

RESEARCH ARTICLE



Bed partner perception of CPAP therapy on relationship satisfaction and intimacy—A European perspective from the ESADA network

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Summary

Obstructive sleep apnea increases morbidity and mortality risks. The most common treatment is continuous positive airway pressure, with nasal mask usage being important, but not always optimal. While most research on treatment adherence focuses on the patient, the bed partner's involvement may be detrimental. Our study aim is to obtain a European-wide picture of the bed partner's attitude and support towards continuous positive airway pressure therapy, including effects on relationship satisfaction and intimacy. The English translation of a German bed partner questionnaire, assessing relationship satisfaction and three major components (general attitude, perceived mask looks, intimacy effects) was distributed within the European Sleep Apnea Database Network and translated in participating countries' local language. Data were collected

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for 2 years. In total, 10 European countries (13 sleep centres) participated with 1546 questionnaires. Overall, 91% of bed partners had a positive attitude towards continuous positive airway pressure therapy, 86% perceived mask looks not negative, 64% stated no negative intimacy effects. More specifically, 71% mentioned improved sleep quality, 68% supported nightly device usage. For 41% of bed partners, relationship satisfaction increased (no change for 47%). These results were significantly more pronounced in Eastern/Southern Europe compared with Middle Europe, especially regarding intimacy effects. However, increased continuous positive airway pressure therapy length affected attitude negatively. These results provide necessary information to improve treatment strategies by including educational couple-focused approaches. Among others, we revealed that negative intimacy effects are not considered a barrier to continuous positive airway pressure adherence. These results may inspire more research identifying regional gaps with need for treatment adjustments.

KEYWORDS

continuous positive airway pressure therapy, intimacy, partner support, questionnaire, relationship, sleep apnea

1 | INTRODUCTION

Obstructive sleep apnea (OSA) is one of the most common forms of sleep-disturbed breathing and is caused by recurrent upper-airway collapse during sleep. It has become an increasing prevalent public health problem, with a global prevalence for moderate to severe OSA with about 425 million (95% confidence interval [CI] 399–450) adults aged 30–69 years. Percentual prevalence was highest in certain European countries, including Switzerland (37%), France (36%) and Germany (33%) (Benjafield et al., 2019; Fietze et al., 2019; Senaratna et al., 2016). OSA impairs sleep quality and autonomous functioning, leads to daytime sleepiness, and affects life quality. If untreated it may increase morbidity and mortality risks (Newman et al., 2001).

The gold-standard treatment of OSA is the use of a continuous positive airway pressure (CPAP) mask, which applies mild air pressure on a continuous basis over the nose and possibly mouth and, therefore, keeps the airways continuously open. CPAP therapy has been shown to successfully improve symptoms, and reduce morbidity and mortality (Engleman et al., 1996). Especially important for therapy success is therapy adherence and regular use of the mask during nighttime, with the goal of using it more than 4 hr per night and more than 70% of nights. However, treatment adherence is not always optimal, and after 1 year of CPAP therapy only about 50% of the patients use the mask for more than 4 hr per night (Cistulli et al., 2019; Pépin et al., 2021). In general, over the past 20 years, CPAP adherence has remained persistently low (Rotenberg et al., 2016). Factors that affect CPAP adherence are excessive daytime sleepiness, disease severity, side-effects, socio-demographic characteristics, but also psychological factors including social support and bed partner involvement (Mehrtash et al., 2019). A study identified barriers for mask usage including practical problems with the mask, negative psychological effects, a negative attitude, and lacking support from healthcare personnel or partner (Broström et al., 2010). Support including

educational programs involving the partner, patient follow-up and troubleshooting, but also support in the form of encouragement does indeed increase mask usage (Baron et al., 2011; Baron et al., 2020; Hoy et al., 1999; Smith et al., 2009). It has been shown with other chronic illnesses that partner inclusion in treatment does improve adherence and health outcome (Martire et al., 2010). As the majority of adult patients with OSA sleep with a bed partner (e.g. 2005 Sleep in America Poll – 61% of adults have a bed partner) and the bed partner is also affected by the patient's disorder, a partner-including approach to improve CPAP adherence has been suggested (Luyster et al., 2016; National Sleep Foundation, 2005).

Unfortunately, there has been little research focusing on the bed partner's opinion, support and experience with CPAP therapy, especially also regarding perceived effects on the relationship. Most research has focused on the patient (Baron et al., 2009; Gentina et al., 2019). The earliest studies to also include the bed partner's point of view during CPAP therapy investigated bed partner's sleepiness and quality of life with standardized questionnaires only (Doherty et al., 2003; Kiely & McNicholas, 1997). However, the bed partners' opinion and involvement in CPAP adherence has recently gained more attention. Studies started to include the bed partner when exploring barriers and facilitators of CPAP use. One study interviewing both the patient and bed partner together identified that intimacy issues may be a barrier of CPAP use (Ye et al., 2017). Another study demonstrated the importance of quality of marriage on CPAP adherence by investigating different clusters of couples (Gentina et al., 2019; Mendelson et al., 2020). Recently, the investigation of couple-oriented treatment approaches such as including the partner in education and support have shown to improve CPAP therapy adherence (Baron et al., 2022; Luyster et al., 2019). A current publication of the validation of a German bed partner questionnaire with a German sample revealed bed partner's positive attitude and support to the CPAP mask therapy and also increased relationship satisfaction (Fietze et al., 2023).

The aim of this study was to apply the German bed partner questionnaire on an extensive international European sample. We explored the effects of the CPAP mask therapy on bed partner's general attitude, perceived looks of the mask and relationship intimacy (three validated components/factors of the questionnaire), and also the effects of the length of mask therapy and relationship with possible geographical differences.

2 | METHODS

2.1 | Questionnaire

Since 2012, a simple two-page questionnaire for the bed partner of the CPAP patient has been part of the clinical routine at the outpatient clinic of the Interdisciplinary Center of Sleep Medicine, Charité – Universitätsmedizin Berlin (English version see Figure S1; Fietze et al., 2023). The questionnaire was the result of literature research, clinical experience, and consensus of psychologists and sleep physicians within the sleep centre. It differentiates between the bed partner of the patient (who answers the questionnaire) and the patient (CPAP mask wearer). Because the questionnaire is filled out by the partner of the patient with OSA, all answers are from

the point of view of the partner and only reflect their opinion. The questionnaire consists of three sections (Figure 1), including: (1) a demographic section (e.g. age, gender, mask type, subjectively reported length of relationship, length of CPAP therapy, etc.); (2) a mask-related statements section (15 statements with five-point answer scale: 1 = agree, 2 = rather agree, 3 = neither/nor, 4 = rather disagree, 5 = disagree); and (3) a satisfaction section (perceived satisfaction of the patient with mask, bedpartner's satisfaction with relationship before and since mask therapy, five-point answer scale: 1 = very satisfied, 2 = satisfied, 3 = neither/nor, 4 = unsatisfied, 5 = very unsatisfied).

