ORIGINAL ARTICLES

The Availability in Spanish Public Hospitals of Resources for Diagnosing and Treating Sleep Apnea-Hypopnea Syndrome

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INTRODUCTION AND OBJECTIVE: Sleep apnea-hypopnea syndrome is associated with an overall deterioration in the patient's health and affects between 1 and 2 million people in Spain. The objective of the present study was to evaluate the diagnostic and therapeutic resources available in Spain for dealing with this problem in terms of both infrastructure and human resources.

METHODS: We selected 461 general hospitals, 457 (99.1%) of which answered a questionnaire in the course of a telephone interview.

RESULTS: At the time of response, 219 hospitals (47.5%) reported performing sleep studies. Conventional polysomnography was available in 53% of those hospitals, respiratory polygraphy was used in 42%, and oximetry in 5%. In 47% of the hospitals, continuous positive airway pressure was titrated empirically in most cases; the number of patients being treated with CPAP was 109 752, that is, 269 per 100 000 population in Spain.

CONCLUSIONS: The level of resources available for diagnosing and treating sleep apnea-hypopnea syndrome, although improving, is clearly still inadequate. Currently, only 0.49 polysomnograph and 0.72 polygraph machines are available per 100 000 population, whereas 1 and 3 machines, respectively, are deemed necessary. Only 5% to 10% of the affected population has been diagnosed, and in 47% of the hospitals interviewed continuous positive airway pressure is not properly titrated. These results should be a clarion call to the health authorities to take the appropriate steps to address this health problem.

Key words: *Sleep apnea-hypopnea syndrome (SAHS). Continuous positive airway pressure (CPAP). Diagnosis. Treatment. Conventional nocturnal polysomnography (PSG). Respiratory polygraphy (RP). General population. Patients.*

El síndrome de apneas-hipopneas durante el sueño en España. Disponibilidad de recursos para su diagnóstico y tratamiento en los hospitales del Estado español

INTRODUCCIÓN Y OBJETIVO: El síndrome de apneas-hipopneas durante el sueño está asociado a un deterioro del estado de salud y constituye un problema sanitario que en España sufren entre 1 y 2 millones de personas. El objetivo del estudio fue evaluar cuáles son los medios diagnósticos y terapéuticos disponibles en España, tanto en infraestructuras como en recursos humanos, para abordar este problema.

MÉTODOS: Se seleccionaron 461 hospitales generales y mediante contacto telefónico se administró un cuestionario a 457 (99,1%).

RESULTADOS: Realizan estudios de sueño 219 centros (47,5%). El 53% dispone de polisomnografía convencional, un 42% emplea la poligrafía respiratoria y un 5% la oximetría. Un 47% de los centros realiza titulaciones de presión positiva continua de la vía aérea de forma mayoritariamente empírica y existen en activo 109.752 aparatos, lo que representa 269 equipos por 100.000 habitantes.

CONCLUSIONES: El nivel de recursos para el diagnóstico y el tratamiento del síndrome de apneas-hipopneas durante el sueño, a pesar de haber mejorado, es claramente insuficiente. Son necesarios un polisomnógrafo convencional y 3 polígrafos, mientras que actualmente se cuenta con 0,49 y 0,72 por 100.000 habitantes, respectivamente. Sólo se ha diagnosticado el 5-10% de la población afectada y en el 47% de los centros la presión positiva continua de la vía aérea se titula de forma inadecuada. Estos resultados deberían suponer una importante llamada de atención a las autoridades sanitarias para abordar apropiadamente este problema sanitario.

Palabras clave: *Síndrome de apneas-hipopneas durante el sueño (SAHS). Presión positiva continua de la vía aérea (CPAP). Diagnóstico. Tratamiento. Polisomnografía convencional nocturna*

Introduction

The Spanish Association of Pulmonology and Thoracic Surgery (SEPAR) defines sleep apnea-hypopnea syndrome (SAHS) as a condition characterized by excessive daytime sleepiness, neuropsychiatric symptoms, and cardiorespiratory disorders caused by an anatomical and functional upper airway abnormality that gives rise to repetitive episodes of airway obstruction during sleep; obstruction, in turn, causes oxyhemoglobin desaturation and transitory arousal, and consequently results in nonrefreshing sleep.[1] The average number of apnea-hypopnea events per hour of sleep is called the apnea-hypopnea index (AHI),

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and the American Academy of Sleep Medicine recently defined SAHS as the presence of more than 5 respiratory events per hour of sleep in association with the symptoms characteristic of the disorder.[2]

