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Review Article

Acupuncture for Adult Obstructive Sleep Apnea or Obstructive Sleep Apnea-Hypopnea Syndrome: A Review of the China National Knowledge Infrastructure Database

Hye Kyung Baek [1,*], Young Jun Kim [1], Yeon Sun Lee [1], Hye Ri Jo [1], Mi So Park [2], Dong Guk Shin [3], Hyun A Shim [3]

1 Department of Acupuncture and Moxibustion Medicine, Bucheon Jaseng Korean Medicine Hospital, Bucheon, Korea
2 Department of Oriental Internal Medicine, Bucheon Jaseng Korean Medicine Hospital, Bucheon, Korea
3 Department of Oriental Neuropsychiatry Medicine, Bucheon Jaseng Korean Medicine Hospital, Bucheon, Korea

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ABSTRACT

The purpose of this study was to analyze acupuncture treatment methods and acupoints used to treat obstructive sleep apnea (OSA) or obstructive sleep apnea-hypoapnea syndrome (OSAHS). The data were retrieved from January 2010 to May 2022 from the China National Knowledge Infrastructure database. The search terms included "adult," "obstructive sleep apnea," "obstructive sleep apnea hypoapnea syndrome," "acupuncture," and "electro-acupuncture." Clinical trials for acupuncture treatment of OSA or OSAHS were included in this review (4 non-randomized controlled studies, 1 was a case report, and 10 randomized controlled studies). For OSA and OSAHS treatment, the acupoints that were most frequently used included REN23, LU7, ST40, EX9, LI11, and DU20. Compared with the control or Western treatment group, the treatment outcome measures of participants in the acupuncture treatment group significantly improved. In some studies, participants in the acupuncture group did not have side effects and the treatment was cost-effective. The data analyzed in this review suggest that acupuncture is an effective treatment for OSA or OSAHS.

Introduction

Obstructive sleep apnea (OSA) is a sleep-related breathing disorder wherein frequent arousal and a decrease in arterial oxygen saturation occur repeatedly during sleep due to the obstruction of airflow through the upper respiratory tract [1]. Untreated OSA can cause various complications including increased risk of surgery, hypertension, heart failure, stroke, coronary artery disease, arrhythmia, pulmonary hypertension, diabetes, and erectile dysfunction [2]. Furthermore, OSA-induced complications can contribute to the deterioration of the quality of life (QOL) of each individual [3].

Current OSA treatments include the use of the continuous positive airway pressure (CPAP) machine, an oral appliance, surgery, and other adjuvant treatments (weight control, posture therapy). Among the treatments, CPAP is the most representative treatment for OSA [4] and involves the use of a machine that is specifically designed to maintain constant air-flow pressure in the upper airways to prevent the airway from collapsing or narrowing [1]. CPAP can improve sleep quality, cognitive function, daytime sleepiness, health-related QOL (for mild OSA), and mood as well as decrease blood pressure, however, in patients with severe

***Corresponding author.** Hye Kyung Baek
Department of Acupuncture and Moxibustion Medicine, Bucheon Jaseng Korean Medicine Hospital, Sangdong 414, Wonmi-gu, Bucheon, Korea
E-mail: rosy1105@naver.com
ORCID: Hye Kyung Baek https://orcid.org/0000-0002-2128-8192, Young Jun Kim https://orcid.org/0000-0001-5193-9307,
Yeon Sun Lee https://orcid.org/0000-0002-7815-0936, Hye Ri Jo https://orcid.org/0000-0003-4735-2874, Mi So Park https://orcid.org/0000-0002-3111-2828,
Dong Guk Shin https://orcid.org/0000-0003-4949-6257, Hyun A Shim https://orcid.org/0000-0002-0597-2138

or moderate OSA, no significant improvement in the QOL was observed [1].

Herbal medicine and acupuncture treatment of OSA has been reported in Korea, although this was a case report and so the nature of the report limits its relevance in treatment effectiveness of CPAP [5].

