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Original Article

Effect of speech therapy as adjunct treatment to continuous positive airway pressure on the quality of life of patients with obstructive sleep apnea

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ABSTRACT

Background: Patients with obstructive sleep apnea (OSA) exhibit reduced quality of life (QoL) due to their daytime symptoms that restricted their social activities. The available data for QoL after treatment with continuous positive airway pressure (CPAP) are inconclusive, and few studies have assessed QoL after treatment with speech therapy or other methods that increase the tonus of the upper airway muscles or with a combination of these therapies. The aim of our study was to assess the effect of speech therapy alone or combined with CPAP on QoL in patients with OSA using three different questionnaires.
Methods: Men with OSA were randomly allocated to four treatment groups: placebo, 24 patients had sham speech therapy; speech therapy, 27 patients had speech therapy; CPAP, 27 patients had treatment with CPAP; and combination, 22 patients had treatment with CPAP and speech therapy. All patients were treated for 3 months. Participants were assessed before and after treatment and after 3 weeks of a washout period using QoL questionnaires (Functional Outcomes of Sleep Questionnaire [FOSQ], World Health Organization Quality of Life [WHOQoL-Bref], and Medical Outcomes Study 36-Item Short-Form Health Survey [SF-36]). Additional testing measures included an excessive sleepiness scale (Epworth sleepiness scale [ESS]), polysomnography (PSG), and speech therapy assessment.
Results: A total of 100 men aged 48.1 ± 11.2 (mean ± standard deviation) years had a body mass index (BMI) of 27.4 ± 4.9 kg/m^2, an ESS score of 12.7 ± 3.0, and apnea–hypopnea index (AHI) of 30.9 ± 20.6. After treatment, speech therapy and combination groups showed improvement in the physical domain score of the WHOQoL-Bref and in the functional capacity domain score of the SF-36.
Conclusions: Our results suggest that speech therapy alone as well as in association with CPAP might be an alternative treatment for the improvement of QoL in patients with OSA.

1. Introduction

Patients with obstructive sleep apnea (OSA) exhibit reduced quality of life (QoL) due to daytime symptoms such as excessive sleepiness, irritability, decreased concentration and memory, reduced energy, erectile dysfunction, depressive symptoms, and an association with cardiovascular and metabolic diseases that restrict their social activities [1,2].

The two types of instruments used to assess QoL are generic and specific questionnaires. The generic instruments are used to assess QoL as a whole in different types of diseases, whereas the specific questionnaires were developed and validated to measure the effects of treatment in patients with OSA. Generic questionnaires include the Medical Outcomes Study 36-Item Short-Form Health Survey (SF-36) [3], Nottingham Health Profile [4], Sickness Impact Profile [5], Functional Limitations Profile (FLP) [6], EuroQol [7], Munich-Life-Quality Dimension List [8], and World Health Organization Quality of Life Assessment (WHOQoL-Bref) [9]. Specific questionnaires include the Calgary Sleep Apnea Quality of Life Index [10], Functional Outcomes of Sleep Questionnaire (FOSQ) [11,12], Obstructive Sleep Apnea Patient-Oriented Severity Index [13], Quebec Sleep Questionnaire [14], among others. These questionnaires assess several features of QoL, including the physical, mental, environmental, and social domains, which are remarkably limited in the patients with OSA [2].

Although previous studies have assessed QoL after OSA treatment with continuous positive airway pressure (CPAP), the results are inconclusive. Some authors showed positive outcomes and others reported no changes [15–19]. Few studies have assessed QoL after other modalities of OSA treatment, such as the use of intraoral

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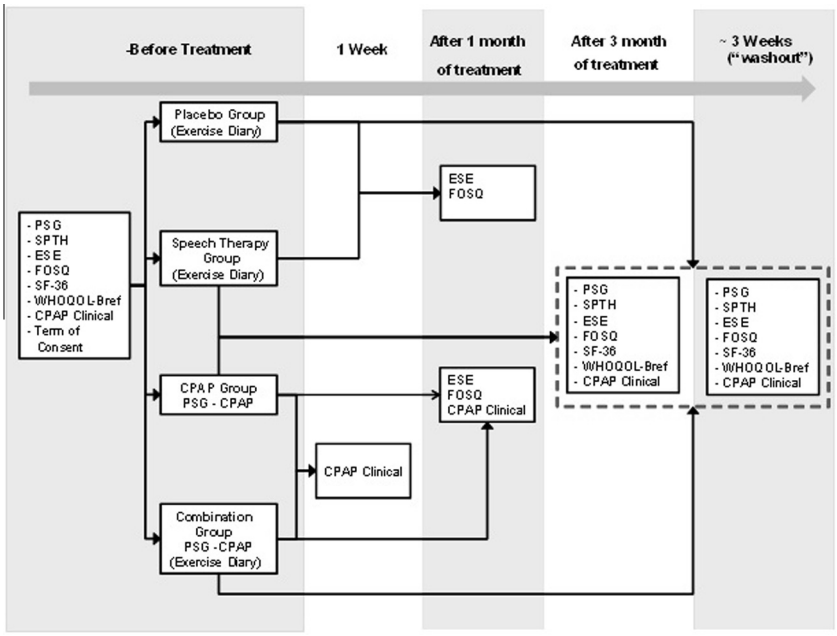

