most women included in the study had severe OSA (496, 70.1%), whereas mild-moderate OSA was present in 212 (29.9%) women.

Patients were followed up for a median of 6.2 (IQR 4.2-7.7) years. During the study period, CPAP dropout occurred in 129 women (18.2%) and CPAP was withdrawn due to OSA resolution or death in 12 (1.6%) and 45 (6.3%) cases, respectively. Only 5 (0.7%) women were lost to follow-up. The proportion of women still on CPAP therapy at 5 and 10 years was 82.8% and 79.9%, respectively (Figure 1). The median use of CPAP for the entire cohort was 6 (IQR 4-7) hours/day, with differences between those women who continued on CPAP treatment (median 6 hours, IQR 5-7) and those who dropped out (median 1 hour, IQR 0-2). CPAP compliance was similar in patients with mild-moderate and severe OSA (median 6.0 [IQR 3-7] vs. 6.0 [IQR 4-7] hours/day, respectively). Most women who continued on CPAP treatment (96.3%) had an objective daily use ≥ 4 h.

In the univariate Cox analysis, age, BMI, psychoactive medication, AHI and CPAP pressure predicted long-term CPAP compliance, whereas the oximetric parameters of the sleep study, cardiovascular comorbidities, type of CPAP titration and EDS measured by the ESS were not associated with adherence (Table 2). No significant interactions were found between CPAP pressure and AHI, BMI, and titration method, or between AHI and BMI. The results of the multivariate Cox analysis showed that the baseline variables independently associated with CPAP dropout were the use of psychoactive medication (HR 1.47, 95% CI 1.03 to 2.08), age (HR 1.01, 95% CI 1.00 to 1.03), and CPAP pressure (HR 0.89, 95% CI 0.81 to 0.96) (Table 3).

DISCUSSION

To the best of our knowledge, this is the first study to assess long-term CPAP compliance in a large cohort of women with OSA. In this large study, which included 708 consecutive women with OSA who started CPAP therapy and were followed up for more than 6 years, we have shown that CPAP compliance in women is good, with 82.8% still on treatment 5 years after starting the therapy. Independent baseline predictors of CPAP dropout were use of psychoactive drugs and increasing age, whereas a higher CPAP pressure level was associated with continued treatment.

Although several studies have investigated long-term adherence rates and predictors of CPAP compliance, most of these cohorts were predominantly composed of men and the number of women included was usually small, accounting for only 7-17% of the samples [12,14–16,20], so their findings may

not be extendible to women. It is known that women manifest OSA differently from men [2–5]. They usually present a less severe sleep disorder [22] and a distinct physiopathology of upper airway collapse [23]. Furthermore, gender itself has been identified by some researchers as a predictor of both good and bad adherence [15,18], whereas other authors did not find gender to be independently associated with CPAP compliance [9,10,12,28]. For all these reasons, adherence to CPAP therapy should be specifically assessed in women. The results of our study show that 82.8% of the women were still using CPAP 5 years after starting treatment, a figure that resembles the 81% reported by Kohler and colleagues [12] and surpasses both the 67% reported by Pelletier-Fleury and colleagues and the 68% of McArdle and coworkers [14,15], although it is lower than the 85% at 7 years reported by Krieger et al [13]. The median use of CPAP in our series was 6 hours/day, which falls within the range of 5.0 to 6.2 hours/day reported in other long-term studies [12–16]. We therefore consider that CPAP adherence in women with OSA is good and, although we did not compare adherence rates with those of men, they at least do not seem to be worse than those reported for mixed cohorts mainly composed of men.

The pattern of CPAP use is established early, within the first weeks of treatment, and is predictive of long-term use, but specific predictive variables of CPAP compliance have not been identified and the various studies that have assessed this topic have yielded conflicting results [9,11–14,16–18,20,28–31]. Since our study is the first exclusively devoted to women, and since these predictors may vary in both genders, it is difficult to compare our findings with

those of other researchers. We have found that intake of psychoactive drugs, age and CPAP pressure level, were independent predictors of long-term CPAP adherence in women.

The association between pressure level and adherence is not clear. Pelletier-Fleury and coworkers found that a pressure of 12 cmH₂O or greater was an independent predictor of bad compliance, probably associated with a higher proportion of side-effects [15], whereas Janson and colleagues reported that patients who continued using CPAP required a higher pressure than those who stopped the therapy (9 vs. 8 cmH₂O, $p < 0.05$) [11]. Sucena and coworkers also found that compliance was significantly correlated with pressure level, so that a higher pressure was linked to a better adherence during follow-up [20]. Other authors, however, did not find that pressure level influenced adherence when other confounders were adjusted for [12–14]. In our study, higher CPAP pressures were independently associated with continued treatment. Although higher pressure suggests greater OSA severity [15], in our study determinants of OSA severity such as AHI and oximetric parameters were not associated with adherence in the adjusted model. We hypothesize that higher pressures may have been needed to control other variables more subtly linked with OSA severity, such as snoring or respiratory effort-related arousals, which are known to be associated with clinical complaints of OSA and may explain why these women were more adherent. Unfortunately, these variables were not assessed in this study.