In China, OSA is classified into the "snoring" and "snoring while sleeping" categories, and the main etiologies are pulmonary, splenic, or renal dysfunction, or a condition/disease that is caused due to Three Intestine dysfunction [6]. In addition, the cause of OSA is attributed to the poor spread of qi as well as impaired pulmonary, splenic, and renal function. Moreover, when a condition/disease reaches the throat where the lung, spleen, and kidney meridian veins are situated, it leads to "clogging" of the throat and prevents smooth passage of air [6]. Based on this hypothesis of the pathology underlying OSA, various research studies evaluating either Chinese medicine alone or an integration of Chinese and Western medicine are ongoing in China. This review presents analysis of data from the latest clinical studies on OSA in China retrieved from the China National Knowledge Infrastructure (CNKI) database. This review was undertaken with an aim to provide basic data for future domestic OSA treatment and clinical research and to contribute to the evidence based for Oriental treatment of OSA.

Materials and Methods

To investigate the clinical efficacy of traditional Chinese medicine for OSA or obstructive sleep apnea-hypopnea syndrome (OSAHS), the CNKI database was searched for clinical trials published from 2010 to 2022. The following keywords in English were used: "Obstructive Sleep Apnea," "Obstructive Sleep Apnea Hypopnea Syndrome," "acupuncture," and "electroacupuncture."

Results

Data selection

A total of 26 studies were retrieved from the CNKI database (Table 1 [6-20]) . Of these, 4 studies included pediatric patients (≤

Table 1. Clinical Studies on Obstructive Sleep Apnea or Obstructive Sleep Apnea Hypopnea Syndrome.

1st Author [ref] (y)	Study title	Journal
Sun [9] (2022)	Clinical study on needle knife acupuncture and acupuncture combined with continuous positive airway pressure ventilation in the treatment of obstructive sleep apnea hypopnea syndrome	Guiding Journal of Traditional Chinese Medicine and Pharmacy
Shen [6] (2022)	Effect of electro-acupuncture on sleep quality and inflammatory response in patients with mild obstructive sleep apnea hypopnea syndrome	Guangming Journal of Chinese Medicine
Zhou [10] (2021)	Observations on the efficacy of acupuncture for obstructive sleep apnea-hypopnea syndrome	Shanghai Journal of Acupuncture and Moxibustion
Zhao [11] (2020)	Clinical observation of Yiqi Huatan Anshen prescription combined with acupuncture in treating severe obstructive sleep apnea hypopnea syndrome with anxiety	China's Naturopathy
Liang [12] (2020)	Clinical research of function of using acupuncture adjusting obstructive sleep apnea-hypopnea syndrome patients' sleeping respiration	Liaoning Journal of Traditional Chinese Medicine
Lu [13] (2020)	Effect of the acupuncture on the patients with obstructive sleep apnea hypopnea syndrome combined with hypertension	Journal of Hainan Medical University
Zhang [14] (2019)	Clinical efficacy observation on treatment of obstructive sleep apnea syndrome complicated with essential hypertension with acupuncture combined with medicine	Hebei Journal of Traditional Chinese Medicine
Zheng [7] (2018)	Protective effect of Chinese medicine combined with acupuncture on obstructive sleep apnea hypopnea syndrome: a randomized controlled study	Modern Medicine Journal of China
Zhu [15] (2018)	Clinical observation of acupuncture-moxibustion plus rehabilitation for post-stroke obstructive sleep apnea coupled with deglutition disorders	Shanghai Journal of Acupuncture and Moxibustion
Li [16] (2017)	Clinical observation of obstructive sleep apnea hypopnea syndrome treated by consciousness-restoring and orifices-opening acupuncture	Henan Traditional Chinese Medicine
Cui [17] (2015)	Effect of acupuncture therapy on ambulatory blood pressure in patients with obstructive sleep apnea syndrome	Liaoning Journal of Traditional Chinese Medicine
Wang [8] (2015)	Therapeutic observation of acupuncture for acute cerebral infarction coupled with obstructive sleep apnea-hypopnea syndrome	Shanghai Journal of Acupuncture and Moxibustion
Song [18] (2015)	Curative observation of the electro-acupuncture and nasal continuous positive airway pressure on patients with obstructive sleep apnea hypoventilation syndrome	Journal of Emergency in Traditional Chinese Medicine
Zhou [19] (2012)	Effect of acupuncture and moxibustion on changes of IFN-γ and IL-4 serum levels in obstructive sleep apnea syndrome patients	Journal of Liaoning University of Traditional Chinese Medicine
Ye [20] (2010)	Study of acupuncture on stroke combined with obstructive sleep apnea syndrome	Modern Journal of Integrated Traditional Chinese and Western Medicine