Epidemiological studies carried out in the United States of America[3] and Spain[4-6] show that between 9% and 25% of middle-aged adults have an abnormal AHI index, and that between 2% and 4% of the general adult population fulfill the diagnostic criteria for SAHS. Furthermore, it has been demonstrated that age, body mass index, and male sex are the main risk factors for the appearance of this disorder. Numerous studies have shown a relationship between untreated SAHS and the following conditions: a deterioration in quality of life[7]; systemic hypertension[4,8-12]; cardiovascular[13,14] and cerebrovascular diseases[15,16]; the occurrence of traffic accidents[17,18]; and excessive mortality.[19] On the other hand, treatment with continuous positive airway pressure (CPAP) is the most effective[20] and cost effective[21] treatment. For all the above reasons, SAHS is deemed to constitute a public health problem.[22] Recent studies have even shown that the consumption of resources by patients with SAHS whose condition had not been diagnosed or treated was 2 to 3 times greater than that of the general population.[23,24] The implication of all this research is that both the medical community and the health authorities must start to pay more attention to this disorder which, far from being new, has been with us for many years without its importance being recognized.

According to the 2001 census, the population of Spain is 40 847 371 (50.98% women). Table 1 shows the prevalence of SAHS and a pathological AHI based on the results obtained by various authors who studied different sectors of the population.[3,4,25-31] According to these data, between 3 140 389 and 3 811 904 males and between 2 104 820 and 3 484 135 females have a pathological AHI. Moreover, it is estimated that in Spain between 693 371 and 1 111 970 males and between 516 820 and 1 034 044 females suffer from clinically significant SAHS, defined as the presence of a pathological AHI associated with symptoms. An evaluation of the diagnostic and therapeutic resources available in Spain for dealing with this problem (in terms of both infrastructure and human resources) is advisable given the size of the affected population.

Two previous studies have dealt with this question. The first of these was carried out in 1994 by SEPAR's Working Group on Respiratory Insufficiency and Sleep Disorders.[32] The 1994 study found 7602 patients using CPAP and 600 patients using bilevel positive airway pressure (BiPAP); that is, an average of 21 machines per 100 000 population were in use. Those figures showed that the resources for diagnosing and treating SAHS in Spain were very meager at that time. The second study, which was completed in December 1997, found that 3.4 times more patients were being treated with CPAP, giving a total of some 28 000 individuals, or 72 CPAP machines per 100 000 population.[33] That study also demonstrated the inadequacy of diagnostic resources at all levels.

Although our understanding of SAHS and its consequences has improved greatly since 1997,[4, 7-18,21,24,26-29,31] current evidence indicates that the resources available for diagnosing and treating this condition in Spain are still inadequate. Consequently, the objective of the present study was to assess the current situation in Spain with respect to the diagnosis and treatment of SAHS, to identify the system's weak points, and to provide information that would help orient the direction future changes should take.

Methods

The information source targeted was all the general hospitals in Spain, whether public, approved (private hospitals that have contracts with the public health care system), or

TABLE 1
Prevalence of Apneas, Hypopneas, and Sleep Apnea-Hypopnea Syndrome (SAHS) in the Population (Spanish Studies)*

Age (Years) and No. of Patients in Each Age Group	Pathological AHI/RDI	SAHS	Authors
0-12	RDI>2-3	RDI>2-3	
Men: 2 601 550	26 015-78 046 (1%-3%)	26 015-78 046 (1%-3%)	Gislason and Benediktsdottir[25]
Women: 2 464 655	24 646-73 940 (1%-3%)	24 646-73 940 (1%-3%)	Brunetti et al[26]
13-18	RDI>10	RDI>10+EDS	
Men: 1 431 169	254 748 (17.8%)	28 337 (1.98%)	Sánchez-Armengol et al[27]
Women: 1 357 413	24 162 (17.8%)	26 877 (1.98%)	
19-29	AHI>10-15	AHI>10+EDS	
Men: 3 695 929	55 439-236 539 (1.5%-6.4%)	14 784-140 445 (0.4%-3.8%)	Bixler et al[28,29]
Women: 3 529 594	7 059-70 592 (0.2-2.0)	7 059-70 592 (0.2-2.0)	
30-70	AHI>10	AHI>5-10+EDS	
Men: 10 515 041	1 577 256-1 997 858 (15%-19%)	357 511-420 602 (3.4%-4%)	Young et al[3]
Women: 10 777 272	538 864-1 616 591 (5%-15%)	215 545-323 318 (2%-3%)	Durán et al[4]
71-100	AHI>10	AHI>10+EDS	
Men: 1 778 161	1 226 931-1 244 713 (69%-70%)	266 724-444 540 (15%-25%)	Ancoli-Israel et al[30]
Women: 2 696 587	1 510 089-1 698 850 (56%-63%)	242 693-539 317 (9%-20%)	Durán et al[4]
All age groups			
Men: 20 021 850	3 140 389-3 811 904	693 371-1 111 970	
Women: 20 825 521	2 104 820-3 484 135	516 820-1 034 044	

*AHI indicates apnea-hypopnea index per hour of sleep; RDI, respiratory disturbance index (number of respiratory events recorded per hour); EDS, excessive daytime sleepiness.