Fig. 1. Experimental design of the study. *Abbreviations:* PSG, polysomnography; SPTH, speech therapy assessment; ESS, Epworth sleepiness scale; FOSQ, Functional Outcomes of Sleep Questionnaire; SF-36, Medical Outcomes Study 36-Item Short-Form Survey; WHOQoL-Bref, World Health Organization Quality of Life assessment; CPAP, continuous positive airway pressure; PSG-CPAP, polysomnography to adjust CPAP pressure.

appliances [20], surgery [21,22], speech therapy [23], or combinations of these therapies as well as other methods that increase the tonus of the upper airway muscles [24].

Therefore, the aim of our study was to assess the effect of speech therapy alone and combined with CPAP on the QoL of patients with OSA using three different questionnaires.

2. Methods

2.1. Participants

Consecutive patients observed at the sleep outpatient clinic of the Universidade Federal de São Paulo, Brazil, who were diagnosed with OSA based on clinical and polysomnographic criteria independently of severity (American Academy of Sleep Medicine, 2005) [25] were included. The inclusion criteria were men between the ages of 25 to 65 years and body mass index (BMI) <35 kg/m^2. Nonconsenting individuals and patients with a lower level of educational attainment were excluded, as the questionnaires could not be administered or the instructions could not be understood. Additional exclusion criteria were presence of other sleep disorders; previous treatment for OSA, such as CPAP, intraoral appliances, or surgery; severe or decompensated clinical or psychiatric diseases; use of alcohol, stimulants, or sedatives; craniofacial or upper airway anatomic alterations; grade III or IV palatine tonsils; grade II or III septal deviation; and evident micrognathia.

The study was approved by the research ethics committee of the Universidade Federal de São Paulo (Comitê de Ética em Pesquisa-CEP 2002/08) and was registered at ClinicalTrials.gov (NCT01289405). The participants read and signed an informed consent form.

2.2. Protocol

All of the participants were initially evaluated by a physical examination of the upper airway and the facial skeleton, which defined their inclusion in the study. The assessment included a general physical examination, inspection of the facial skeleton and mouth, and anterior rhinoscopy according to previously suggested procedures [26].

After inclusion in the study, the participants were randomly allocated into four groups: placebo, patients receiving sham speech therapy; speech therapy, patients treated with speech therapy; CPAP, patients treated with CPAP without speech or sham therapy; and combination, patients treated with CPAP and speech therapy.

As shown in Fig. 1, patients were asked to complete several procedures before treatment, including questionnaire administration; a physical examination, which involved the measurement of the neck circumference, the weight, and the height of the participant; a speech therapy assessment; and polysomnography (PSG). The CPAP and combination groups underwent a second PSG to adjust the therapeutic pressure before and after treatment. The patients were treated for 3 months. All of the groups answered the specific questionnaires one week and one month after the onset of treatment. Three months after the onset of treatment and after

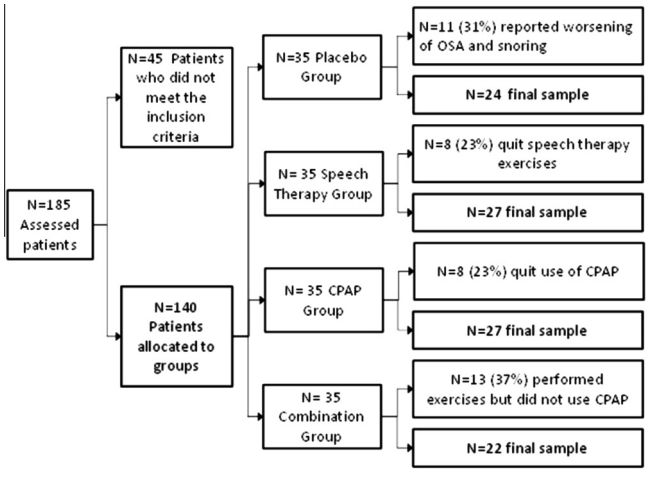

Fig. 2. Flowchart of patient selection and loss during the study. *Abbreviations:* OSA, obstructive sleep apnea; CPAP, continuous positive airway pressure.

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Table 1
Anthropometric and clinical data for the placebo, speech therapy, continuous positive airway pressure, and combination groups before treatment, after treatment, and after washout period. The data are expressed as the mean ± standard deviation.