The questionnaire was validated with a German sample of 508 participants (Fietze et al., 2023). Here, a factor analysis of section 2 (mask-related statements) revealed that the statements assess mainly three separate constructs (Figure 1):

- Attitude (bed partner's general attitude towards the mask therapy – Items 2, 3, 9, 10, 14);
- Looks (bed partner's opinion on the general appearance of the therapy mask – Items 6, 7, 8, 11);
- Intimacy (bed partner's perception of intimacy effects during mask therapy – Item 4, 5, 13, 15; including a subgroup of two items focusing on looks of the mask related to intimacy – Items 1, 12).

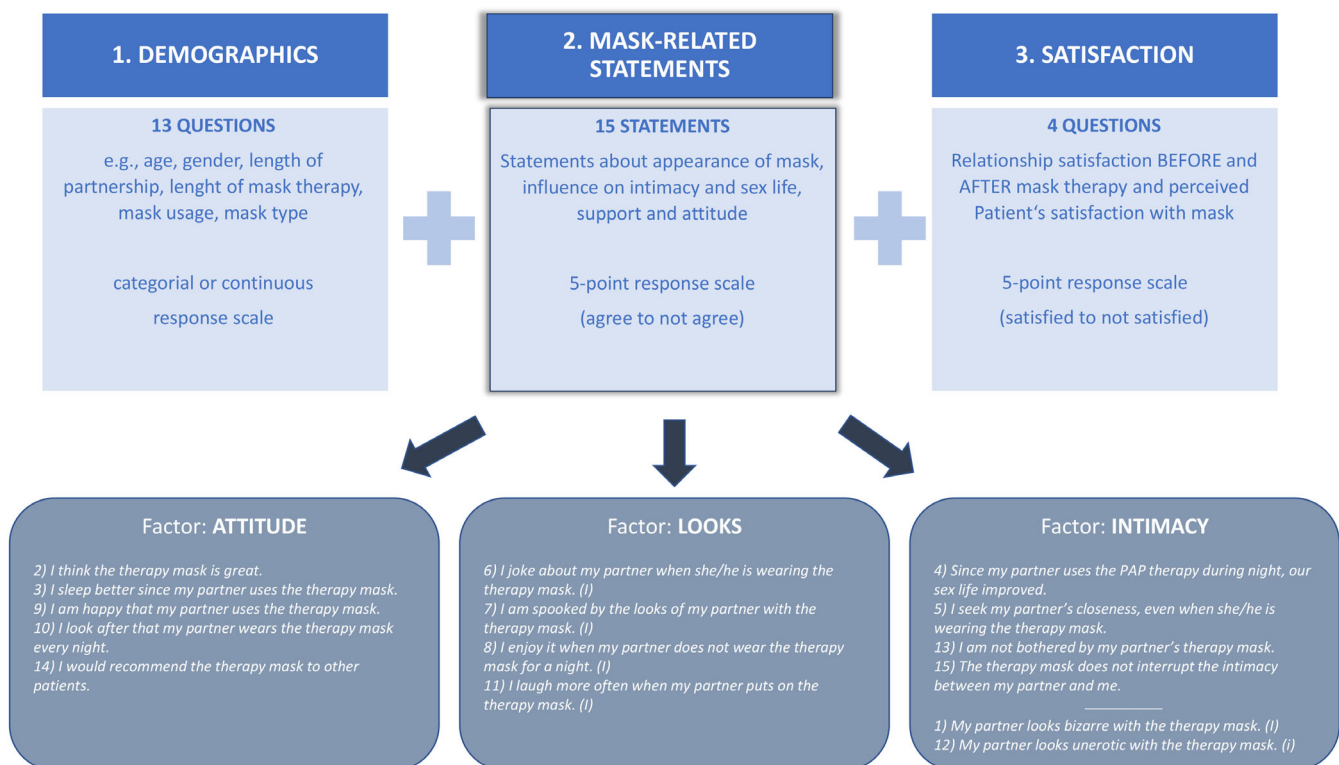


FIGURE 1 Overview of bed partner questionnaire focusing on mask-related statements and factors. The questionnaire was validated with a German sample (Fietze et al., 2022). A principal components analysis of section 2 (mask-related statements) revealed the three factors Attitude (general attitude towards the mask therapy), Looks (perceived looks of the therapy mask), and Intimacy (impact of therapy mask on relationship intimacy). (I) = For analysis, items 1, 6, 7, 8, 11 and 12 were inversed, so that all statements reflected a positive directed statement towards mask therapy.

2.2 | Participating countries of ESADA

The English version of the questionnaire was distributed within the ESADA (European Sleep Apnea Database) network. ESADA emerged in 2007 as a joint project within another European network of nationally appointed sleep apnea experts (European Union COST Action B26). Currently, it consists of 39 contributing European centres with registered data from over 34,000 patients (Bonsignore et al., 2018). Sleep centres participating in the questionnaire study were required to professionally translate the questionnaire to their country's local language (either by a certified translator, or by a back/forth translation from two independent people with a high proficiency in English and the country's native language) and collect at least 100 questionnaires per centre. In total, 13 sleep centres from 10 countries participated in the study (Figure 2).

2.3 | Data collection

Questionnaires were distributed and collected for 2 years (2020/2021). The data collection phase had been extended to include 2021 due to

COVID-19 restrictions (lockdown, temporary closure of sleep centres). There was only one inclusion criterion for the bed partner: they must be the partner of a patient on CPAP therapy. Different collection strategies were allowed to accommodate for different procedures at sleep centres. Some countries distributed the paper version of the questionnaire to the patient or bed partner to take home and mail back, some countries invited the bed partner to join the consultation who were then asked to complete the questionnaire on site, some countries sent the questionnaire directly to the bed partner by mail, email or online survey.