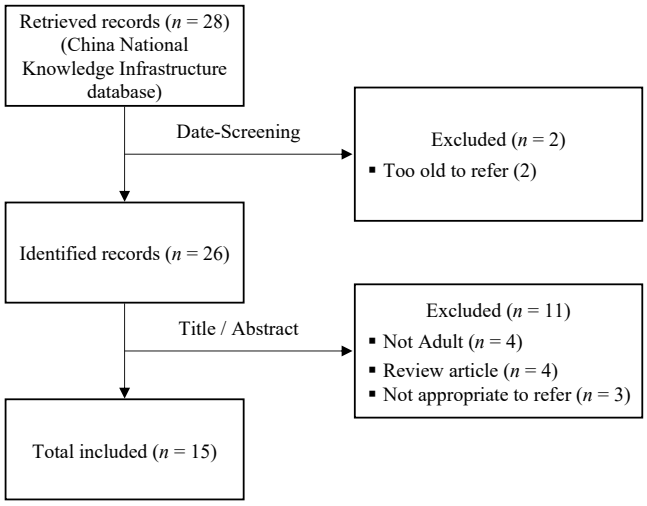

Fig. 1. Flowchart of study selection in this review.

Table 2. Number of Studies by Publication Year Intervals.

Publication period	*N* (%)
2010–2015	5 (34)
2016–2020	7 (46)
2021–2022	3 (20)

15 years), 4 were reviews and meta-analyses, and 3 were unrelated to OSA. Therefore, 15 studies were included in the analysis (Fig. 1).

Publication year

Analysis by the year of publication showed that, from January 2010 to May 2022, 5 studies were published between 2010 and 2015, 7 between 2016 and 2020, and 3 between 2021 and 2022 (Table 2).

Characteristics of 15 studies included in the analysis

Among the 15 studies, 4 reported findings from non-randomized controlled studies, 1 was a case report, and 10 reported outcomes from randomized controlled trials (Table 3 [6–20]).

Discussion

OSA constitutes a recurrent obstruction of the upper airway during sleep, and the resultant increased resistance induces snoring, intermittent hypoxia, and hypercapnia. Moreover, sleep cycles are impaired by frequent arousal. These physiological changes during sleep induce an increase in the production of reactive oxygen species and systemic inflammation due to repeated hypoxia-reoxygenation. OSA is related to the amount of abdominal fat, and the prevalence of OSA is reported to be high not only in the West, but also in Korea where there has been an increase in the proportion of the obese individuals due to westernized eating habits and lifestyle [21]. A study of the prevalence of sleep apnea in adults aged 40 to 69 years showed that the prevalence of mild obstructive sleep apnea was 27% in men and 16% in women in Korea [22].

Polysomnography is an objective test to study sleep and is used to accurately diagnose and evaluate sleep disorders. This test includes measurement of the patients' brain waves, eye movements, electromyography of the lower extremities and jaws, electrocardiograms, chest and abdominal breathing movements, blood oxygen saturation, and respiratory flow are recorded mainly during sleep and then analyzed. Snoring, sleep apnea, insomnia, narcolepsy, and periodic limb movements are identified in polysomnography, which is useful for diagnosing abnormal behavior during sleep as well as for diagnosing the therapeutic effect.

In the majority of studies included in this review, OSA was diagnosed using polysomnography. In particular, the apnea-hypopnea index (AHI), which is used as an evaluation index in most studies, is an index for evaluating the severity of OSA and represents the sum of sleep apnea and hypopnea that is divided by the total sleep time. Thus, an AHI of < 15, 15 to < 30, and ≥ 30 indicates mild, moderate, and severe sleep apnea, respectively.

In this study, to determine the effects of acupuncture on OSA and OSAHS the results of a literature review of 15 studies published from 2010 to May 2022 were assessed. The analysis showed that acupuncture or electroacupuncture had a significant effect on OSA and OSAHS. Although most of the studies described acupuncture treatment for OSA or OSAHS, conditions/diseases such as depression and stroke that may be caused by, or accompany OSA or OSAHS, were also investigated. Therefore, the acupoints used for these other conditions/diseases differ slightly, depending on the characteristics of the diagnosed condition/disease (Table 4). With regard to the improvement of OSA, common acupoints could be ascertained (Table 5 [6–20]). In particular, REN23 was used in 11 of the 15 studies and was the most frequently used acupoint (Table 5 [6–20]). REN23 is located in the larynx, which is the intersection of the yin and yin you veins, and the branches of the sublingual and glossopharyngeal nerves are located under the acupoint [7]. Thus, by directly stimulating the sublingual and glossopharyngeal nerves, the pressure on the lumen of the throat can be reduced and this would keep the pressure constant in the throat and strengthen the muscles [8].