Parameters	Placebo group (n = 24)			Speech therapy group (n = 27)			CPAP group (n = 27)			Combination group (n = 22)			P value
	Before	After	Washout	Before	After	Washout	Before	After	Washout	Before	After	Washout	
Age (years)	42.9 ± 10.5	43.4 ± 10.4	43.4 ± 10.4	45.2 ± 13.0	45.5 ± 13.0	45.6 ± 13.0	46.4 ± 9.1	46.8 ± 9.2	46.9 ± 9.1	47.5 ± 10.9	48.0 ± 10.8	48.1 ± 9.1	.33
Circ. (cm)	41.9 ± 3.7	41.9 ± 3.6	42.9 ± 3.7	41.6 ± 3.7	41.5 ± 2.3	41.9 ± 2.5	41.9 ± 3.9	41.9 ± 3.7	41.5 ± 3.4	42.4 ± 2.8	41.8 ± 3.5	41.7 ± 3.5	.78
BMI (kg/m^2)	28.6 ± 4.0	28.3 ± 3.9	29.0 ± 4.0	25.0 ± 7.4	26.7 ± 2.9	26.9 ± 2.9	28.7 ± 3.3	29.5 ± 3.2	27.4 ± 6.9	27.9 ± 2.4	28.3 ± 2.6	28.2 ± 2.8	.27
ESS	12.8 ± 3.1	12.2 ± 5.2	10.5 ± 5.1	13.7 ± 3.2	7.5 ± 3.7[a,d]	10.4 ± 4.3[c]	12.0 ± 2.1	7.2 ± 3.6[a,e]	8.8 ± 4.4[b]	12.0 ± 2.6	7.3 ± 5.7[a,f]	9.5 ± 6.3	<.001

Abbreviations: CPAP, continuous positive airway pressure; Circ., neck circumference; BMI, body mass index; ESS, Epworth sleepiness scale.
Repeated-measures analysis of variance with Tukey posteriori. The results were controlled for the effect of the apnea–hypopnea index.
[a] Before vs after, $P < 0.001$.
[b] Before vs washout, $P < 0.02$.
[c] After vs washout, $P < 0.01$.
[d] Placebo (after) vs speech therapy (after), $P \leqslant 0.04$.
[e] Placebo (after) vs continuous positive airway pressure (after), $P < .04$.
[f] Placebo (after) vs combination (after), $P < .02$.

approximately 3 months of washout (after the end of treatment), all of the participants underwent the same procedures.

2.3. Subjective assessment

The Epworth sleepiness scale (ESS) was used to measure excessive daytime sleepiness. Participants were rated as sleepy when they scored a 10 or higher on the ESS [27].

The FOSQ, WHOQoL-Bref, and SF-36 questionnaires were used to measure QoL. The FOSQ was specifically designed for individuals with sleep disorders [11]. The WHOQoL-Bref assesses four QoL domains, including physical, psychologic, social, and environmental [9]. The SF-36 is a multidimensional questionnaire that comprises 36 items corresponding to eight domains, including functional capacity, physical health, pain, general health, vitality, social functioning, emotional concerns, and mental health as well as one additional question comparing the participants' current state of health to that of the previous year [28].

2.4. Physical examination

The neck circumference, height, and weight of the participants were measured, and their BMI (weight [kg]/height^2 [m^2]) was calculated.

2.5. Speech therapy assessment

The speech therapy assessment was performed according to the protocols established in the literature [29–32] and included an investigation of the orofacial structures, lips, tongue, cheeks, chin, mandible, pharynx, soft palate, and teeth, in addition to the orofacial functions of mastication, deglutition, and respiration.

2.6. Polysomnography

A full-night PSG was performed at the sleep laboratory using a digital system (EMBLA® S7000, Embla Systems, Inc., Broomfield,