The questionnaire was completely anonymous to optimize the best response rate due to sensitive topics, participation of the bed partner was voluntary. The study was approved by the Institutional Ethics and Scientific Review Committee of the Charité – Universitätsmedizin Berlin, Germany (EA1/108/21). In addition, each participating country also obtained local ethical approval.

2.4 | Statistical analysis

Required sample size was calculated based on the estimated number of CPAP patients in Germany (about one-million CPAP patients a

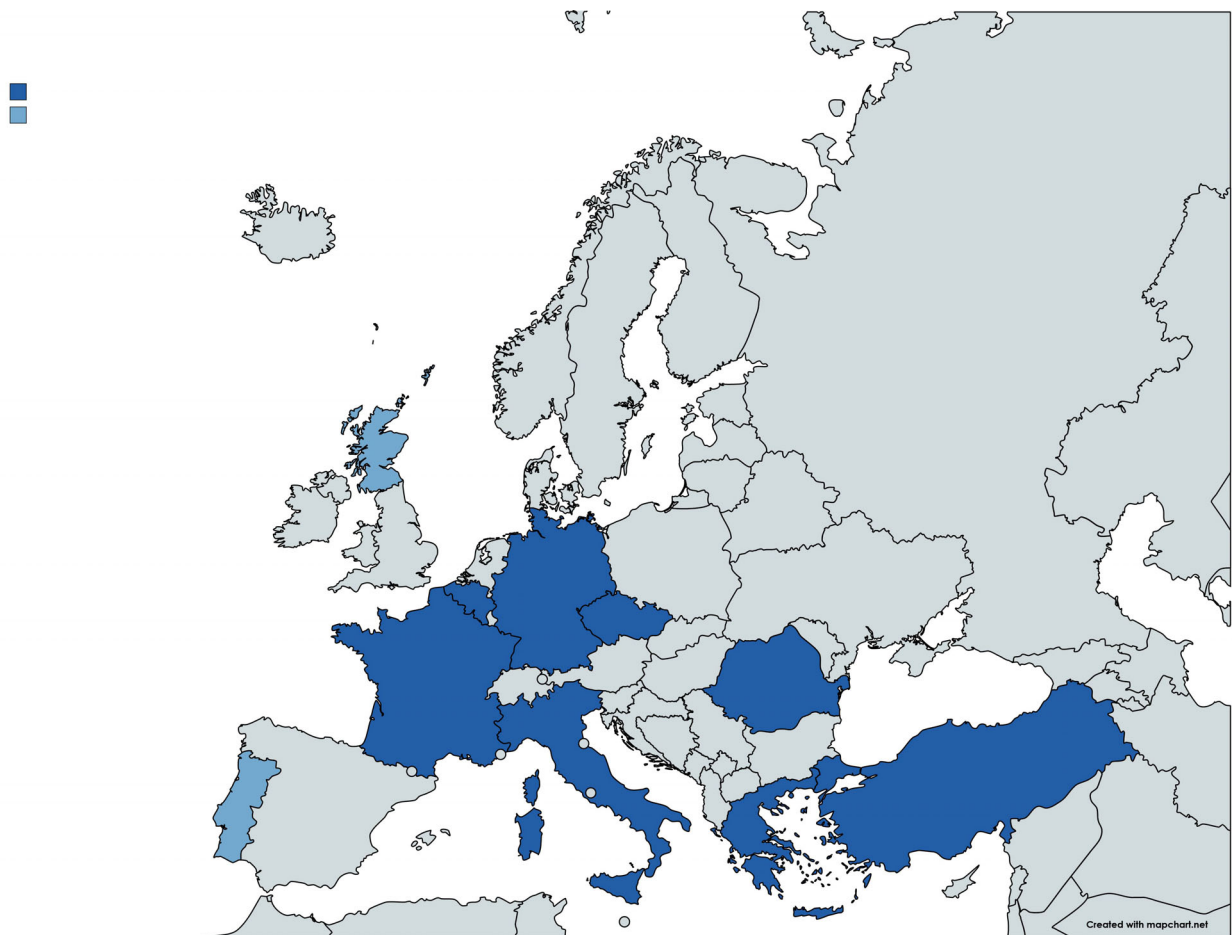


FIGURE 2 Participating countries. Light blue = countries with less than 100 participants.

year) and the estimated number of CPAP patients with a bed partner (about 67% = 670.000 patients). With an accepted error rate of max. 10% and a CI of 95%, the sample size was set to 100 questionnaires per country. Two countries (Portugal $n = 24$, Scotland $n = 44$) were not able to reach the required sample size of 100 questionnaires due to the small size of their sleep centre/limited number of patients and the restrictions of the pandemic COVID-19 and timewise closure of the sleep centre. They were still included in the overall analysis but excluded from specific geographical comparisons. Due to the large sample size, significant differences between sleep centres need to be regarded with caution.

The patient cohort was described using a descriptive analysis with means/standard deviation and percentages/frequency counts. For analysis of the therapy mask-related statements, we inverted items 1, 6, 7, 8, 11 and 12, so that all statements were phrased to reflect a positive directed statement towards the CPAP therapy. For each factor (Attitude, Looks, Intimacy), we computed an overall score with the mean score of the corresponding single item scores. For dependency analysis, a non-parametric correlation (Spearman Rho) was used to explore the effects of some independent variables (e.g. subjectively reported length of relationship, length of CPAP therapy). We refrained from correcting for multiple comparisons in order to identify as many

TABLE 1 Demographic information by each country.