The second most frequently used acupuncture point was LU7, which comprises the pulmonary meridian, eight extra meridians, and yin meridian, and harmonizes the pulmonary qi that reaches the throat [8]. In addition, ST40 was relevant in the context that one of the causes of OSA is wetness, and ST40 was used to remove moisture and phlegm [7].

Shen et al [6] conducted a study on patients with mild OSHAS, and the AHI, $LSaO_2$, and LAT levels were higher in the group that was treated with electroacupuncture as compared with the control group which received noninvasive positive pressure ventilation ($p < 0.05$). Furthermore, levels of IL-6, nuclear transcription factor-kB, and tumor necrosis factor-α were lower in the treatment group compared with the control group and this suppressed the inflammatory response ($p < 0.05$) (Table 6 [6–20]).

Table 3. General Characteristics of the Studies Included in the Review.

First author [ref] (y)	Study type	Sample size (T:C)	General characteristics			
			Sex		Age (y), mean (SD)	Treatment period (d)
			Male	Female		
Sun [9] (2022)	RCT	T: 30	24	6	45.77 ± 7.82	90
		C: 30	23	7	44.40 ± 1.69	
Shen [6] (2022)	RCT	T: 50	28	22	47.46 ± 3.01	30
		C: 50	26	24	47.03 ± 3.17	
Zhou [10] (2021)	RCT	T: 34	27	7	47 ± 13	30
		C: 35	26	9	46 ± 11	
Zhao [11] (2020)	RCT	T: 36	21	15	51.5 ± 3.7	30
		C: 36	22	14	50.5 ± 3.5	
Liang [12] (2020)	RCT	T: 30 C: 30	Not reported		51.00 ± 9.05 49.44 ± 9.52	90
Lu [13] (2020)	nRCT	T: 32	17	15	68.41 ± 4.57	14
		C: 34	18	16	67.38 ± 4.48	
Zhang [14] (2019)	RCT	T: 41	35	6	56.3 ± 11.3	10
		C: 41	34	7	55.0 ± 11.8	
Zheng [7] (2018)	RCT	T1: 19 T2: 19 T3: 18	46	14	56.54 ± 14.98	20
Zhu [15] (2018)	RCT	T: 40	17	23	63 ±11	30
		C: 40	21	19	64 ± 10	
Li [16] (2017)	RCT	T: 50	29	21	50.7 ± 3.5	30
		C: 50	27	23	51.2 ± 3.3	
Cui [17] (2015)	nRCT	T: 26 C: 37	46	17	54.8	30
Wang [8] (2015)	RCT	T: 63	35	28	64 ± 13	30
		C: 63	35	28	63 ± 14	
Song [18] (2015)	nRCT	T: 36	24	12	53.17 ± 10.20	42
		C: 34	23	11	52.71 ± 11.26	
Zhou [19] (2012)	nRCT	T: 20	20		Not reported	30
		C: 20	20			
Ye [20] (2010)	CS	21	17	4	60.83 ± 2.02	30

C, control group; RCT, randomized controlled trial; T, treatment group.

Table 4. Top 6 Acupoints Used for Treating OSA.

Frequency	Acupoint
11	REN23
6	LU7
5	ST40, EX9
4	LI11, DU20

OSA, obstructive sleep apnea.

Zheng et al [7] compared patients with obstructive sleep apnea hypopnea treated with simple herbal medicine, simple acupuncture, or a combination of herbal medicine and acupuncture. The authors determined that the AHI, snoring index, minimum oxygen saturation, sleep stage, and ESS score was significantly higher in the group that received acupuncture and herbal medicine compared with the other treatments ($p < 0.05$). In particular, an improvement in deep sleep (Stage 3% + Stage 4%) and rapid eye movement

Table 5. Results of the Selected Studies That Were Included in This Review.