Unlike other researchers [12–14], we did not find OSA severity to be an independent predictor of CPAP adherence. In our study, OSA severity

measured by the AHI was associated with adherence in the univariate analysis, but it was no longer associated with compliance when other confounders were adjusted for. Oximetric parameters were not associated with adherence in either the univariate or multivariate analyses. Since most studies that have analysed adherence have predominantly or exclusively included men, it may be possible that this association between OSA severity and adherence cannot be applied to women. In fact, it is known that females usually have a lower AHI (and, therefore, a lower OSA severity) than men [22], so this variable may not be an independent predictor of adherence in women, as we have found in our study. Nevertheless, given the high proportion of women with severe OSA in our study (70.1%), a possible selection bias as regards the association between OSA severity and compliance cannot be ruled out.

Women with increasing age were at higher risk of CPAP dropout in our cohort, which concurs with the findings of Janson and colleagues, who reported that high age was an independent predictor of non-compliance and CPAP dropout, mainly due to nasal and pharyngeal side-effects [11]. Other comorbidities such as nocturia have been found to be independently associated with poorer CPAP adherence in an elderly OSA cohort [17]. Although age has not been acknowledged as an independent predictor of adherence in other studies [10,12,14,15], the median age of our cohort was 60 years, which is significantly higher than the 50-55 years of the participants in those studies. These findings concur with the knowledge that women are usually diagnosed with OSA at a higher age than men [2,22]. It is therefore possible that older women may be more prone to stopping CPAP due to additional problems such as neurological

impairment, dementia and physical disability, which may be more closely linked to age than to gender. Nevertheless, given that the aforementioned studies were conducted in predominantly male population (men accounted for 83-92% of the samples in these studies), it cannot be ruled out that women may behave differently regarding the association between age and adherence.

Some psychiatric disorders such as anxiety and depression are common in women with OSA, and they are usually frontline complaints in individuals referred for suspicion of this sleep disorder. Moreover, OSA women have been reported to be heavier users of psychoactive medications such as anxiolytic and antidepressant drugs than OSA men [5,32]. Although one study has observed that CPAP adherence was not correlated with baseline levels of depression, anxiety and stress, some psychological variables have been implicated in the prediction of adherence to CPAP [19,31]. In our cohort, the use of psychoactive medication independently predicted CPAP dropout, suggesting that it may be a risk factor per se or a marker of an underlying psychiatric disorder, or simply reflect a poorer perceived health status and quality of life, a feature that has been associated with poorer CPAP adherence in women [15].

The lack of any association between CPAP compliance and EDS measured by the ESS was not unexpected, since this score may not be an adequate tool for assessing daytime somnolence in women. Baldwin and colleagues observed that ESS was a more sensitive measure of subjective sleepiness in men than in women [33], and recent data from the Wisconsin Sleep Cohort showed that

sleep-disordered breathing was not associated with significant increased subjective sleepiness (measured by the ESS) in women of any age [34].

Our study has some limitations. Although it is a prospective observational cohort study, the main endpoints were cardiovascular outcomes and not treatment adherence, so some potentially interesting variables such as type of interface, use of humidifiers, adherence during the first weeks of use, specific side-effects and social factors have not been evaluated. In addition to EDS, other symptoms or questionnaires that may have been useful in determining the women's quality of life or health status were not recorded, and nor were more subtle determinants of OSA severity such as snoring, arousals or respiratory effort-related arousals. Finally, although the use of psychoactive drugs was strongly associated with CPAP dropout, we did not separately record the different types of medication included in this group (hypnotics, antidepressants, anxiolytics, etc), nor did we investigate the presence of baseline co-morbid psychiatric disorders, which may have provided us with a more precise understanding of the association between this variable and CPAP adherence. It is therefore possible that these patients were less compliant as a result of concomitant co-morbid depression or insomnia, or even side-effects associated with these treatments, rather than any direct effect of the psychoactive medication.

In conclusion, in a large cohort of OSA women with a prolonged follow-up we have shown that most of them are still using CPAP 5 years after starting the treatment. Psychoactive medication and increasing age independently predicted

CPAP dropout, whereas a higher CPAP pressure level was associated with continued use of the therapy. These findings imply that older women under psychoactive medication should be carefully followed up to detect adherence problems.