	N	Patient age (years) mean \pm SD	Length of relationship (years) mean \pm SD	Length of CPAP therapy (years) mean \pm SD	
Belgium (Antwerp)	169	63.1 \pm 10.0	32.5 \pm 15.2	9.1 \pm 6.5	
Belgium (Leuven)	150	59.0 \pm 10.1	30.7 \pm 14.4	4.9 \pm 4.9	
Czech Republic	104	52.3 \pm 10.7	22.3 \pm 13.0	2.0 \pm 1.4	
France	200	65.5 \pm 9.5	22.2 \pm 6.0	4.8 \pm 1.8	
Germany	100	61.2 \pm 13.7	30.2 \pm 17.4	6.9 \pm 6.1	
Greece (Athens)	111	61.8 \pm 13.1	31.7 \pm 13.7	4.3 \pm 4.3	
Greece (Crete)	186	59.8 \pm 12.0	32.1 \pm 15.3	2.8 \pm 3.3	
Greece (Thessaloniki)	103	57.2 \pm 10.7	21.2 \pm 11.9	3.9 \pm 2.7	
Italy	100	64.3 \pm 9.9	36.2 \pm 13.7	5.3 \pm 3.8	
Portugal	24	59.0 \pm 10.0	31.3 \pm 14.0	3.3 \pm 3.4	
Romania	153	55.6 \pm 11.1	27.2 \pm 11.4	2.2 \pm 2.9	
Scotland	44	62.8 \pm 7.5	30.5 \pm 14.1	9.4 \pm 3.9	
Turkey	102	53.8 \pm 10.2	27.2 \pm 12.9	3.6 \pm 3.4	
Total	1546	59.9 \pm 11.5	28.6 \pm 14.0	4.6 \pm 4.5	
	N	Patient gender (male) n (%)	Sleeping in same room (yes) n (%)	Therapy initiation (by bed partner) n (%)	Mask type (nasal mask) n (%)
Belgium (Antwerp)	169	135 (79.9%)	152 (89.9%)	49 (29.0%)	104 (61.5%)
Belgium (Leuven)	150	125 (83.3%)	135 (90.0%)	77 (51.3%)	101 (67.3%)
Czech Republic	104	73 (70.2%)	87 (83.7%)	27 (26.0%)	40 (38.5%)
France	200	147 (73.4%)	n/a	95 (47.5%)	110 (55.0%)
Germany	100	83 (83.0%)	71 (71.0%)	36 (36.0%)	22 (22.0%)
Greece (Athens)	111	81 (73.0)	10 (9.0%)	61 (55.0%)	60 (54.1%)
Greece (Crete)	186	138 (74.2%)	184 (98.9%)	3 (1.6%)	127 (68.3%)
Greece (Thessaloniki)	103	57 (55.3%)	69 (67.0%)	56 (54.4%)	33 (32.0%)
Italy	100	58 (58.0%)	93 (93.0%)	10 (10.0%)	38 (38.0%)
Portugal	24	16 (66.7%)	22 (91.7%)	4 (16.7%)	6 (25.0%)
Romania	153	112 (73.2%)	129 (84.3%)	86 (56.2%)	136 (88.9%)
Scotland	44	31 (70.5%)	37 (84.1%)	12 (27.3%)	5 (11.4%)
Turkey	102	66 (64.7%)	84 (82.4%)	34 (33.3%)	71 (69.6%)
Total	1546	1122 (72.6%)	1073 (69.4%)	550 (35.6%)	853 (55.2%)

Note: Length of relationship and length of CPAP therapy were reported subjectively by the bed partner. For the categorical variables, only the main category with the highest overall frequency is presented in a detailed country overview.

Abbreviations: %, percent of total n ; CPAP, continuous positive airway pressure; n , number; SD, standard deviation.

significant correlations as possible as a base for further explorations. We acknowledge that some of these significant correlations may be false positives (Type I error). For comparing satisfaction with the relationship before and after the mask therapy, a non-parametric Wilcoxon Test for related samples was used. For analysis of geographical differences, we excluded countries with less than 100 participants and divided the remaining countries into two groups based on climate/location. Chi-square tests and independent t-tests were used for comparisons. Significance level was set at 0.05. Statistical analysis was performed using SPSS (IBM SPSS Statistics, Version 29).

3 | RESULTS

3.1 | Demographics

The main demographic information separated for each country is displayed in Table 1(a,b). Two countries were represented by sleep centres from more than one city (Belgium with Antwerp and Leuven; Greece with Athens, Crete, Thessaloniki). While the two centres of Belgium showed only marginal differences in overall scores and satisfaction change, the three Greek centres showed some significant

differences. Therefore, the Belgian and Greek centres were treated as separate country/city groups and not summarized to one overall country group. The entire sample of $n = 1546$ bed partner questionnaires recorded a mean patient age of 59.9 ± 11.5 years (min-max: 25–92 years), a mean length of relationship of 28.6 ± 14.0 years (min-max: 0.4–65.0 years), and a mean subjectively reported length of CPAP therapy of 4.6 ± 4.5 years (min-max: 0.1–30.0 years). Overall, 72.6% of the patients were male, and the most used mask model was nasal mask (55.2%) followed by full-face mask (31.4%). For most variables, only slight differences between sleep centres could be seen.

3.2 | European sample and general tendencies

The mask-related statements were answered on an agreement scale from 1 to 5, including a middle category of neither agreeing nor disagreeing. Overall, the statements were answered reflecting a positive opinion (answers 1 and 2) towards CPAP therapy (Figure 3). Especially regarding intimacy, most bed partners did not think that the partner looked bizarre with the mask (48%). Only few believed that their sex life improved (27%), but even less that it did not improve (20%). They