First author [ref] (y)	Group	Evaluation of treatment
Sun [9] (2022)	A: CPAP + needle knife acupuncture + acupuncture B: CPAP	1. A (93.33%), B (76.67%)
Shen [6] (2022)	A: noninvasive positive pressure ventilation therapy + electro-acupuncture B: noninvasive positive pressure ventilation therapy	1. A (92.00%), B (76.00%)
Zhou [10] (2021)	A: acupuncture B: none	1. A (82.4%), B (22.9%)
Zhao [11] (2020)	A: CPAP + acupuncture + HM (Yiqi Huatan Anshen prescription) B: CPAP	2. A (5.22 ± 1.06), B (6.65 ± 1.13) 3. A (97.75 ± 6.36), B (94.10 ± 6.8) 4. HAMA A (15.66±3.45), B (17.86±3.52)
Liang [12] (2020)	A: acupuncture B: nCPAP	1. A (96.66%), B (93.33%)
Lu [13] (2020)	A: acupuncture + GBE + CPAP B: GBE + CPAP	1. A (90.62%), B (61.76%)
Zhang [14] (2019)	A: WM + acupuncture + HM (Huatan Tongqi decoction) B: WM	1. A (95.12%), B (80.49%)
Zheng [7] (2018)	A: HM B: acupuncture B-1: HM + acupuncture	2. A (16.32 ± 6.10), B (17.61 ± 9.76), B-1 (11.18 ± 6.53) 3. A (86.21 ± 4.94), B (85.68 ± 5.87), B-1 (89.78 ± 3.84) 4. Stage 3 % + Stage 4 % A (49.43 ± 16.30), B (48.76 ± 11.07), B-1 (59.13 ± 12.87) REM % A (11.07 ± 8.56), B (10.10 ± 7.39), B-1 (7.59 ± 5.28) ESS A (9.89 ± 2.47), B (8.26 ± 2.66), B-1 (7.56 ± 3.26)
Zhu [15] (2018)	A: acupuncture-moxibustion + oropharyngeal rehabilitation and routine neurological treatment B: oropharyngeal rehabilitation and routine neurological treatment	1. A (92.5%), B (75.0%)
Li [16] (2017)	A: acupuncture (Xing Nao Kai Qiao Needling Technique) + CPAP B: CPAP	1. A (88.0%), B (70.0%)
Cui [17] (2015)	A: hypertension B: OSAHS alone	4. DSBP (mmHg) A (144.1 ± 10.51), B (109.4 ± 8.0) NSBP (mmHg) A (132.5 ± 10.5), B (98.4 ± 8.1) DDBP (mmHg) A (86.0 ± 7.1), B (71.1 ± 5.8) NDBP (mmHg) A (78.9±7.5), B (59.3±5.6)
Wang [8] (2015)	A: acupuncture + conventional comprehensive treatment B: conventional comprehensive treatment	1. A (93.7%), B (82.5%)
Song [18] (2015)	A: electro-acupuncture + nCPAP B: nCPAP	2. A (8.65 ± 3.31), B (19.42 ± 7.06) 3. A (92.98 ± 10.01), B (83.17 ± 9.13) 4. Maximum duration of apnea A (12.93 ± 3.41), B (18.81 ± 4.49) PP (mmHg) A (40.55 ± 6.66), B (47.24 ± 3.87) SAS score A (44.97 ± 1.53), B (51.63 ± 1,67) ESS score A (2.93 ± 1.52), B (7.63 ± 1.61) SDS score A (50.08 ± 3.71), B (53.60 ± 2.68)
Zhou [19] (2012)	A: OSAS B: normal	4. IFN-γ (ng/L) A (2352.03 ± 435.87), B (2008.03 ± 491.30) IL-4 (pg/mL) A (177.81 ± 22.62), B (200.62 ± 24.31)
Ye [20] (2010)	Acupuncture	2. 26.87 ± 3.63 3. 56.62 ± 5.15 4. ESS (5.10 ± 0.69)

* A: Treatment group.
† B, B-1: Control group.
‡ 1. Clinical efficacy, 2. Sleep apnea-hypopnea index (AHI), 3. Saturation of partial pressure oxygen [SpO_2 (%)], 4. Others.
CPAP, continuous positive airway pressure; DSBP, daytime systolic blood pressure; DDBP, daytime diastolic blood pressure; ESS, Epworth sleepiness scale; GBE, Gingko biloba extract; HAMA, Hamilton anxiety scale; HM, herbal medicine; IFN-γ, interferon gamma; IL-4, interleukin-4; NSBP, nocturnal systolic blood pressure; NDBP, nocturnal diastolic blood pressure; OSA, obstructive sleep apnea; PP, pulse pressure; REM%, rapid eye movement; SAS score, self-rating anxiety score; SDS score, self-rating depression score; Stage 3% + Stage 4%, deep sleep stage; WM, Western medicine.