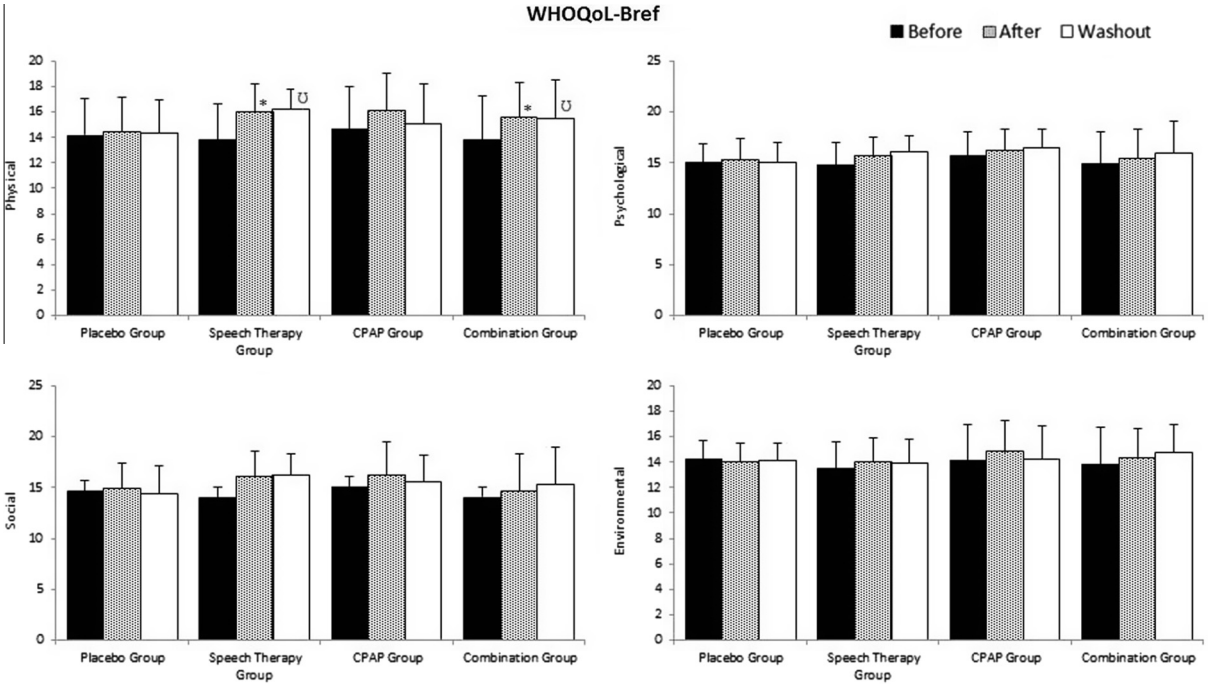

Fig. 3. Quality of life assessment before and after 3 months of treatment assessed using the World Health Organization Quality of Life assessment in the placebo, speech therapy, continuous positive airway pressure, and combination groups before treatment, after treatment, and after washout period. The data are expressed as the mean ± standard deviation.*Before vs after, $P < .001$; ∪ Before vs washout, $P < .001$.

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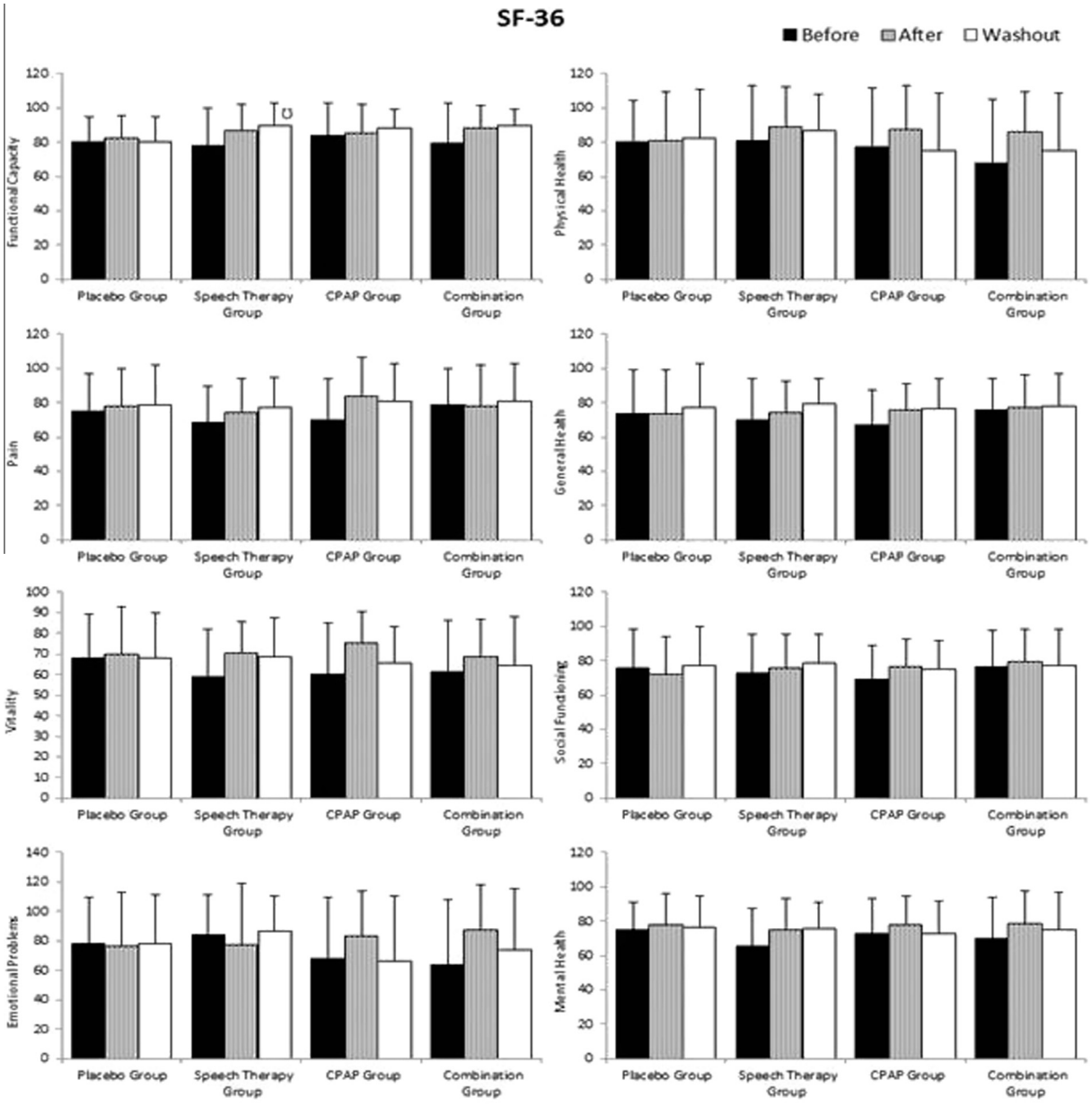