TABLE 2
Distribution by Autonomous Community According to Whether Sleep Studies Are Performed and Number of Centers Using Standard Polysomnography (PSG)

Autonomous Community	1994[32]			2003		
	No	Yes	PSG	No	Yes	PSG
Andalusia	30	11 (27%)	2 (5%)	36	24 (40%)	12 (20%)
Aragon	8	4 (33%)	2 (17%)	11	9 (45%)	3 (15%)
Asturias	10	1 (9%)	1 (9%)	8	8 (50%)	1 (6%)
Balearic Islands	5	1 (17%)	1 (17%)	6	5 (45%)	2 (18%)
Canary Islands	21	0	0	16	7 (30%)	7 (30%)
Cantabria	5	1 (17%)	1 (17%)	3	2 (40%)	1 (20%)
Castile-La Mancha	8	4 (33%)	2 (17%)	8	6 (43%)	3 (21%)
Castile-Leon	26	5 (16%)	2 (6%)	25	15 (37%)	7 (17%)
Catalonia	48	16 (25%)	5 (8%)	28	46 (62%)	17 (23%)
Ceuta-Melilla	4	0	0	2	2 (50%)	0
Extremadura	6	2 (25%)	2 (25%)	7	5 (42%)	2 (17%)
Galicia	37	4 (10%)	3 (7%)	26	12 (31%)	10 (26%)
La Rioja	3	1 (25%)	0	3	3 (57%)	0
Madrid	10	13 (57%)	8 (35%)	16	28 (64%)	24 (54%)
Murcia	10	4 (29%)	0	11	6 (35%)	4 (23%)
Navarre	3	3 (50%)	2 (33%)	2	5 (71%)	1 (14%)
Basque Country	18	6 (25%)	3 (13%)	17	13 (43%)	6 (20%)
Valencia	20	9 (31%)	5 (17%)	13	23 (64%)	16 (44%)
Total	272	85 (24%)	39 (11%)	238	219 (48%)	116 (25%)

TABLE 3
Distribution of Technical Resources for Diagnosing and Treating Sleep Apnea-Hypopnea Syndrome According to the American Sleep Disorders Association (ASDA) Classification: Comparison of data since 1994*

ASDA Level[35]	1994[32]	1997[33]	2003
Level I (complete and attended PSG)	33 (38.8%)	42 (29.4%)	116 (53.0%)
Level II (complete unattended PSG)	6 (7.1%)	6 (4.2%)	1 (0.5%)
Level III (RP)	17 (20%)	43 (30.1%)	91 (41.5%)
Level IV (oximetry)	29 (34.1%)	52 (36.4%)	11 (5.0%)
Total	85 (100%)	143 (100%)	219 (100%)

*PSG indicates standard polysomnography; RP, respiratory polygraphy.
The level assigned to each hospital was determined by the highest level facility reported there. A hospital that undertook studies at different levels—for example level I (PSG), and level III (RP)—was catalogued as a level I facility.

private. Specialized clinics and hospitals were excluded (pediatric, maternity, geriatric, psychiatric, and prison hospitals and facilities specializing in ophthalmology, dermatology, traumatology, and rehabilitation). The information was obtained from the 2002 Medical Health Directory.[34] The study was carried out between March and July 2003. The data was collected using a questionnaire (Appendix). The information was obtained from the person in charge of the sleep unit by way of a telephone conversation. When necessary, the questionnaire was faxed to the hospital so that it could be duly completed and returned. When the telephone number provided was incorrect, we requested the correct number from the telephone company's directory services. We also asked each hospital or unit to identify other similar units in their area, and these were then cross checked with the directory. Hospitals found in this way were also contacted even though they did not appear in the directory. At least 5 calls were made before a hospital or clinic was excluded. A hospital was only classified as a facility that undertook sleep studies if such studies were carried out on a regular basis.

Results

Initially, 488 Spanish hospitals were included in the study. Subsequently, 27 of these were excluded because they were found to be specialized and did not therefore fulfill the inclusion criteria. It was, in any case, established that none of the 27 facilities excluded undertook sleep studies. The final sample consisted of 461 hospitals. Of these we managed to contact 457 (99.1%), all of which agreed to take part in the study; 226 were public hospitals, 83 had contracts to provide services within the public health care system, 136 were private, and 16 had both private and public health care beds. We found that sleep studies were carried out by 62.7% of public hospitals, 33.6% of the private facilities, 36.6% of the hospitals contracted to provide public services, and 18.7% of the institutions with both public and private beds. In total, 219 (47.5%) of the hospitals in the sample performed some kind of sleep study. Table 2 shows the numbers of hospitals per autonomous community that undertook sleep studies in 2003 compared to the data obtained in 1994. There was an increase in the number of hospitals that undertake sleep studies. In 2003, 2.6 times more hospitals undertook sleep studies of some sort, and 3 times more offered polysomnography (PSG). However, there were no hospitals whatsoever in the autonomous communities of Ceuta-Melilla or La Rioja equipped to perform PSG studies.