Table 6. List of Acupoints Used.

First author [ref] (y)	Acupoint
Sun [9] (2022)	EX-HN9
Shen [6] (2022)	DU20, GB20, EX11, EX3, LI20, LI4
Zhou [10] (2021)	EX11, LI20, Bang-REN23, EX-HN22, LU7, KD3, SP3
Zhao [11] (2020)	LI11, ST25, SP9, ST40, LV3
Liang [12] (2020)	EX-HN21, DU16, DU15, LU7, KD6, ST36, ST40
Lu [13] (2020)	LI11, LV3, ST9, REN23
Zhang [14] (2019)	REN23, ST9, REN17, REN6, SP6, ST36, LU7, KD6, LI4, DU20, DU16, DU26
Zheng [7] (2018)	REN23, Bang-REN23, EX-9, ST40, SP9, LI11, ST44
Zhu [15] (2018)	DU15, GB20, REN22, REN23, LI4
Li [16] (2017)	PC6, EX11, SP6, EX9, REN23, GB20, LU7, ST40, KD6
Cui [17] (2015)	ST9, REN23, REN22, LI11, LV3
Wang [8] (2015)	DU20, EX9, REN23, GB20, REN22, LU7, KD6, SP9, KD3
Song [18] (2015)	EX-HN22, EX9, HT7, ST36, SP6, KD6
Zhou [19] (2012)	EX-HN21, DU20, DU15, GB20, SJ17, EX9, LU7, HT7, ST40, KD6
Ye [20] (2010)	REN23

was observed ($p < 0.05$ for both). In the case of herbal medicine, samnyeongbaekchulsan gamma was used, because most of the OSAHS patients were obese and the practitioner chose to improve symptoms by treating splenic weakness and excess moisture. In addition, both SP9 and ST40 were selected in the same context; therefore, these acupoints can be used in the patient group with OSA caused by splenic weakness and excessive wetness (Table 6 [6-20]).

Wang [8] observed that OSAHS showed a better improvement when acupuncture along with Western therapy was applied to patients with acute cerebral infarction accompanied by OSAHS, compared with the control group which was Western therapy such as thrombolytic drug administration. The AHI and SaO_2 improved more when acupuncture was combined with other treatments compared with the control group ($p < 0.05$). The acupoints used were DU20, EX9, REN23, GB20, REN22, LU7, KD6, SP9, and KD3, and scalp acupuncture was performed in parallel with the scalp motor and sensory areas. In the case of upper limb paralysis, LI15, LI11, LI10, SJ5, and LI4 were included, whereas in case of lower limb paralysis, GB30, ST41, GB34, GB39, and UB60 were added. In this study, treatment was carried out by adding or subtracting different acupoints to the stasis according to the injured part of the patients who had cerebral infarction. It can be deduced that the acupoints used in the case of patients who have paralysis in other parts of the body are meaningful in the improvement of OSAHS (Table 6 [6-20]).

Sun et al [9] reported the AHI, snoring index, longest apnea time (LAT), nocturnal hypoxic saturation ($LSaO_2$), serum interleukin (IL-33), serum interleukin-37 (IL-37), and QOL in the treatment group compared with the control group, and determined that the AHI, snoring indices, LAT, IL-33, and IL-37 levels in the treatment group receiving acupuncture and CPAP treatment were lower than the control group ($p < 0.05$), and the SF-36 score was higher ($p < 0.05$). Thus, compared with the simple CPAP treatment group, when acupuncture treatment and needle knife acupuncture are combined with CPAP, the sleep-related evaluation index was higher, the inflammation index of the patient was lower, and the QOL was better. Furthermore, a method of stabbing the patient's lymph follicles, the lateral side of the pharynx, and tonsils with a needle by using the needle-knife acupuncture was used. This method reportedly lowered the pressure in the throat and was effective. Therefore, the application of this acupuncture method is recommended. In the case of EX-HN9, the acupuncture used treats nasal congestion and itching by clearing lung heat, removing hematomas, and clearing the meridians, and constitutes a basis for the use of this acupoint for treating OSA as well as nasopharyngeal conditions/diseases such as rhinitis and nasal congestion (Table 6 [6-20]).

