

RESEARCH ARTICLE

The effects of cognitive-behavioral training and muscle relaxation on the degree of tinnitus and the quality of sleep

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Abstract

Background and Aim: Tinnitus is an annoying distressing phantom phenomenon that can cause major problems, such as insomnia and sleep deprivation. Therefore, the present study was conducted to determine the effects of cognitive-behavioral training (CBT) and muscle relaxation on the level of tinnitus and the quality of sleep in patients with tinnitus in Ahvaz City in 2018–2019.

Methods: This study is a semi-experimental, pretest, post-test, and follow-up with control group. There are two experimental groups and one control group in this plan. Participants in the first experimental group received eight sessions of CBT and participants in the second experimental group received eight sessions of relaxation training. Control group were not subject to any intervention.

Results: The results of this study showed that cognitive-behavioral approach and muscle relaxation have reduced the amount of tinnitus and increased sleep quality using multivariate covariance analysis. The most important results of this study are the effectiveness and usefulness of cognitive-behavioral approach and muscle relaxation on reducing tinnitus and increasing

the quality of sleep.

Conclusion: Cognitive-behavioral therapy and muscle relaxation approaches were effective in improving tinnitus and quality of sleep. More attention and emphasize in these approaches will be a good alternative to some invasive (electric stimulation) or with some side-effects (drug therapy) approaches.

Keywords: Cognitive-behavioral training; muscle relaxation; tinnitus; sleep quality

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Introduction

Tinnitus is the perception of noise in the absence of an external sound source [1] that has affected a large number of people and the quality of life of 2% of these people is affected by this disorder. The US National Institutes of Health and Nutrition estimates that around 15% of the general population experience tinnitus and nearly 20 million people struggle with chronic tinnitus, while two million people experience severe and disabling cases. Moreover, scholars have reported that 1.5% of students suffer from tinnitus according to estimates

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from the U.S. high schools [2]. Women with a history of tinnitus have reported pain, sleep problems, and depression [3]. While most people with tinnitus seem to cope well with it, 1.5% of them are emotionally affected by its negative impact. In addition, 1.6% of this population has high distress, and 0.5% feel as if they have a disorder that leads to their inability to have normal life [4]. The term tinnitus is derived from the Latin word “tinnire” meaning “ringing”; however, it can be a buzzing sound of a fly, the sound of an insect, or even the noise heard in one or both ears or in the middle of the head. This problem is mild in some people or disappears over time, but in others it can be almost intolerable [5]. There are currently no medications available for definitive treatment or prevention of tinnitus. Physicians and researchers are constantly trying to identify the main causes of tinnitus, and find comprehensive and low-risk treatments for this problem. So far, the methods that have been used for treatment of tinnitus include: hearing aids, sound therapy, ambient sound enrichment, supportive therapies, vasodilation using corticosteroids, anticonvulsants, antispasmodics, lidocaine, benzodiazepines, and etc. [6].

Tinnitus in most people is a subjective disorder that can lead to some psychological problems. The tinnitus, in addition to suffering at individual and communication levels, has many negative implications at both human and economic levels [7]. While the vast majority of patients with this problem only report mild symptoms, many seek treatment for this disease because it significantly affects the quality of sleep [2].

Plenty of researches have sought to find a method to treat this disorder, but so far no true cure with definitive efficacy has been found for this disease; effective methods are mostly management strategies [7]. The purpose of some of these methods (passive therapies) is to omit the tinnitus, or at least reduce it and increase the quality of sleep.

A group of therapies are active methods in which patients have active participation in the treatment including psychotherapy, cognitive behavioral training (CBT) and relaxation

therapy. In these types of treatments, affected people learn to consider tinnitus as an additional and insignificant external factor. In this type of treatments, the individual's perception of tinnitus changes fundamentally. It can be said that stress is the main cause which can be controlled and reduced by psychotherapy. In a meta-analysis, it was reported that psychotherapy is effective in treating tinnitus [8].

In psychotherapy, the goal is to help the patients control their anxiety and stress by creating relaxation and concentration and increasing efficiency [9,10]. Mechanisms used by psychological factors to reduce tinnitus discomfort have been effective in improving sleep quality [11]. So far, therapeutic methods including relaxation therapy and CBT have been used to reduce, detect and change the emotions associated with tinnitus [2,12].

Symptoms of tinnitus are very annoying to the patients and disrupt their daily life [7]. CBT can greatly help the patient to challenge the negative emotions and affect the quality of his/her sleep [12,13]. Mottaghi et al. [14] on studying the effectiveness of CBT on the quality of sleep in elderly people with insomnia, found out that CBT improves the general quality of sleep in old people and reduces the symptoms of insomnia. Berger et al. [15] in a study using an intervention program to promote sleep (as a CBT program) also reported improvement in overall sleep quality and sleep efficiency. The effect of relaxation therapy [16] on the reduction of tinnitus and improvement of sleep quality has also been considered by researchers. Relaxation techniques, focus on breathing and meditation techniques in clinical medicine have been introduced for over 30 years. These methods have been effective in treating a broad range of stress disorders [17,18], anxiety and mood disorders [19], and/or chronic pain [20,21]. In the study of Saeedi et al. [22] on 42 hemodialysis patients, concluded that progressive muscle relaxation can decrease the severity of insomnia and improve sleep variables in hemodialysis patients. It can be taught as a useful method to be used in hemodialysis departments. On the other hand, clinical studies have reported that the use of

relaxation techniques in treatment of chronic tinnitus had very encouraging outcomes [23,24]. Given that tinnitus is a chronic pain, the present study seeks to examine some of the therapies for this disorder. In this regard, according to review of literature and suggestion of previous studies in the field of tinnitus, CBT and relaxation therapy were selected and deeply examined. Hence, this study aimed to answer the question that whether the CBT and relaxation therapy have significant effect on tinnitus and sleep quality improvement or not.