REFERENCES

1. 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: 1230–5
2. Quintana-Gallego E, Carmona-Bernal C, Capote F, Sánchez-Armengol A, Botbol-Benhamou G, Polo-Padillo J, Castillo-Gómez J. Gender differences in obstructive sleep apnea syndrome: a clinical study of 1166 patients. *Respir Med* 2004; 98: 984–9
3. Shepertycky MR, Banno K, Kryger MH. Differences between men and women in the clinical presentation of patients diagnosed with obstructive sleep apnea syndrome. *Sleep* 2005; 28: 309–14
4. Wahner-Roedler DL, Olson EJ, Narayanan S, Sood R, Hanson AC, Loehrer LL, Sood A. Gender-specific differences in a patient population with obstructive sleep apnea-hypopnea syndrome. *Gen Med* 2007; 4: 329–38
5. Sforza E, Chouchou F, Collet P, Pichot V, Barthélémy JC, Roche F. Sex differences in obstructive sleep apnoea in an elderly French population. *Eur Respir J* 2011; 37: 1137–43
6. Campos-Rodriguez F, Martinez-Garcia MA, de la Cruz-Moron I, Almeida-Gonzalez C, Catalan-Serra P, Montserrat JM. Cardiovascular mortality in women with obstructive sleep apnea with or without continuous positive

- airway pressure treatment: a cohort study. *Ann Intern Med* 2012; 156: 115–22
7. Indications and standards for use of nasal continuous positive airway pressure (CPAP) in sleep apnea syndromes. American Thoracic Society. Official statement adopted March 1994. *Am J Respir Crit Care Med* 1994; 150: 1738–45
 8. Weaver TE, Maislin G, Dinges DF, Bloxham T, George CFP, Greenberg H, Kader G, Mahowald M, Younger J, Pack AI. Relationship between hours of CPAP use and achieving normal levels of sleepiness and daily functioning. *Sleep* 2007; 30: 711–9
 9. Collen J, Lettieri C, Kelly W, Roop S. Clinical and polysomnographic predictors of short-term continuous positive airway pressure compliance. *Chest* 2009; 135: 704–9
 10. Gagnadoux F, Le Vaillant M, Goupil F, Pigeanne T, Chollet S, Masson P, Humeau M-P, Bizieux-Thaminy A, Meslier N. Influence of marital status and employment status on long-term adherence with continuous positive airway pressure in sleep apnea patients. *PLoS ONE* 2011; 6: e22503
 11. Janson C, Nöges E, Svedberg-Randt S, Lindberg E. What characterizes patients who are unable to tolerate continuous positive airway pressure (CPAP) treatment? *Respir Med* 2000; 94: 145–9

12. Kohler M, Smith D, Tippet V, Stradling JR. Predictors of long-term compliance with continuous positive airway pressure. *Thorax* 2010; 65: 829–32
13. Krieger J, Kurtz D, Petiau C, Sforza E, Trautmann D. Long-term compliance with CPAP therapy in obstructive sleep apnea patients and in snorers. *Sleep* 1996; 19: S136–143
14. McArdle N, Devereux G, Heidarnajad H, Engleman HM, Mackay TW, Douglas NJ. Long-term use of CPAP therapy for sleep apnea/hypopnea syndrome. *Am J Respir Crit Care Med* 1999; 159: 1108–14
15. Pelletier-Fleury N, Rakotonanahary D, Fleury B. The age and other factors in the evaluation of compliance with nasal continuous positive airway pressure for obstructive sleep apnea syndrome. A Cox's proportional hazard analysis. *Sleep Med* 2001; 2: 225–32
16. Pieters T, Collard P, Aubert G, Dury M, Delguste P, Rodenstein DO. Acceptance and long-term compliance with nCPAP in patients with obstructive sleep apnoea syndrome. *Eur Respir J* 1996; 9: 939–44
17. Russo-Magno P, O'Brien A, Panciera T, Rounds S. Compliance with CPAP therapy in older men with obstructive sleep apnea. *J Am Geriatr Soc* 2001; 49: 1205–11
18. Sin DD, Mayers I, Man GCW, Pawluk L. Long-term compliance rates to continuous positive airway pressure in obstructive sleep apnea: a population-based study. *Chest* 2002; 121: 430–5