Fig. 4. Quality of life assessment before and after 3 months of treatment assessed using the Medical Outcomes Study 36-Item Short-Form Survey in the placebo, speech therapy, continuous positive airway pressure, and combination groups before treatment, after treatment, and after washout period. The data are expressed as the mean ± standard deviation. υ Before vs washout, $P < .001$.

CO, USA). The following parameters were monitored simultaneously: electroencephalogram (C3–A2, C4–A1, O1–A2 and O2–A1), electrooculogram (left and right), electromyogram (chin and anterior tibial muscles), electrocardiogram, airflow (nasal cannula connected to pressure transducer and oronasal thermistor), chest and abdomen respiratory effort (inductance plethysmography), oxyhemoglobin saturation (SpO_2), snoring, and body position.

Sleep scoring was performed following the criteria suggested by Rechtschtaffen and Kales [33], and the arousals were measured according to the criteria of the American Sleep Disorders Association [34]. The respiratory events were analyzed according to the criteria suggested by the American Academy of Sleep Medicine [35]. The severity of OSA was established (mild, apnea–hypopnea index [AHI] 5–15/h; moderate, AHI 15–30/h; and severe, AHI >30/h).

2.7. Placebo and speech therapy

Sham therapy consisted of performing head movements without any therapeutic function, such as relaxing and elongating the cervical muscles. Speech therapy included exercises of localized muscle resistance to strengthen the tonus of the muscles in the oropharyngeal area. The exercises were performed to optimize the tension and mobility of the muscles, adjust the position of the soft tissues (soft palate, pharyngeal constrictor muscles, suprahyoid muscles, tip and root of the tongue, cheeks, and lips), and to improve the orofacial functions of mastication, suction, deglutition, and breathing [23,31,32,36–43].

Sham and speech therapy were administered over 3 months. The participants performed three series of exercises every day at their homes, which lasted 20 minutes each, and maintained an exercise diary on a daily basis. The participants were prescribed a new series

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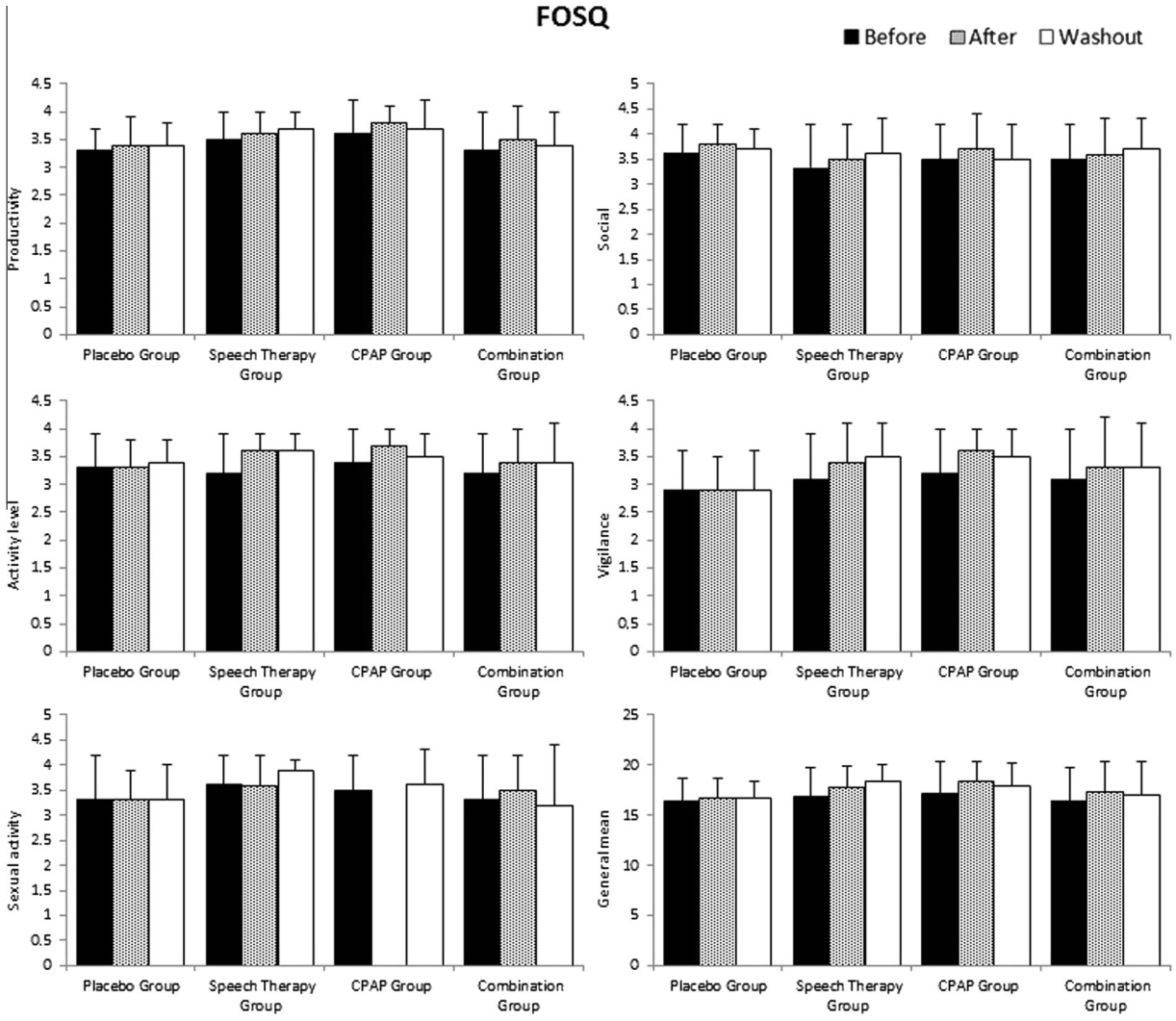