Zhou et al [10] compared the AHI, SaO_2, and the Epworth Sleepiness Scale (ESS) score. Unlike in the control group which did not receive treatment, other than health education, the treatment group received health education, acupuncture and electroacupuncture, and the AHI, SaO_2, and all ESS scores were significantly better than the control group ($p < 0.05$). However, in the control group, the ESS score improved through health education ($p < 0.05$), thereby indicating that health education alone can help improve OSA (Table 6 [6-20]).

Zhao [11] investigated the treatment of severe OSA accompanied by anxiety and hypoventilation syndrome, and the control group received intelligent CPAP. Moreover, in the treatment

group, acupuncture and Yiqi Huatan Anshen prescription were administered. The results showed that the AHI and the Hamiltonian Anxiety Scale score in the treatment group decreased from the pretreatment level, and the oxygen saturation SpO_2 improved compared with the baseline ($p < 0.05$). In the case of OSAHS patients, the quality of nocturnal sleep deteriorates, which disturbs the sleep cycles, and induces anxiety by causing abnormal activity of noradrenergic or serotonergic neurons. In Oriental medicine, the heart and spleen should be taken care of, because the restless mind and dystrophy are the cause of conditions/diseases. In the case of OSAHS patients with anxiety, a prescription was used to calm the nerves by soothing the qi and releasing phlegm (Table 6 [6–20]).

Liang et al [12] conducted a study with a control group that received nasal continuous positive airway pressure (nCPAP) therapy and a treatment group that received acupuncture, and both groups showed improvement after 3 months of treatment ($p < 0.05$). However, the treatment group showed a superior treatment effect ($p < 0.05$). The items evaluated included the AHI, Snoring Scale, ESS, Pittsburgh Sleep Quality Index, and World Health Organization Quality of Life Scale. In particular, the study showed that acupuncture was superior to nCPAP for OSA and hypopnea in terms of stability and economic feasibility of acupuncture. nCPAP increased intrathoracic pressure and caused symptoms such as chest tightness and chest muscle discomfort and, in severe cases, caused lung pressure–induced trauma (Table 6 [6–20]).

Lulu et al [13] investigated the effect of acupuncture on the improvement of sleep apnea and reduction of blood pressure in patients with OSA accompanied by hypertension. In the control group, gingko biloba extract and CPAP were administered, whereas in the treatment group acupuncture was added to these two treatments. As a result, the respiratory index was better than the control, blood pressure was lower, and the oxidizing substances, including reactive oxygen species and malondialdehyde, were lower after treatment compared with the control ($p < 0.05$). In addition, the antioxidants superoxide dismutase and glutathione peroxidase were higher after the treatment compared with the control ($p < 0.05$). Although the study period was rather short (14 days), there was treatment for 6 days per week for 2 weeks; suggesting that short term intensive treatment is meaningful in OSAHS treatment (Table 6 [6–20]).

Zhang et al [14] reported that in the treatment of OSA accompanied by essential hypertension, the AHI and ESS scores were lower than the control and the $LSaO_2$ were higher than the control ($p < 0.05$) in patients who received Huatan Tongqi decoction and acupuncture as compared with control patients who received Western medicine treatment. In addition, the mean day and night systolic and diastolic blood pressure decreased in both the control and the treatment groups compared with baseline values, although the treatment group showed greater improvement ($p < 0.05$). This study was meaningful in the improvement of essential hypertension, sleep disturbance, and respiration, although this study was limited because the treatment period was (10 days) (Table 6 [6–20]).

Zhu et al [15] conducted a study on patients suffering from poststroke OSA and dysphagia. The control group received oropharyngeal rehabilitation training and routine neurological treatment and in addition, the treatment group had acupuncture and moxibustion. The results on polysomnography and symptoms of dysphagia improved in the treatment group compared with the control group ($p < 0.05$). In stroke patients, the use of a general-purpose CPAP is limited, so this result may serve as a good basis for applying acupuncture (Table 6 [6–20]).