19. Stepnowsky CJ Jr, Bardwell WA, Moore PJ, Ancoli-Israel S, Dimsdale JE. Psychologic correlates of compliance with continuous positive airway pressure. *Sleep* 2002; 25: 758–62
20. Sucena M, Liistro G, Aubert G, Rodenstein DO, Pieters T. Continuous positive airway pressure treatment for sleep apnoea: compliance increases with time in continuing users. *Eur Respir J* 2006; 27: 761–6
21. Bixler EO, Vgontzas AN, Lin HM, Ten Have T, Rein J, Vela-Bueno A, Kales A. Prevalence of sleep-disordered breathing in women: effects of gender. *Am J Respir Crit Care Med* 2001; 163: 608–13
22. O'Connor C, Thornley KS, Hanly PJ. Gender differences in the polysomnographic features of obstructive sleep apnea. *Am J Respir Crit Care Med* 2000; 161: 1465–72
23. Jordan AS, Wellman A, Edwards JK, Schory K, Dover L, MacDonald M, Patel SR, Fogel RB, Malhotra A, White DP. Respiratory control stability and upper airway collapsibility in men and women with obstructive sleep apnea. *J Appl Physiol* 2005; 99: 2020–7
24. Simpson L, Mukherjee S, Cooper MN, Ward KL, Lee JD, Fedson AC, Potter J, Hillman DR, Hillman Fanzca DR, Eastwood P, Palmer LJ, Kirkness J. Sex differences in the association of regional fat distribution with the severity of obstructive sleep apnea. *Sleep* 2010; 33: 467–74

25. Montserrat JM, Amilibia J, Barbé F, Capote F, Durán J, Mangado NG, Jiménez A, Marín JM, Masa F, Teran J. Treatment of sleep apnea-hypoapnea syndrome. *Arch Bronconeumol* 1998; 34: 204–6
26. Grupo Español de sueño (GES). Consenso nacional sobre el síndrome de apneas-hipopneas del sueño. *Arch Bronconeumol* 2005; 41 (Supl 4): 1–100
27. Rechtschaffen A, Kales A. A manual of standardized terminology and scoring system for sleep stages of human subjects. Los Angeles: Brain information service/Brain research institute, University of California at Los Angeles; 1968.
28. Weaver TE, Grunstein RR. Adherence to continuous positive airway pressure therapy: the challenge to effective treatment. *Proc Am Thorac Soc* 2008; 5: 173–8
29. Budhiraja R, Parthasarathy S, Drake CL, Roth T, Sharief I, Budhiraja P, Saunders V, Hudgel DW. Early CPAP use identifies subsequent adherence to CPAP therapy. *Sleep* 2007; 30: 320–4
30. Gay P, Weaver T, Loubé D, Iber C. Evaluation of positive airway pressure treatment for sleep related breathing disorders in adults. *Sleep* 2006; 29: 381–401
31. Wild MR, Engleman HM, Douglas NJ, Espie CA. Can psychological factors help us to determine adherence to CPAP? A prospective study. *Eur Respir J* 2004; 24: 461–5

32. Greenberg-Dotan S, Reuveni H, Simon-Tuval T, Oksenberg A, Tarasiuk A. Gender differences in morbidity and health care utilization among adult obstructive sleep apnea patients. *Sleep* 2007; 30: 1173–80
33. Baldwin CM, Kapur VK, Holberg CJ, Rosen C, Nieto FJ. Associations between gender and measures of daytime somnolence in the Sleep Heart Health Study. *Sleep* 2004; 27: 305–11
34. Morrell MJ, Finn L, McMillan A, Peppard PE. The impact of ageing and sex on the association between sleepiness and sleep disordered breathing. *Eur Respir J* 2012; 40: 386–93

Table 1. Baseline characteristics of the sample.

Variables	Values
<i>Categorical variables (n, %)</i>	
Valme Sleep Clinic	565 (79.8)
Polysomnography	292 (41.2)
Conventional CPAP titration	453 (64.0)
Psychoactive medication	244 (34.5)
Arterial hypertension	501 (70.8)
Diabetes mellitus	246 (34.7)
Hyperlipidemia	391 (55.2)
Previous stroke/ischemic heart disease	108 (15.3)
Smoking habit >20 pack-year	94 (13.3)
Alcohol intake >10 grams/day	41 (5.8)
<i>Continuous variables (median, IQR)</i>	
Age (years)	60 (52-67)
Body mass index (Kg/m ²)	37.5 (32.4-43.0)
Epworth Sleepiness Scale	13 (9-16)
Apnoea-hypopnoea index	43 (27.2-66.8)
Time spent with oxygen saturation below 90% (%)	13.3 (3.0-42.9)
Minimum oxygen saturation (%)	74 (62-81)
CPAP pressure (cmH ₂ O)	9.0 (8.0-11.0)

CPAP = continuous positive airway pressure.