Fig. 5. Quality of life assessment before and after 3 months of treatment assessed using the Functional Outcomes of Sleep Questionnaire in the placebo, speech therapy, continuous positive airway pressure, and combination groups before treatment, after treatment, and after washout. The data are expressed as the mean ± standard deviation.

of speech therapy exercises every week and completed new exercise diaries. Adherence to Sham and speech therapy was assessed by weekly diary.

2.8. Treatment with CPAP

All of the participants in the CPAP and combination groups had an additional PSG to adjust the optimal positive airway pressure before and after treatment. Participants received a CPAP device (REMstar® Plus; Respironics Inc., Murrysville, PA) with a nasal mask but without a humidifier. Adherence to CPAP treatment was objectively assessed by a coupled pressure hour meter. Participants completed an educational program on OSA and CPAP use, which comprised three visits (first week, first month, and third month) and was supervised by the trained staff of the CPAP Service of the Sleep Institute/Associação Fundo de Incentivo à Pesquisa. CPAP questionnaire follow-ups were used to assess the health state and sleep habits of the participants and to follow-up on the use and side effects.

2.9. Statistical analysis

Statistical analyses were performed using SPSS 18.0 and Statistica (version 7.0; StatSoft, Inc., Tulsa, USA). Normality was assessed using the Kolmogorov–Smirnov test. The data are presented as the mean and the standard deviation. The results that did not exhibit normal distribution were standardized using a z score.

Comparisons of the demographic, PSG, and questionnaire (WHOQoL-Bref, FOSQ, SF-36) data among the groups were performed using a repeated-measures general linear model and an analysis of variance with a posteriori Tukey honestly significant difference test when appropriate. The results of the comparisons were controlled for the effect of the AHI at baseline.

A paired-samples t test (Student t test) was used to compare the values of CPAP pressure indicated by pre- and posttreatment PSG, and the average CPAP duration was used for the CPAP and combination groups. The level of significance was set at .05.

3. Results

3.1. Case series and baseline data

A total of 185 patients with OSA were assessed and 45 did not meet the inclusion criteria at the initial assessment. An additional 40 patients dropped out during the study for the reasons indicated in Fig. 2. A total of 100 patients completed the study and

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Table 2
Polysomnographic data for the placebo, speech therapy, continuous positive airway pressure, and combination groups before treatment, after treatment, and after washout period. The data are expressed as the mean ± standard deviation.