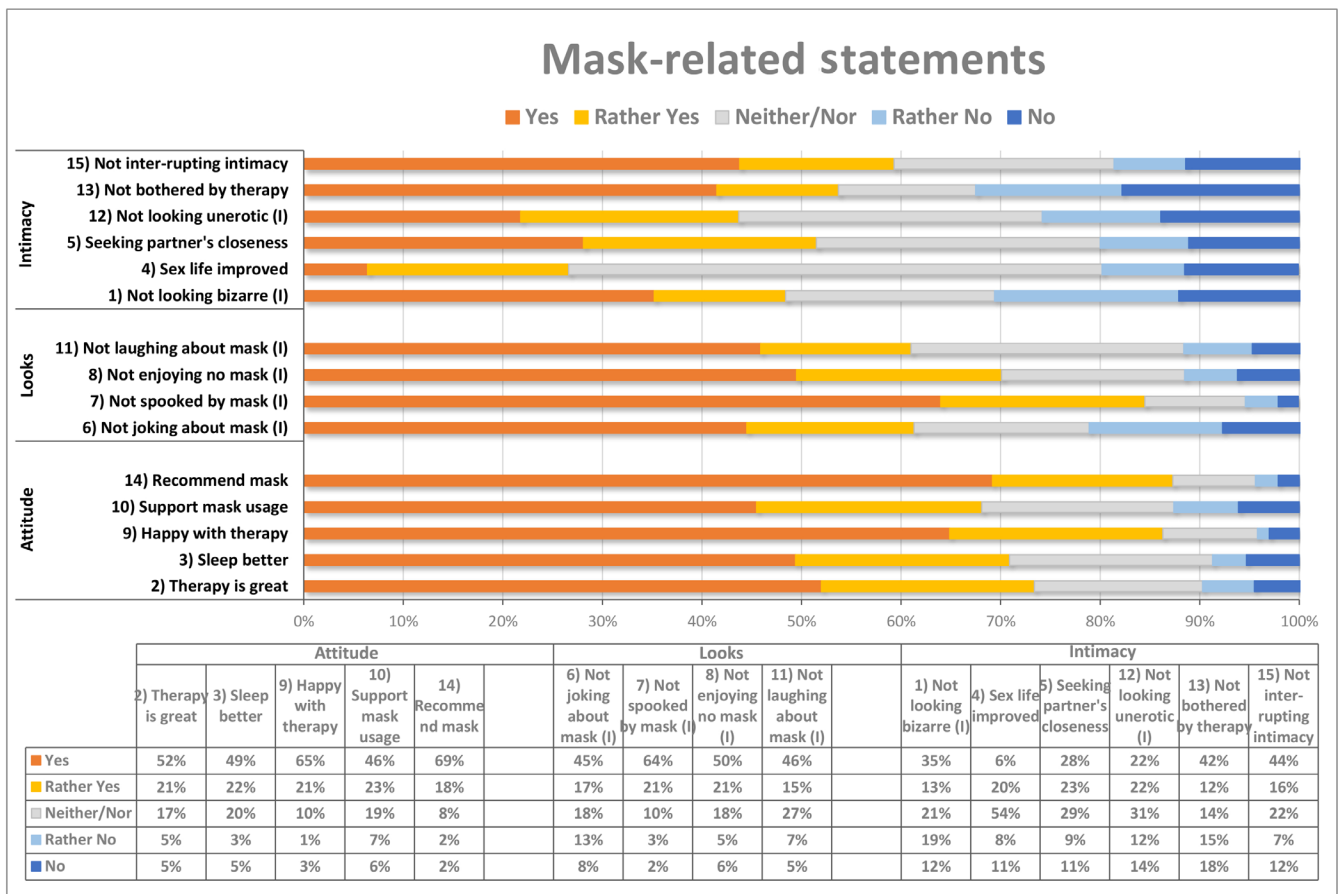


FIGURE 3 Bed partners' opinion towards the mask. I = Items 1, 6, 7, 8, 11 and 12 were inverted to represent a positive directed statement towards mask therapy. Factor Attitude includes items 2, 3, 9, 10, 14 of the mask-related statements. Factor Looks includes items 6, 7, 8 and 11. Factor Intimacy includes items 4, 5, 13 and 15, as well as the subcategory items 1 and 12.

believed it did not interrupt intimacy (59%) and they were still seeking their partner's closeness (52%). In general, they thought CPAP therapy was great (73%), were happy about it (86%), and were not bothered by it (54%). They stated that they indeed slept better while their partner wore the mask (71%). The bed partner supported their partner by looking after that they were wearing the mask (68%) and would recommend the mask therapy (87%).

The overall scores for the three factors Attitude, Looks and Intimacy revealed the following: 91% of bed partners had an overall positive attitude towards the mask therapy; 86% had a positive opinion towards the looks of the mask; and 64% of bed partners believed that the CPAP therapy did not have a negative impact on intimacy (with 31% stating the neither/nor middle category, and only 5% stating a negative effect on intimacy).

Questions about satisfaction with the relationship before and after the initiation of CPAP therapy showed a significant increase in satisfaction since wearing the mask ($p < 0.001$). For 41% of bed partners, the satisfaction increased after the start of CPAP therapy, for 47% there was no change, and only for 12% the satisfaction decreased.

3.3 | European sample and dependency analysis

We explored whether certain variables affected how CPAP therapy was perceived and influenced their relationship. We found a significant correlation between sleep quality (item 3) and daily mask usage ($r = -0.157$; $p < 0.001$), indicating an increased sleep quality with increased therapy mask usage. However, CPAP usage/adherence was reported subjectively and not evaluated objectively. It was not the focus of this study. Also, with increased sleep quality, bed partner's relationship satisfaction since CPAP therapy start increased ($r = 0.301$; $p < 0.001$). Relationship satisfaction also increased with increased length of CPAP therapy ($r = -0.07$, $p = 0.012$). There was a significant positive correlation between bed partner's support (item 10) and their perceived patient satisfaction with CPAP therapy ($r = 0.106$; $p < 0.001$).

There were several significant correlations between the subjectively reported length of CPAP therapy/length of relationship and the mask-related statements (Table 2). While the correlations were mostly below 0.2 and weak, they did indicate trends. The overall scores Attitude and Intimacy were correlated with length of CPAP therapy. This revealed a trend towards an increase in negative attitude and negative intimacy effects with increased therapy length (Attitude: $r = 0.075$; $p = 0.004$; Intimacy: $r = 0.117$; $p < 0.001$). However, the bed partner still did not seem bothered by the mask ($r = -0.08$, $p = 0.002$). Looks was only correlated with length of relationship, indicating a more positive perceived look the longer the relationship ($r = -0.133$; $p < 0.001$). While Attitude and Intimacy factors were not correlated with length of relationship, with increased relationship duration, the bed partner was happy with CPAP therapy ($r = -0.06$, $p = 0.013$) and supported device usage at night ($r = -0.07$, $p = 0.005$).

TABLE 2 Effects of length of relationship and length of CPAP therapy on bed partners' opinion towards mask.

	Length of relationship r (p)	Length of CPAP therapy r (p)
Overall attitude	n.s.	$r = 0.075$; $p = 0.004$
(2) Therapy is great	n.s.	$r = 0.101$; $p < 0.001$
(3) Sleep better	n.s.	n.s.
(9) Happy with therapy	$r = -0.064$; $p = 0.013$	n.s.
(10) Support mask usage	$r = -0.072$; $p = 0.005$	n.s.
(14) Recommend mask	n.s.	$r = -0.062$; $p = 0.017$
Overall looks	$r = -0.133$; $p < 0.001$	n.s.
(6) Not joking about mask (I)	$r = -0.126$; $p < 0.001$	n.s.
(7) Not spooked by mask (I)	$r = -0.109$; $p < 0.001$	n.s.
(8) Not enjoying no mask (I)	n.s.	$r = 0.078$; $p = 0.003$
(11) Not laughing about mask (I)	$r = -0.126$; $p < 0.001$	n.s.
Overall intimacy	n.s.	$r = 0.117$; $p < 0.001$
(1) Not looking bizarre (I)	$r = -0.111$; $p < 0.001$	$r = 0.073$; $p = 0.005$
(4) Sex life improved	$r = 0.119$; $p < 0.001$	$r = 0.155$; $p < 0.001$
(5) Seeking partner's closeness	n.s.	$r = 0.152$; $p < 0.001$
(12) Not looking unerotic (I)	n.s.	$r = 0.107$; $p < 0.001$
(13) Not bothered by therapy	n.s.	$r = -0.081$; $p = 0.002$
(15) Not interrupting intimacy	n.s.	$r = 0.081$; $p = 0.002$