Table 2. Association between baseline variables and CPAP dropout. Univariate Cox analysis.

<i>Variables</i>	<i>CPAP drop out (n=129)</i>	<i>Still on CPAP (n=579)</i>	<i>HR (95%CI)</i>	<i>p</i>
Valme Sleep Clinic*	98 (75.9)	467 (80.6)	0.83 (0.55-1.25)	0.38
Polysomnography study*	54 (41.8)	238 (41.1)	0.87 (0.72-1.46)	0.87
Conventional CPAP titration*	77 (59.6)	376 (64.9)	0.83 (0.58-1.18)	0.32
Psychoactive medication*	55 (42.6)	189 (32.6)	1.46 (1.03-2.07)	0.033
Arterial hypertension*	85 (65.8)	416 (71.8)	0.78 (0.54-1.12)	0.180
Diabetes mellitus*	52 (40.3)	194 (33.5)	1.33 (0.94-1.90)	0.106
Hyperlipidemia*	68 (52.7)	323 (55.7)	0.89 (0.63-1.26)	0.54
Previous stroke or ischemic heart disease*	17 (13.1)	91 (15.7)	0.85 (0.51-1.42)	0.55
Smoking habit*	18 (13.9)	76 (13.1)	1.07 (0.65-1.07)	0.77
Alcohol intake*	9 (6.9)	32 (5.5)	1.20 (0.61-2.37)	0.58
Age†	61 (53-71)	60 (52-66)	1.01 (1.00-1.03)	0.031
Body mass index†	35.8 (32.0-43.0)	37.6 (32.9-43.0)	0.97 (0.95-1.00)	0.067
Epworth Sleepiness Scale†	12 (8-15)	13 (9-16)	0.97 (0.94-1.01)	0.162
CPAP pressure†	8 (8-10)	9 (8-11)	0.89 (0.82-0.97)	0.009
Apnoea-hypopnoea index†	38 (25-61)	45 (28-69)	0.99 (0.98-0.99)	0.019
Time spent with oxygen saturation below 90% (%)†	11 (3-41)	15 (3-44)	0.99 (0.99-1.00)	0.58
Minimum oxygen saturation†	73 (61-82)	74 (62-81)	1.00 (0.98-1.01)	0.97

CPAP = continuous positive airway pressure.

Categorical variables (*) are expressed as absolute values (%) and continuous variables (†) as median (IQR).

Table 3. Variables associated with CPAP dropout. Results of the adjusted multivariate Cox regression analysis.

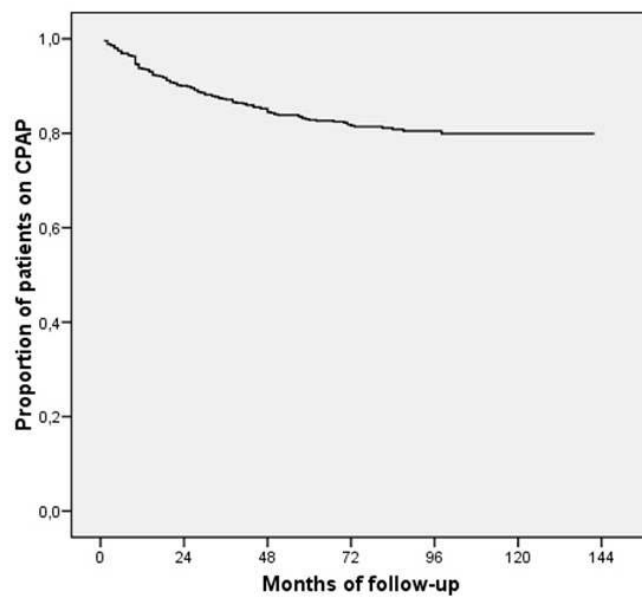
Variables	<i>Adjusted model *</i>	
	<i>HR (95%CI)</i>	<i>p</i>
Age	1.01 (1.00-1.03)	0.043
Psychoactive medication	1.47 (1.03-2.08)	0.031
CPAP pressure	0.89 (0.81-0.96)	0.007

* Adjusted for Age, Body Mass Index, Epworth Sleepiness Scale, CPAP pressure, Apnoea-Hypopnoea Index, Psychoactive medication use, Arterial hypertension, Diabetes mellitus and CPAP titration method.

CPAP = continuous positive airway pressure.

FIGURE LEGENDS

Figure 1. Kaplan Meier plot, showing the proportion of patients on CPAP therapy versus time.



The probability of being still on CPAP therapy at 5 and 10 years was 82.8% and 79.9%, respectively.