	Placebo group (n = 24)			Speech therapy group (n = 27)			CPAP group (n = 27)			Combination group (n = 22)			P value
	Before	After	Washout	Before	After	Washout	Before	After	Washout	Before	After	Washout	
AHI	27.8 ± 20.3	30.6 ± 21.8	27.8 ± 15.0	28.0 ± 22.7	13.9 ± 18.5[a,d]	21.3 ± 21.4	34.4 ± 22.4	4.3 ± 4.0 [a,e]	29.7 ± 25.4[c]	30.4 ± 19.8	3.4 ± 2.7 [a,f]	29.6 ± 25.1[c]	<.001
AI	24.9 ± 13.6	26.7 ± 16.6	22.6 ± 11.1	26.3 ± 18.7	21.3 ± 15.6	23.4 ± 16.9	28.2 ± 14.9	11.8 ± 5.6 [a,e]	28.4 ± 20.5[c]	27.7 ± 15.5	11.7 ± 5.3 [a,f]	28.0 ± 21.2[c]	<.001
SpO_2 min (%)	82.6 ± 6.3	82.8 ± 6.2	82.9 ± 7.0	83.7 ± 7.7	84.9 ± 8.8	83.0 ± 8.0	80.4 ± 6.8	90.2 ± 3.6[a]	81.8 ± 6.7[c]	80.5 ± 11.0	89.3 ± 4.1[a]	81.2 ± 8.3[c]	<.001

Abbreviations: CPAP, continuous positive airway pressure; AHI, apnea–hypopnea index per sleep hour; AI, arousal index per sleep hour; SpO_2 min, minimal saturation of oxyhemoglobin.
Repeated-measures analysis of variance with Tukey posteriori. The results were controlled for the effect of the apnea–hypopnea index.
[a] Before vs after, $P < 0.001$.
[b] Before vs washout, $P < 0.02$.
[c] After vs washout, $P < 0.01$.
[d] Placebo (after) vs speech therapy (after), $P \leqslant 0.04$.
[e] Placebo (after) vs continuous positive airway pressure (after), $P < .04$.
[f] Placebo (after) vs combination (after), $P < .02$.

included 24 patients in the placebo group, 27 in the speech therapy group, 27 in the CPAP group, and 22 in the combination group. Forty-two percent of the patients had severe OSA (AHI >30), 32% had moderate OSA (AHI, 15–30), and 26% had mild OSA (AHI, 5–15).

3.2. Demographic data and EES

The final sample included 100 men aged 48.1 ± 11.2 years (mean ± standard deviation), BMI of 27.4 ± 4.9 kg/m^2, ESS score of 12.7 ± 5.0, and AHI of 30.9 ± 20.6. The patients who did not complete the study were similar to those who comprised the final sample except for their age, which was lower for the participants who dropped out (48.1 ± 11.2 years vs 39.4 ± 10.1 years, respectively; $P < .001$).

The four groups did not significantly differ in age, neck circumference, or BMI (Table 1). The speech therapy, CPAP, and combination groups demonstrated improved ESS scores after treatment ($P < .001$) compared to the placebo group ($P = .04$; $P < .04$; $P < .04$, respectively). Subjective sleepiness did not vary after the washout period in the CPAP and combination groups. However, the ESS score decreased in the speech therapy group.

3.3. QoL questionnaires

The analysis of the QoL data showed significant improvement in the physical domain of the WHOQoL-Bref (Fig. 3) in the speech therapy and combination groups after treatment ($P < .05$) and washout ($P < .03$) compared to the pretreatment assessment. The functional capacity domain of the SF-36 (Fig. 4) improved in the speech therapy group ($P < .03$). QoL did not significantly change in the FOSQ (Fig. 5) in any of the four assessed groups at any of the three assessment end points.

3.4. Results of PSG

The objective assessment of sleep using PSG showed similarity among the groups before treatment. After treatment the AHI, minimum SpO_2, and arousal index improved in the CPAP ($P < .04$, $P < .02$, and $P < .04$, respectively) and combination ($P < .02$, $P < .02$, and $P < .02$, respectively) groups compared to the pretreatment assessment. Compared to the placebo group, the CPAP and combination groups exhibited reduced AHI and arousal index scores ($P < .04$ and $P < .02$, respectively). The speech therapy group had a significantly reduced AHI compared to the placebo group ($P < .001$) (Table 2).

3.5. Hours of CPAP use

After 3 months of CPAP use, the patients in the combination group exhibited a longer duration of use (5.1 ± 2.3 h) compared to the CPAP group (3.6 ± 1.8 h) ($P = .02$).

4. Discussion

Our results show that speech therapy, particularly when combined with CPAP, can improve some QoL domains in patients with OSA. In patients with OSA, excessive daytime sleepiness, obesity, sleep fragmentation, and hypoxemia may cause of the reduction of QoL [2]. Compared to healthy individuals, patients with OSA are less likely to engage in social activity and have fewer feelings of well-being in addition to greater physical and emotional limitations [44].

The two types of instruments used to assess QoL are generic and specific questionnaires. The studies published in the literature disagree on the capacity of the generic and specific instruments to assess QoL in patients with OSA, and thus both types are used in clinical practice [45]. Among the generic questionnaires used to assess QoL in patients with OSA, the SF-36 is the most frequently administered [45]. A multicenter study that assessed QoL using the SF-36 showed that patients with OSA exhibited the worst scores across all domains compared to normal individuals. The largest differences were observed in the domains of physical health, vitality, functional capacity, and mental health ($P < .001$), and although significant, the smallest difference was identified in the pain domain when compared to individuals with primary snoring. The objective parameters of OSA (hypoxemia, AHI, sleep fragmentation, and arousals) appeared to exert a small effect only on the domains related to physical functioning, whereas obesity and daytime sleepiness contributed more significantly to the limitations in all SF-36 domains [44]. The vitality domain of the SF-36 is the most sensitive domain for identifying the complaints of patients with OSA [46].