Note: I = Item was inverted to reflect a positive directed statement towards mask therapy. Length of relationship and length of CPAP therapy were reported subjectively by the bed partner. A non-parametric correlation (Spearman's rho) was used with the ordinal dependent variable "mask-related statements" (five-point Likert scale answers from 1 = total agreement to 5 = total disagreement). Displayed are the two-tailed significance p -values and correlation coefficients r . Significance level was set at $p < 0.05$. A negative correlation means a higher agreement with the statement with increasing length of relationship/mask therapy. We refrained from correcting for multiple comparisons in order to identify as many significant correlations as possible as a base for further explorations. We acknowledge that some of these significant correlations may be false positives (Type I error).

Abbreviations: CPAP, continuous positive airway pressure.

3.4 | Geographical differences

We formed two groups based on geographical location and climate differences that were similar in size (inspired by Staats et al., 2021):

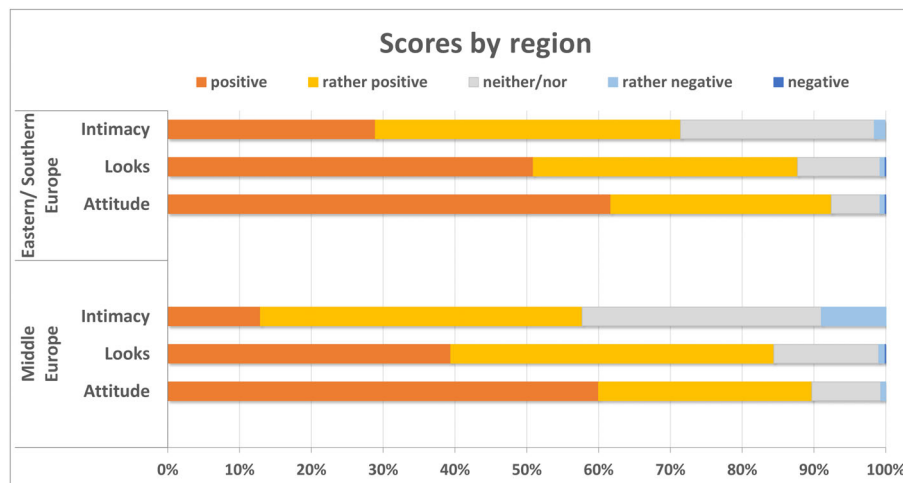


FIGURE 4 Regional differences regarding scores on the three factors Attitude, Looks and Intimacy. For each of the three factors Attitude, Looks, Intimacy, an overall score with the mean score of the corresponding single questionnaire items was computed. First, items 1, 6, 7, 8, 11 and 12 were inverted to represent a positive directed statement towards mask therapy. Then, for the factor Attitude, the average of items 2, 3, 9, 10, 14 was calculated, for the factor Looks the average of items 6, 7, 8 and 11, and for the factor Intimacy the average of items 1, 4, 5, 12, 13, 15.

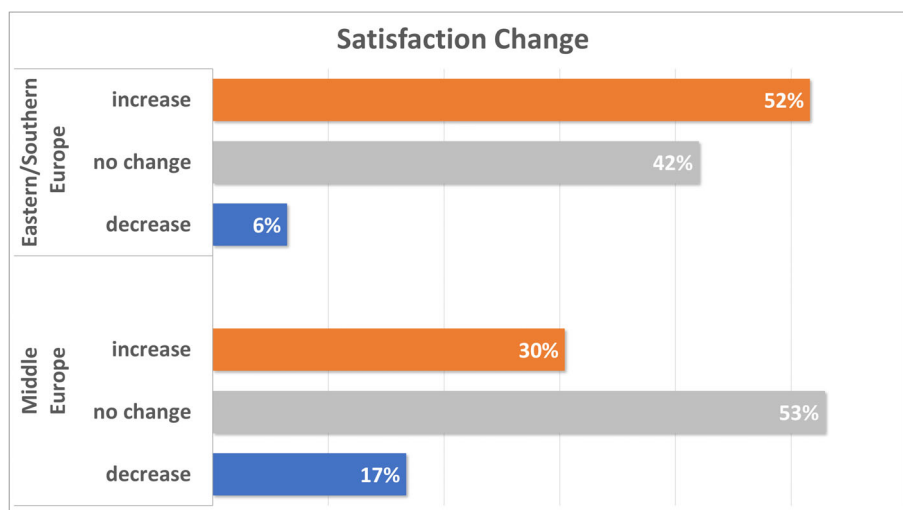


FIGURE 5 Regional differences regarding relationship satisfaction change since continuous positive airway pressure (CPAP) therapy start. Satisfaction change was computed by subtracting the satisfaction scores before mask therapy from the satisfaction scores since mask therapy, as lower scores indicate higher satisfaction agreement. Positive score differences were categorized as satisfaction increase, negative differences as a worsening satisfaction. A zero difference indicated no change.

- Middle Europe including Belgium/Antwerp, Belgium/Leuven, Czech Republic, France, Germany ($n = 723$, 48.9%);
- Eastern/Southern Europe including Greek/Athens, Greek/Crete, Greek/Thessaloniki, Italy, Romania, Turkey ($n = 755$, 51.1%).

While both groups were similar in size, there were some demographic differences. The Eastern/Southern Europe group had slightly more female patients (22% in Middle Europe versus 32% in Eastern/Southern Europe; chi-square: $p < 0.001$), and more participants that did not sleep in the same room as the patient (8% in Middle Europe versus 16% in Eastern/Southern Europe; chi-square: $p < 0.001$). While age of patient and length of relationship were similar in both groups, length of mask therapy was shorter for Eastern/Southern Europe (mean length: 5.6 years in Middle Europe versus 3.5 years in Eastern/Southern Europe; t -test: $p < 0.001$).