TABLE 4
Distribution and Classification of Technical Resources by Autonomous Community. Equipment Available According to the American Sleep Disorders Association Classification*

Autonomous Community	1994[32]				2003			
	Level I	Level II	Level III	Level IV	Level I	Level II	Level III	Level IV
Andalusia	3	0	11	4	23	1	40	26
Aragon	3	1	3	4	10	0	5	11
Asturias	1	0	1	0	2	0	9	6
Balearic Islands	2	0	0	2	3	0	4	5
Canary Islands	0	0	0	0	7	0	6	6
Cantabria	2	0	2	2	1	0	8	5
Castile-La Mancha	2	0	1	3	4	0	8	7
Castile-Leon	2	0	3	7	10	0	14	15
Catalonia	16	0	5	19	29	0	68	43
Ceuta and Melilla	0	0	0	0	0	0	2	2
Extremadura	4	0	4	1	5	0	6	3
Galicia	3	0	2	7	13	0	18	14
La Rioja	0	0	0	2	0	0	4	5
Madrid	9	4	6	12	43	0	31	34
Murcia	0	0	1	4	4	0	7	3
Navarre	1	1	0	2	7	0	6	4
Basque Country	6	0	15	4	14	0	32	12
Valencia	4	1	1	9	26	0	26	32
Total	58	7	55	82	201	1	294	233

*Level I indicates the number of standard polysomnographs per autonomous community used for complete and attended polysomnography; level II, the number of polysomnographs per autonomous community used for complete but unattended polysomnography; level III, the number of respiratory polygraphs with at least 4 information channels used for respiratory polygraphy; and level IV, the number of oximeters per autonomous community used for oximetry studies.

TABLE 5
Number of Standard Polysomnograph (PSG) Machines and Respiratory Polygraph (RP) Devices per 100 000 Population by Autonomous Community*

Autonomous Community	1994[32]			2003		
	Population	PSG/100 000 Pop.	RP/100 000 Pop.	Population	PSG/100 000 Pop.	RP/100 000 Pop.
Andalusia	6 993 400	0.0429	0.1572	7 357 558	0.3126	0.5436
Aragon	1 187 700	0.3368	0.2525	1 204 215	0.8304	0.4152
Asturias	1 111 500	0.0900	0.0899	1 062 998	0.1881	0.8467
Balearic Islands	689 700	0.2900	0	841 669	0.3564	0.4752
Canary Islands	1 509 000	0	0	1 694 477	0.4131	0.3541
Cantabria	529 000	0.3781	0.3780	535 131	0.1869	1.4950
Castile-La Mancha	1 697 100	0.1178	0.0589	1 760 516	0.2272	0.4544
Castile-Leon	2 598 200	0.0768	0.1154	2 456 474	0.4071	0.5699
Catalonia	6 053 900	0.2643	0.3138	6 343 110	0.4572	1.0720
Ceuta-Melilla	122 000	0	0	137 916	0	1.4501
Extremadura	1 103 100	0.3626	0.0906	1 058 503	0.4724	0.5668
Galicia	2 855 800	0.1050	0.0700	2 695 880	0.4822	0.6677
La Rioja	262 000	0	0	276 702	0	1.4456
Madrid	4 904 400	0.2651	0.1223	5 423 384	0.7929	0.5716
Murcia	1 040 000	0	0.0961	1 197 646	0.3340	0.5845
Navarre	521 000	0.3838	0	555 829	1.2594	1.0795
Basque Country	2 154 200	0.2785	0.6963	2 082 587	0.6722	1.5365
Valencia	3 793 500	0.1318	0.0263	4 162 776	0.6246	0.6246
Total	39 125 500	0.1661	0.1405	40 847 371	0.4921	0.7197

*Pop. indicates population.

Table 3 shows the distribution of technical resources according to the American Sleep Disorders Association (ASDA classification,[35] and the evolution of this infrastructure since 1994. There was an increase in the percentage of hospitals with level I resources (attended PSG), which went from 39% in 1994 to 53% in 2003, and in the number of facilities with level III resources (respiratory polygraphy [RP]), which rose from 20% in 1994 to 41% in 2003. We observed a progressive phasing out of units with level II resources (unattended PSG), and a substantial decline in the percentage of hospitals using oximetry alone (level IV), which fell from 34% in 1994 to 5% in 2003. Table 4 details the total number of machines per autonomous community broken down according to ASDA levels, and compares the results obtained in the present study with the data gathered in 1994. The number of machines at all levels had increased. In 1994, 39 hospitals around the country had 58 PSG machines, and by 2003 there were 201 in 116 hospitals. This means that there were 3.5 times more machines available than in

TABLE 6
Number of Continuous Positive Airway Pressure (CPAP) Machines in Use at the Time of the Study by Autonomous Community: Comparative Data from 1994, 1997, and 2003*