In addition to the generic SF-36 questionnaire, two other questionnaires (FOSQ and Calgary) are widely used in the assessment of QoL in patients with OSA and frequently reflect the reduction of QoL [45]. The FOSQ successfully discriminates between the reduction of QoL in individuals with OSA and those in healthy individuals, as it includes specific domains such as vigilance (ability to stay awake) [45]. Because no published normal values are available for the FOSQ, Antic et al. [47] applied a cutoff point of 17.9 or higher, as described by Weaver et al. [17]. In the study by Antic et al. [47], only 35% of the patients who complied with treatment exhibited normal scores on the FOSQ after 3 months of treatment with CPAP.

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Our study showed that, as a whole, some QoL domains similarly improved after treatment with speech therapy alone or combined with CPAP. However, CPAP alone did not have any effect on QoL. There is no consensus in the literature on the effect of CPAP on the QoL of patients with OSA. Some studies found positive results [10,11,48–53], but others were unable to find any significant alteration compared to the pretreatment assessment [47,54–60]. Although our results point to a greater therapeutic effect of CPAP on the reduction of the AHI compared to speech therapy, the QoL only improved with speech therapy, regardless of its association with CPAP. It is possible that speech therapy combined with CPAP induced better compliance with the use of the device and consequently improved patient QoL. The opposite also can take place; for example, speech therapy could have improved QoL thereby increasing compliance with CPAP. Some studies have identified that self-efficacy and outcome expectancies are critical factors to determine CPAP adherence [61,62].

Some studies have shown that the therapeutic effect of CPAP was better in the vitality domain of the SF-36 [46,47,51]. The improved sleep quality resulting from CPAP may bestow more vitality and an ability to participate in normal activities, hence improving QoL [17]. However, our study did not find such results. We demonstrated improvement in the functional capacity domain on the assessment performed at the washout end point in the speech therapy group and no change in the CPAP alone or combination groups.

Regarding the improvement of QoL measured by the FOSQ, Weaver et al. [17] showed a strong correlation between the efficacy of CPAP and the duration of use. The authors suggested that long periods of CPAP use (>7 h) are associated with the greatest improvement in QoL as assessed by the FOSQ. In our study, the patients in the combination group exhibited a longer duration of CPAP use compared to the CPAP group. After 3 months of use the average durations of CPAP use in the combination and CPAP groups were 5.1 ± 2.3 hours and 3.6 ± 1.8 hours, respectively. This finding may explain the lack of alterations in the FOSQ scores, because the duration of CPAP use was shorter than that reported by the previously described study [17]. Moreover, Sawyer et al. [62] observed that the improvement of QoL in patients with OSA treated with CPAP depends on the number of hours the device is used per night.

Our results show that 3 months of speech therapy exercises significantly improved some QoL domains in patients with OSA compared to the placebo and CPAP groups, regardless of associated CPAP use. According to Guimarães et al. [23], exercises focusing on the oropharyngeal area reduce the collapsibility of the upper airway muscles, improve the repositioning of the tongue during sleep, and improve sleep quality in patients with moderate OSA. In the randomized controlled study conducted by Randerath et al. [63], 67 patients were treated with intraoral electric neurostimulation for 20 minutes twice weekly for 8 weeks. Their treatment regimen increased the FOSQ scores. Another study that used upper airway training with a didgeridoo over 4 months did not find a difference in the SF-36 between the treated groups and the placebo group [64].

The improvement in QoL exhibited by the combination group in our study may have resulted from better CPAP adherence compared to the CPAP group after 3 months of treatment. Therefore, we may consider that the additional healthcare education provided by speech therapy resulted in better adherence to CPAP because the follow-up was similar in both groups. For example, all patients of both groups had three visits to our institution (first wk, first month, and third month) and were supervised by the trained staff of our CPAP service. This increase in adherence in our study was observed as early as the first week of treatment with CPAP combined with a series of exercises specific for the treatment of OSA. This finding is in agreement with the recommendations of the literature to improve the adherence to and the use of CPAP, particularly during the first 15 days of treatment, as it impacts long-term use [16].

In conclusion, our study showed that a 3-month training period using an exercise program for the oropharyngeal muscles alone and in association with CPAP in patients with OSA resulted in QoL improvement compared to CPAP treatment. Therefore, speech therapy in patients with OSA should be considered as an alternative and secondary treatment to improve QoL.

Conflict of interest

The ICMJE Uniform Disclosure Form for Potential Conflicts of Interest associated with this article can be viewed by clicking on the following link: http://dx.doi.org/10.1016/j.sleep.2013.03.016.

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