Figure 4 displays the questionnaire scores for the three factors Attitude, Looks and Intimacy by region. All factors scored similar and high for both groups, with Eastern/Southern Europe having slightly higher positive scores. Attitude did not show a significant difference. However, bed partner's support was significantly higher in the

Eastern/Southern Europe group (56% in Middle Europe versus 80% in Eastern/Southern Europe, chi-square: $p < 0.001$). The factors Looks (pos. score Middle Europe: 84% versus pos. score Eastern/Southern Europe: 88%; $p = 0.001$) and Intimacy (pos. score Middle Europe: 58% versus Eastern/Southern Europe 72%; $p < 0.001$) did show significant differences, especially pronounced for the Intimacy category.

The change of satisfaction with the relationship from before to after mask therapy initiation is displayed in Figure 5. The positive increase of satisfaction is significantly higher for the Eastern/Southern region ($p < 0.001$).

4 | DISCUSSION

This is the first international survey interviewing the bed partner of a patient with OSA regarding CPAP therapy and its effects on the relationship. The bed partner plays an important role in adherence of CPAP therapy and success, but is often dismissed during treatment education (Baron et al., 2020; Ye et al., 2015). For the survey, we used a German questionnaire that was validated with a German cohort and

now applied to a comprehensive European cohort (Fietze et al., 2023). In order to provide a secure space for the bed partner to answer honestly and reduce social biases, the questionnaire was completely anonymous. We were able to confirm the general tendencies of the validation cohort that the bed partner is supportive and that CPAP therapy does not negatively impact intimacy and rather has a positive effect on relationship satisfaction. Furthermore, we started to explore how increased length of CPAP therapy may change the bed partner's attitude towards the negative. We also revealed regional differences, with bed partners from warmer climate zones being even more supportive.

4.1 | Overall tendencies on an international level

4.1.1 | Bed partner's support and positive attitude

The very comprehensive and representative sample included 10 different European countries and over 1500 returned questionnaires. Overall, the statements were answered reflecting a positive opinion towards CPAP therapy. In general, over 90% of bed partners had a positive attitude. More specifically, almost 75% of bed partners believed that the therapy was great and only 10% did not. Importantly, most of the bed partners actively supported the usage of the mask and, therefore, CPAP adherence, and would recommend the therapy. These findings are important as previous research has shown that the bed partner plays an important role in treatment adherence, and lacking partner support is one of the barriers for CPAP adherence (Broström et al., 2010; Ye et al., 2015). Positive partner behaviour, spousal support, and encouragement indeed positively influence CPAP adherence and may increase mask usage (Baron et al., 2011; Baron et al., 2020; Baron et al., 2022; Hoy et al., 1999; Luyster et al., 2019; Smith et al., 2009). Already 3 days after CPAP initiation, long-term adherence may be predicted (Budhiraja et al., 2007). Therefore, early involvement of the bed partner from the initial patient's assessment throughout the disease course with close collaboration with the sleep physician may be crucial.

4.1.2 | Intimacy is not affected

In a previous study, possible negative effects on intimacy have been identified as a main barrier for CPAP adherence (Ye et al., 2017). However, our study was not in line with this as we showed that intimacy was not negatively affected, at least not from the point of view of the bed partner. Overall, over two-thirds of bed partners did not believe that CPAP therapy had a negative impact on intimacy, and only 5% stated a negative effect. When specifically asked, less than 20% believed that it did interrupt the intimacy, that they did not seek their partner's closeness anymore because of the mask and that the sex life did not improve. However, that does not necessarily mean it got worse. Moreover, satisfaction with the relationship increased since therapy start for almost half of the bed partners (only for 12% it

decreased, the remaining bed partners did not notice a change). This is especially important as previous research has shown that quality of marriage does influence CPAP adherence (Baron et al., 2009; Gentina et al., 2019; Mendelson et al., 2020). A French study investigated different couples and revealed that adherence was highest in older retired couples (Mendelson et al., 2020). Other studies have also shown that good CPAP adherence is related to a better intimate relationship with the bed partner possibly due to reduced daytime sleepiness (Lai et al., 2016).

4.2 | Sleep quality and dependency effects

4.2.1 | Bed partner's increased sleep quality

The majority of the bed partners noticed an improvement in their own sleep quality. We found that sleep quality of the bed partner and nightly CPAP mask usage and relationship satisfaction were related. While we cannot draw a causal conclusion, it may be suggested (and supported by previous studies) that increased use of the device accounted for a better sleep quality not only for the patient, but also for the bed partner, and therefore led to a greater relationship satisfaction (Lai et al., 2016). Sleep apnea is a form of sleep-disordered breathing that not only affects the patient but also the bed partner (Luyster, 2017). Its symptoms such as snoring can be highly disruptive for the partner's sleep and also their quality of life (Cartwright, 2008; Parish & Lyng, 2003). Research has shown that CPAP therapy can positively affect life and sleep quality not only of the patient, but also the bed partner (Doherty et al., 2003; Kiely & McNicholas, 1997; McArdle et al., 2001; Siccoli et al., 2008).

4.2.2 | Increased support with increased length of relationship

On average, the bed partners had a length of relationship of 29 years with a maximum of 65 years. We found that the longer the relationship, the less negative did the bed partner perceive the overall looks of the mask. However, relationship length did not seem to affect overall attitude or intimacy. Yet, there was an increase in support of therapy mask usage with increased relationship length. This is a very important finding, confirming the results of a recent study conducted in France that identified the role of quality of marriage on CPAP adherence, showing that adherence was highest in older retired couples (Gentina et al., 2019; Mendelson et al., 2020).

4.2.3 | Possible attitude change with increased CPAP therapy length

The length of CPAP therapy had an even stronger impact on overall attitude and intimacy. Here, the average length of therapy was about 5 years, with a maximum of 30 years. With increased length of

therapy, the bed partner's opinion seemed to change to a more negative attitude towards the therapy and its effect on intimacy. They admitted that they enjoyed it when the mask was not worn for a night. However, the effect was not very strong, and the bed partners did also state that they were not really bothered by the mask and were indeed more satisfied with the relationship the longer the therapy.