Autonomous Community	Until 1994[32]			Until 1997[33]			Until 2003		
	Population	No. of CPAP-BiPAP Machines	No. of CPAP-BiPAP/ 100 000 Pop.	Population	No. of CPAP-BiPAP Machines	No. of CPAP-BiPAP/ 100 000 Pop.	Population	No. of CPAP-BiPAP Machines	No. of CPAP-BiPAP/ 100 000 Pop.
Andalusia	6 993 400	1403	20.1	7 363 245	4752	64.5	7 357 558	16 038	218.0
Aragon	1 187 700	233	19.6	1 187 546	926	78	1 204 215	2835	235.4
Asturias	1 111 500	277	24.9	1 087 885	735	67.6	1 062 998	2375	223.4
Balearic Islands	689 700	169	24.5	760 379	1035	136.1	841 669	2494	296.3
Canary Islands	1 509 000	96	6.5	1 606 534	276	17.2	1 694 477	2110	124.5
Cantabria	529 000	272	51.4	527 437	759	143.9	535 131	1263	236.0
Castile-La Mancha	1 697 100	254	15	1 712 529	1543	90.1	1 760 516	2409	136.8
Castile-León	2 598 200	388	14.9	2 508 496	1540	61.4	2 456 474	4731	192.6
Catalonia	6 053 900	1605	26.5	6 090 040	4540	74.5	6 343 110	26 480	417.5
Ceuta- Melilla	122 000	0	0	–	–	–	137 916	237	172.6
Extremadura	1 103 100	265	24	1 070 244	1014	94.7	1 058 503	3200	302.3
Galicia	2 855 800	315	11	2 742 622	501	18.3	2 695 880	4567	169.4
La Rioja	262 000	48	18.3	264 941	155	58.5	276 702	600	216.8
Madrid	4 904 400	1092	22.3	5 022 289	3686	73.4	5 423 384	15 981	294.7
Murcia	1 040 000	115	11.1	1 097 249	817	74.4	1 197 646	1830	152.8
Navarra	521 000	79	15.2	520 574	892	171.3	555 829	1467	263.9
Basque Country	2 154 200	1016	47.2	2 098 055	2876	137.1	2 082 587	8506	408.4
Valencia	3 793 500	575	15.2	4 009 329	2712	67.6	4 162 776	12 629	303.4
Total	39 125 500	8202	21	39 669 394	28 759	72.5	40 847 371	109 752	268.7

*BiPAP indicates bilevel positive airway pressure machine; Pop, population.

1994, with a ratio of 1.7 PSGs per hospital. In addition, the number of level III (RP) machines had increased 5.3 times by 2003, with 294 devices in use. Level II installations have tended to disappear, while the number of hospitals with level IV monitors (oximetry) increased 2.8 times with respect to 1994.

Table 5 shows the number of PSG and RP machines per 100 000 population in each autonomous community and compares this data with the results obtained in 1994. The level of equipment had improved in almost all of the autonomous communities. The rates of PSG and RP per 100 000 population, which were 0.1661 and 0.1405 in 1994, had risen to 0.4921 and 0.7197 respectively by 2003.

Table 6 shows the total number of CPAP and BiPAP treatments prescribed for SAHS in each autonomous community. In 1994, 8202 patients were being treated (7% with BiPAP). This figure had risen to 28 759 (4% BiPAP) by 1997, and to 109 752 (2% BiPAP) by 2003. This means that 13.3 times more patients were being treated in 2003 than in 1994.

The mean (SD) number of months in service of sleep units in Spain was 86.7 (97.8) months. Some 72.4% of these units dealt specifically with respiratory disorders during sleep, while 27.6% dealt with all kinds of sleep disorders. In 59.3% of the hospitals that performed sleep studies there was a specialized unit where the mean number of patients attended per month in relation to SAHS was 75.9 (84.4). These units were performing a mean of 18.5 (22.1) RP, 13.8 (22.0) PSG, and 8.8 (9.9) CPAP titrations per month. The mean number of specialized sleep experts per unit was 0.81 (1.1). These experts were assisted by other staff who were not permanently assigned to the unit (a mean of 0.60 per unit).