Li et al [16] showed that in patients with OSAHS, compared with the control group treated with nCPAP alone, the polysomnography test results were better than the control group when the Xing Nao Kai Qiao needling technique was used which employs PC6, EX11, and SP6 as the main acupoints ($p < 0.05$). Moreover, CRP, IL-6, and tumor necrosis factor-α values, which indicate inflammation, showed more improvement compared with the control ($p < 0.05$) (Table 6 [6–20]).

A study by Cui et al [17] involved a comparison of patients with OSA with and without hypertension, and showed that the patient group with OSA and hypertension had significantly reduced ambulatory blood pressure during acupuncture treatment compared with patients with OSA ($p < 0.05$). OSA is an independent risk factor for hypertension, and in the case of severe hypertension due to lack of appropriate treatment, the ST9, REN23, REN22, LI11, and LV3 acupoints were used to produce a blood pressure–lowering effect (Table 6 [6–20]).

Song et al [18] reported that the AHI, $LSaO_2$, LAT, the pulse pressure, self-rating anxiety score, self-rating depression score, and Epworth sleepiness scale score improved more in the group treated with electroacupuncture and nCPAP compared with the control group treated with nCPAP alone ($p < 0.05$) (Table 6 [6–20]).

Zhou et al [19] studied the changes in serum interferon (IFN)-γ and IL-4 between the normal group and the OSAHS group. In the case of OSAHS patients, the pretreatment level of IFN-γ increased compared with that in the normal group, and IL-4 level decreased. Moreover, the level of IFN-γ decreased and the level of IL-4 increased after receiving acupuncture and noninvasive mechanical ventilation ($p < 0.05$). IFN-γ is a Th1-type cytokine, and IL-4 is a Th2-type cytokine, and the ratio of Th1/Th2 is balanced in normal conditions, whereas an imbalance leads to immune-related conditions/disease. This study showed that an imbalance of Th1/Th2 was associated with the condition/disease. In addition, acupuncture and ventilation can be balanced when combined, and serological results provide meaningful objective evidence (Table 6 [6–20]).

A case study by Ye et al [20] reported on sleep apnea in a stroke patient. The AHI decreased from baseline, $LSaO_2$ increased, and the ESS score significantly decreased (all $p < 0.05$). However, in the case of the National Institutes of Stroke Scale, not significant differences were observed ($p > 0.05$; Table 6 [6–20]).

Acupuncture was reported to be effective in treating OSA and OSAHS in 15 studies. CPAP, which is currently the most commonly used OSA treatment, was used as the control alone or in a treatment combination. It was inferred that acupuncture may replace CPAP and when used together with the treatment, a synergistic effect occurred. OSA and OSAHS can be seen as a result of lifestyle-related conditions/diseases. Most of the treatment periods were less than 30 days, so judging treatment continuity is limited. Currently, oriental medical treatment approaches for OSA and OSAHS in Korea are insufficient. Based on the studies reviewed, the results are meaningful if observed over a long period of time. In addition, Zhou et al [10] and Zheng et al [7] used the

Bang-REN23, which is an acupoint located 1 cun to the left and right from the REN23, and is used for the treatment of OSA and OSAHS. It is an acupoint that is not frequently used for OSA treatment in Korea. In the future, it would be good if papers using the above acupoints could be published in Korea to prove the effect.

Conclusion

A total of 15 studies related to OSA or obstructive sleep apnea hypopnea syndrome were analyzed to determine the research trends of treatment using acupuncture from January 2010 to May 2022.

The most commonly used acupoints in obstructive sleep apnea studies were REN23, LU7, ST40, EX9, LI11, and DU20.

The use of acupuncture in the treatment of OSA is reliable and economical. It may be a good alternative to CPAP (which is generally used) or may be a more effective method. In addition, a greater synergistic effect will be achieved when the two treatments are combined.

More effective and appropriate treatment methods can be selected by using acupuncture points suitable for OSA and its conditions/diseases.

Author Contributions

Conceptualization: BHK. Methodology: BHK and KYJ. Formal investigation: BHK, PMS and SDK. Data analysis: BHK, JHR and SHA. Writing original draft: BHK. Writing – review and editing: BHK and LYS.

Conflicts of Interest

The authors have no conflicts of interest to declare.

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Ethical Statement

This research did not involve any human or animal experiments.

Data Availability

All relevant data are included in this manuscript.

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