4.3 | Geographical differences

It is known that there are OSA symptom differences due to ethnicity and socioeconomic disparities in OSA treatment (Billings et al., 2011; Chen et al., 2015; Simon-Tuval et al., 2009). In certain chronic diseases, such as metabolic syndrome and stroke recurrence, it has been shown that geographic differences also play an important role (Gurka et al., 2018; Lanska & Kuller, 1995). OSA management in general is quite homogenous among European countries, but with certain differences, for example regarding more options of outpatient treatment in northern European countries (Fietze et al., 2011; Fietze et al., 2022). Yet, little is known about specific geographic variations in CPAP therapy and adherence. Dunietz and colleagues (2021) is one of the few studies that investigated regional differences, and suggested that there may be geographical disparities in CPAP treatment and adherence on the state and regional levels within the USA (Dunietz et al., 2021). Identifying regional gaps in treatment adherence or in our case, spousal support, is important to improve treatment strategies. Our survey allowed us to look at European-wide geographical and cultural differences. Loosely inspired by Staats and colleagues (2021), we divided the European countries by region and climate zones: the Middle European countries versus the more Eastern/Southern countries (Staats et al., 2021). Here, we found indeed that environmental differences and temperature may influence the attitude and behaviour of the bed partner towards CPAP therapy. The group with the countries that belonged to warmer climate zones (Eastern/Southern Europe) displayed an increase in positive attitude and support, positive perception of the looks of the mask, and lack of negative intimacy effects compared with the Middle Europe group. This was most pronounced for the effects on intimacy. Bed partners from more southern regions felt that the therapy affected the intimacy less negatively than bed partners from the more middle regions. The increase in relationship satisfaction was also more pronounced in the southern regions. Geographical differences have been seen to affect personality traits (Rentfrow et al., 2008; Schmitt et al., 2007); however, it is not completely known how exactly. However, climate and temperature are strong indicators (Wei et al., 2017). Milder climates have been shown to lead to a more positive mood and a higher helping behaviour (Cunningham, 1979). Social behaviour, in general the role of family and possible support, may be more pronounced in southern countries with a milder climate. A recent study investigated two culturally very distinct countries, China and USA. They concluded that climate and temperature do affect individuals. Those who grew up in warmer climates were more agreeable, conscientious and emotionally stable, factors that account for socialization and stability

(Wei et al., 2017). It would be interesting to further explore differences including race, ethnicity and culture to find a more detailed explanation for the variation in bed partner attitude, support and satisfaction.

4.4 | Limitation

A major difficulty of the study was the ongoing COVID-19 restrictions. Some sleep centres had to close down temporarily, and data collection was difficult (Grote et al., 2020). We do not know whether the pandemic situation had a negative impact on the bed partner's attitude and relationship satisfaction. However, the main results of the entire sample are in line with the results of the German validation sample of 10 years ago (Fietze et al., 2023). Also, while we investigated the effects of length of relationship and CPAP therapy, these two factors were intercorrelated. This may only be due to the large sample size as a scatter plot revealed no linear association. The dependency analyses were considered explorative to provide a first look into possible long-term tendencies for further exploration. Therefore, the intention was to find as many significant correlations as possible and not correcting for Type I error. Further research needs to consider that some correlations may be false positives. In our study, the bed partner replied to nightly mask usage with an almost perfect adherence and a median of 7 nights per week, which prevented us from further analysis of these data. Future studies in this area may want to include a comparison between compliant and non-compliant patients. Also noteworthy, this study was a questionnaire study, meaning that the answers are purely subjective and prone to possible biases such as social expectancies. However, during questionnaire development, those typical issues were considered by, for example, inverting certain items (Fietze et al., 2023). While the original questionnaire was in German, for this study we had to translate the questionnaire into English and the local country's language. This was done under the strict requirements of professional translation. While some topics were highly sensitive (e.g. intimacy questions), a major strength of this study included the independent and completely anonymous questioning of the bed partners. We believe that the anonymity provided a safe space for the bed partners to respond honestly. Another unique strength of the study included the opportunity to explore regional differences. While OSA management has become more and more homogenous among European countries, there are some regional differences between northern, southern, western or eastern European countries (Fietze et al., 2011; Fietze et al., 2022). Future research may want to include those countries. There is also potential for further investigation, including differences due to gender, race and ethnicity (O'Connor et al., 2003).

5 | CONCLUSION

We confirmed that bed partners have in general a positive and supportive attitude towards CPAP therapy, and that therapy effects on intimacy are not a barrier to CPAP adherence. Also, bed partner's own

sleep quality and relationship satisfaction increased. This is more pronounced in countries with warmer climate zones (Eastern/Southern Europe). Support in nighttime mask usage even increased with relationship length. However, we also noticed a slight trend towards a more negative attitude and negative intimacy effects with increased length of therapy that may need to be explored in more detail. Results may increase awareness of the necessity of partner support and the effects of CPAP therapy for both partner and patient. The results can help to improve treatment strategies by including couple-focused educational programs and support, which subsequently may enhance treatment adherence, sleep quality and relationship satisfaction. This may inspire future research on a broader international scope beyond Europe, and research including spousal support for non-CPAP therapies such as mandibular advancement device, surgery or hypoglossal nerve stimulation.

AUTHOR CONTRIBUTIONS

Naima Laharnar: Conceptualization; investigation; writing – original draft; methodology; validation; visualization; writing – review and editing; formal analysis; project administration; supervision; data curation. **Sebastien Bailly:** Conceptualization; writing – review and editing; data curation. **Ozen K. Basoglu:** Data curation; writing – review and editing; conceptualization. **Jitka Buskova:** Conceptualization; writing – review and editing; data curation. **Marta Drummond:** Conceptualization; writing – review and editing; data curation. **Francesco Fanfulla:** Conceptualization; writing – review and editing; data curation. **Stefan Mihaicuta:** Conceptualization; writing – review and editing; data curation. **Athanasia Pataka:** Conceptualization; writing – review and editing; data curation. **Renata L. Riha:** Conceptualization; writing – review and editing; data curation. **Izolda Bouloukaki:** Conceptualization; writing – review and editing; data curation. **Dries Testelmans:** Conceptualization; writing – review and editing; data curation. **Georgia Trakada:** Conceptualization; writing – review and editing; data curation. **Johan Verbraecken:** Conceptualization; writing – review and editing; data curation. **Sandra Zimmermann:** Conceptualization; methodology; validation; writing – review and editing; investigation. **Thomas Penzel:** Conceptualization; investigation; writing – review and editing; validation; supervision; resources. **Ingo Fietze:** Conceptualization; investigation; validation; writing – review and editing; supervision; resources.

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CONFLICT OF INTEREST STATEMENT

The authors declare no conflict of interest.

DATA AVAILABILITY STATEMENT

The data that support the findings of this study are available from the corresponding author upon reasonable request.

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SUPPORTING INFORMATION

Additional supporting information can be found online in the Supporting Information section at the end of this article.

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