Table 7 shows the characteristics of the studies undertaken in 2003 compared to the data gathered in 1994. In total 65% of all studies were performed in hospitals. A progressive increase was observed in the

TABLE 7
Description of Work Methods Used for the Diagnosis and Treatment of Sleep Apnea-Hypopnea Syndrome: Comparison with Data Collected in 1994*

	1994	2003
Location where sleep studies are carried out		
Hospital	69 (81.2%)	141 (65.3%)
Home	6 (7.1%)	12 (5.5%)
Both	10 (11.8%)	63 (29.2%)
Method used in sleep studies		
Attended	34 (40%)	47 (21.7%)
Unattended	36 (42.4%)	101 (46.8%)
Both	15 (17.6%)	68 (31.5%)
Availability of a dedicated sleep laboratory or unit		
Yes	48 (56.5%)	129 (60.8%)
No	37 (43.5%)	83 (39.2%)
What department is responsible for the sleep disorders unit?		
Respiratory medicine	74 (87.1%)	174 (79.4%)
Neurophysiology	2 (2.3%)	28 (12.8%)
Both	6 (7.1%)	–
Other departments	3 (3.5%)	17 (7.8%)
How is CPAP titrated?		
Standard polysomnography	–	55 (26.8%)
Respiratory polygraphy	–	21 (10.2%)
Auto-CPAP	–	28 (13.7%)
Oximetry	–	5 (2.4%)
Empirically	–	96 (46.8%)

*CPAP indicates continuous positive airway pressure.

number of units that conducted sleep studies both in hospital and in patients' homes, and 83% of the studies performed by these units were RP. Forty-seven percent of hospitals performed only unattended studies (83% of which were RP). Furthermore, 39% of hospitals did not have a dedicated sleep laboratory; the studies undertaken by these units were RP in 80% of cases, oximetry in 10%, and PSG in the remaining 10%. It was mainly respiratory medicine specialists who ordered and supervised sleep studies (79%), although a gradual increase was found in the involvement of neurophysiologists (13%), and other specialists (9%). In conclusion, 71% of hospitals prescribed CPAP in accordance with the SEPAR guidelines, and 47% titrated empirically.

Discussion

The results of the present study show that, notwithstanding the increase since 1994 in the number of machines in Spain for diagnosing and treating SAHS and the overall improvement in the quality of available equipment, resources are still limited and clearly inadequate.

It is now accepted that RP is a good alternative to PSG for diagnosing SAHS.[37] Some 75% of patients presenting with symptoms indicative of SAHS can be screened using RP, while PSG can be reserved for the most difficult and unclear cases.[38] Consequently, we can estimate that only 1 PSG machine is required for every 3 RP devices. In fact, the greatest increase was in the sleep units equipped to level I and level III standards. Moreover, hospitals with level IV resources, which accounted for 34.1% and 36.4% of the total in 1994 and 1997 respectively,[32,33] represented only 5% of the total in 2003. This is an indication that the equipment in these hospitals has now been upgraded to levels I and III, and that oximetry is no longer being used because it is a poor tool for diagnosing SAHS.[37] However, considerable differences still exist between autonomous communities.

Between 5 and 7 million people in Spain have an abnormal AHI. Since these individuals are at risk for medical complications and deteriorating health, they must be identified so that their physicians can intervene to promote a healthier lifestyle, decide on treatments, and perform clinical checkups.[4,7-24] Moreover, between 1 and 2 million individuals have clinically significant SAHS and should be using CPAP. The early identification of such patients is a health priority. However, if we analyze what has been achieved to date, only 4% to 6% of the population with an abnormal AHI and 5% to 10% of the patients with clinically relevant SAHS have been diagnosed. In fact, there are only 201 PSG machines and 294 RP devices available in Spain to diagnose between 4 700 000 and 6 700 000 patients with an abnormal AHI and between 900 000 and 1 900 000 patients with established SAHS. If we accept that the ratio of RP to PSG machines should be 3 to 1, and assume, in a maximum optimization of the resources, that all the machines are functioning 365 days a year, it would take between 33 and 47 years to diagnose the individuals with abnormal AHI with the available RP devices, and between 16 and 23 years with the PSG machines currently in the system. Even if our objective was more modest, and our aim was to identify patients with clinically relevant SAHS, this task would take between 6 and 13 years with the RP devices and between 2 and 6 years with the PSG machines. Furthermore, we would have to add the same amount of time again to this estimate for both PSG and RP to provide for the titration of the CPAP appliances. However, it is unlikely that all members of the affected population will be diagnosed and treated. If our aim is to diagnose and treat even 50% of this population, the task would still be impossible with the resources currently available. These statistics supply a perfect explanation for the existence of unacceptably long waiting lists in most sleep clinics.

Similarly, 39% of the hospitals do not have a specific laboratory or suite where sleep studies are performed. The current situation is not very different from that found in 1994, when this figure was 43%,[32] despite the fact that these sleep clinics have now existed for an average of over 7 years. The scant resources are, however, properly used, with each unit performing some 41 studies a month (including PSG, RP, and CPAP titrations), although considerable differences exist in this respect between autonomous communities and between hospitals.

It is difficult to compare some autonomous communities with others. The demand for sleep studies differs from area to area depending on the resources available, awareness of the health consequences of SAHS, and the characteristics of the area's population and medical community. Consequently, resources that might appear scant in one autonomous community could, depending on the demand, be adequate in another. However, according to our results, 1 PSG machine and 3 RP devices are needed per 100 000 population. This would imply a stock of 408 PSG machines (the current stock is 201) and 1225 RP devices (the current stock is 294). The ideal rate is not attained by most autonomous communities. Some hospitals do, however, have these resources, and some even exceed the minimum. In this day and age, it is difficult to accept that an RP device, which costs approximately the same as a spirometer, does not deserve consideration in the resource plans and budget projections of respiratory medicine departments. We are not just "daytime" pulmonologists, and the symptoms our patients develop while awake may be the result of events that have taken place during sleep. Consequently, information concerning the physiopathology of such events in respiratory patients, whether or not they have SAHS, is a fundamental component of a better approach to the patients' treatment and prognosis.

In spite of the limitations specified above, the number of patients being treated with CPAP/BiPAP rose considerably, going from 8202 in 1994 to 109 752 in 2003. Although the implication of this figure is that only 5% to 10% of patients with clinically significant SAHS in Spain were receiving treatment in 2003, it also means that the number of CPAP machines in use had increased by a factor of 13.3 over the number in use in 1994, and that

there were 269 CPAP machines per 100 000 population in stock. Moreover, this increase occurred despite the fact that in 71% of hospitals CPAP is prescribed according to the SEPAR guidelines,[36] which are quite restrictive and limit such prescription to patients with severe SAHS. The situation reflected in these figures is, however, still very far from what could be considered a reasonable goal (the diagnosis and treatment of 50% of the population with clinically relevant SAHS). In order to attain this goal, a stock of between 1102 and 2203 CPAP machines per 100 000 population would be necessary.

Such an increase in the number of CPAP treatments prescribed should be accompanied by a serious review of the public health cost of CPAP treatment. The current system of leasing these appliances from a supplier for an annual rent equivalent to 100% of the cost of a new appliance can never be cost-effective unless the suppliers are directly involved in the supervision and care of patients, working in collaboration with the prescribing physicians. Another possibility would be for the health authorities or hospitals to buy equipment backed by a maintenance contract. This system would, however, have to incorporate solutions for the replacement and amortization of the equipment in order to ensure that patients would be able to obtain the most effective and comfortable appliances. Another important factor is that the market dealing with CPAP machines and their accessories (masks, head straps, humidifiers, etc) is in a continuous state of renovation and growth. The latest appliances are capable of recording and storing data on what happens to the patient every night, and they can even modify their own settings accordingly. New models are increasingly more comfortable, aesthetic, ergonomic, and silent, although at the same time more expensive. Under the existing contracts, most companies do not supply expensive machines and accessories, but rather opt for a standard quality over which the prescribing physician has little control. If an individual patient wants a higher quality appliance, he or she faces enormous difficulties in obtaining the newer equipment, even privately. On the other hand, this superior quality is sometimes required to prevent side effects and to resolve specific problems. However, it is unrealistic to suppose that public resources could ever completely finance all the solutions available on the market. Therefore, a reasonable approach could be that the public health system would finance an appliance of an acceptable and satisfactory quality that would ensure good health, and that patients would also have the option of obtaining an appliance of superior quality by paying the difference in cost. This system is already used for other types of equipment characterized by a high level of innovation, such as wheelchairs. This notwithstanding, a specific piece of equipment could always be prescribed and financed by public health system if the physician submitted a special report on the case and the authorities deemed that the special prescription was medically justified.

Another practice that we must oppose energetically and condemn is the existence in some autonomous communities of so-called "quotas" for CPAP treatment. In these closed systems the public health authorities finance a previously agreed number of CPAP machines per year at a fixed price. If the treatments prescribed by physicians exceed this number, the suppliers do not receive financing for the supply of the extra appliances. This system is unacceptable from every standpoint. It is unfair to the suppliers, who are obliged to install machines for which they are not paid. It is bad for the patients, who run the risk of receiving low quality machines, accessories, and service from the suppliers. It is discouraging for physicians, who find it difficult to prescribe CPAP treatments and obtain high quality equipment. Finally, this practice highlights the contradictory attitude of the health authorities, which appear to be trying to hinder rather than favor the prescription of CPAP, particularly when they are the principal parties responsible for the fact that the prescription of CPAP treatments only reached 5% to 10% of patients with severe SAHS.

Another aspect that is cause for concern is the high percentage of patients for whom CPAP was prescribed empirically without any kind of titration. In 1997, Terán et al[33] found that 34% of hospitals prescribed CPAP empirically. This figure has now risen to around 47%, in spite of the fact that all the professional associations advise against this practice. Moreover, the results that can be obtained using modern automatic CPAP titration systems are similar to those obtained with PSG,[39] and these devices are inexpensive and easy to interpret. It is, therefore, unacceptable that the prescription of a long-term treatment subject to side effects be based solely on the improvement of symptoms, renouncing even the most minimum guarantees that would ensure optimum CPAP pressure for each patient. Obviously, many patients will improve with empirical treatment because even too little or too much pressure is probably better than none at all. However, this does not mean that this is a correct approach, at least so long as no evidence has been adduced to justify the use of empirical titration. We have observed that this practice is due, in most cases, to a shortage of equipment and of the human resources needed to perform a proper CPAP titration study, to the impossibility of referring patients, and to excessively long waiting lists. Empirical titration could, therefore, be used until the definitive titration can be performed, but should never be a substitute for the latter. We are responsible for the diagnosis and treatment of these patients, and we should not relinquish certain minimum levels of quality that ensure the optimum CPAP prescription. If we were to relinquish these minimum levels, society would be right to hold us responsible for this failure.

A limitation of this study is that it was based on data obtained using a questionnaire. However, the absence of any refusals to participate is an indication of the interviewees' positive motivation, and the quality controls carried out did not reveal any discrepancies. Another noteworthy aspect of this study was the inclusion of private hospitals, which had been excluded from earlier studies. We wanted to obtain information on "all" the diagnostic and therapeutic resources for the "whole" country. In any

case, the results show that it is the public hospitals that spend more on the diagnosis and treatment of SAHS.

In conclusion, we can state that SAHS is a public health problem with important social and health repercussions affecting some 2 million people in Spain, most of whom are yet undiagnosed. The role of primary care is crucial in the identification of cases where there is clinical suspicion of SAHS, and one essential task is to promote a better understanding of this disorder among the general public. In addition, we specialists must be better prepared to diagnose and treat this disorder backed by adequate training and resources, and SEPAR must play an active role in this process. Finally, the management of this health risk is clearly the responsibility of the health authorities, who must review the situation and play an active role in ensuring the provision of the infrastructure and personnel needed to deal with the problem in a timely manner, eliminating the resource shortages and unacceptably long waiting lists that currently plague most hospitals and clinics.

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APPENDIX

Survey of the Availability of Resources for Diagnosing Sleep Apnea-Hypopnea Syndrome*

Hospital: ____ Autonomous Community: ________________________________

Province: ____ City: ____

Type of hospital: public/private/private with public health contract

Telephone: ____ Date of interview: ____

Sleep studies

1. Does your hospital undertake sleep studies (of any kind)? Yes/No Since when? (Months)
2. What kind of sleep study unit do you have? Only respiratory/Complete (all sleep disorders)
3. What is the highest level of facility you have in your hospital?
   Level I (attended PSG)/level II (unattended PSG)/level III (RP)/level IV (oximetry)
4. Do you have a specialized sleep disorder unit? Yes/No
5. How many patients are seen per month in the sleep disorder unit?
6. How many RP are performed each month? How many PSGs are performed each month?
7. Do you do CPAP titrations? Yes/No How many titrations are performed each month?
8. How is the optimum CPAP pressure titrated? PSG/RP/Auto-CPAP/empirically
9. What is the percentage of CPAP titrations carried out by PSG: RP: Auto-CPAP: Empirically:
10. Where are the studies carried out? Hospital/Home/Both
11. How are they carried out? Attended/Unattended/Both systems
12. What percentage of studies are done…? Attended: Unattended:
13. Are these studies performed in a specific laboratory or suite, rather than in hospital beds? (Except if such beds are used only for this purpose and are in the same place) Yes/No
14. How many people work exclusively in the sleep disorder unit?
15. What department orders sleep studies, prescribes treatments, and monitors these patients?
    Respiratory Medicine/Neurophysiology/Neurology/ Otorhinolaryngology/Internal Medicine/Other
16. In addition to the sleep expert or nurse, does anyone else perform RPs?
    Residents/nursing staff/agency nurses/others
17. What department is in charge of the sleep unit?
    Respiratory Medicine/Neurophysiology/Neurology/ Otorhinolaryngology/Internal Medicine/Other
18. How many oximeters do you have which are used alone?
19. How many RP systems do you have in use? (Specify brand and number of devices).
    Mesam 4: Polymesam: Apno I: Apno II: Apno III:
    Sibel: Breas: Embleta: Other:
20. How many PSG machines do you have in use? (Specify brand and number of machines).
    Alice 3: Alice 4: Compumedics-Siesta: Compumedics-other: Ultrasom:
    Sensor-Medics: Sleep-lab: Meditel: Other 1: Other 2:
21. How many CPAP and BiPAP treatments have been prescribed by your unit for sleep apnea-hypopnea syndrome since you opened?
    No. of CPAP: No. of BiPAP:
22. Currently, how many CPAP and BiPAP are prescribed per year by your unit?
    No. of CPAP: No. of BiPAP:
23. Do you prescribe CPAP according to SEPAR guidelines? Yes/No
24. How many CPAP did you prescribe last month?

Comments:

_ *i*

*PSG indicates standard polysomnography; CPAP, continuous positive airway pressure; BiPAP, bilevel positive airway pressure; RP, respiratory polygraphy; SEPAR, Spanish Society of Pulmonology and Thoracic Surgery.