Methods

This was a quasi-experimental study with pretest/post-test/follow-up design. Study population consisted of all patients with tinnitus in Ahvaz, Iran. Of them, 45 patients with a mean (SD) age of 50.44 ± 8.88 were randomly selected as study samples and were randomly divided into three groups of CBT ($n = 15$), relaxation ($n = 15$) and control ($n = 15$). Since for muscle relaxation there was a need for touching the subject and on the other hand, there was no female colleague in this research, all samples were selected from among male patients. Inclusion criteria were: complaining of subjective tinnitus lasted for more than three months (in the ear or head); obtaining normal results in audiometry and tympanometry examinations; not being in noisy areas recently (shooting, blasting); no history of ear infections; and no use of certain drugs (ototoxic or psychoactive drugs). The exclusion criteria were: unwillingness to continue with participation; attending meetings on an irregular basis; and not doing home exercises given to them.

In assessing the tinnitus and history of the subjects, they described different perceived noises such as the sounds of wind, waterfall, pressure cooker, mosquito buzzing, and other sounds. In pitch-matching test, their tinnitus frequency range was set between 3200 and 6500 Hz. In loudness-matching, the loudness range was set between 1 and 3 dB SL. The duration of tinnitus in subjects varied from about three months to three years, and none of them used any of the tinnitus management strategies.

Before intervention, subjects received pretests (tinnitus and sleep quality tests). Then the CBT group received eight sessions of CBT and the relaxation group received eight sessions of relaxation therapy. The control group received no intervention. In addition to giving necessary training during the sessions in both experimental groups (CBT and relaxation), home exercises were also assigned to them and by calling, texting, and creating social groups in applications they were reminded to perform them. Then, participants from the experimental and control groups were followed up after 45 days.

Data collection tools

Data collection tools were Persian versions of Tinnitus Handicap Inventory (THI) and sleep quality questionnaire (SQQ). The THI was developed by Newman et al. [25]. It has 25 items and three subscales of functional (7 items), emotional (12 items) and catastrophic (6 items) reactions. Their answers were rated based on 3-point Likert scale (0 = no, 2 = sometimes, and 4 = yes). Newman et al. reported its good validity and reliability [25]. For its Persian version, Mahmoudian et al. [26] reported a total test-retest reliability of $r = 0.96$ and Cronbach α coefficient of 0.94 for its internal consistency. Also, the correlation of its total score with the scores of its subscales was very close to the original American version.

In the current study, to examine its reliability, Cronbach α coefficient was calculated. The SQQ was developed by Girschik et al. [27]. It has 8 items measuring the quality of sleep in subjects. The total score of this tool is obtained by averaging the score of items which ranges between 8 and 31. Higher scores indicates better quality of sleep and lower scores shows the poor sleep quality. Girschik et al. reported an acceptable test-retest reliability ranging from 0.45 to 0.78 for this questionnaire. They also reported a reliability coefficient of 0.78 by finding the correlation of each items with total items.

Cognitive-behavioral training

The CBT intervention consisted of 8 sessions (90 min per session) held once a week for two

months according to the protocol suggested by Martinez-Devesa et al. [13]. The contents of sessions are summarized as following:

Session 1: Familiarizing participants with CBT, reviewing the program, initial education about tinnitus, determining the date and time of treatment sessions;

Session 2: Teaching patients about their disorder; talking about a model of thinking on behavior and emotions; how to think logically and rationally; and providing effective strategies;

Session 3: Discussing about how thoughts affect mood; the discussion about what thoughts are; the practice of positive thoughts instead of negative thoughts; teaching cognitive-behavioral skills; and homework assignment;

Session 4: Identifying unhelpful thinking styles; teaching relaxation; homework assignment;

Session 5: Teaching how to control negative thoughts, thinking management technique, attention control technique, and homework assignment;

Session 6: Visual teaching and homework assignment;

Session 7: Self-education statements and homework assignment;

Session 8: An overview of all cognitive techniques and a general summarization

Relaxation therapy

The protocol of 8-session relaxation therapy in this study was as follows:

Session 1: Brief introduction, performing pre-tests, description of the principles of relaxation therapy, treatment goals, the role of therapist and patient during the treatment, explaining the effect of relaxation on reducing depression and anxiety caused by tinnitus and improving sleep quality;

Session 2: Discussions about the experience of the previous session; answering questions; performing relaxation therapy on 8 muscle groups through illustration of a correct scene; homework assignment and out-of-class exercises (twice a day for 20 min);

Session 3: Reviewing notes, questions, problems and out-of-class exercises; discussing about factors related to tinnitus and sleep quality,

emphasis on continues training for the effectiveness of relaxation therapy, performing relaxation therapy on 8 muscle groups;

Session 4: Asking subjects to relax their muscles, motivating subjects by praising them; giving recommendations to improve their performance; performing relaxation therapy in a shorter time through imagination of heavy and warm hands; out-of-class exercises on fewer muscles and using techniques learned in the sessions;

Session 5: Deeper and faster relaxation by counting and imagining heat and heavy in hands; reading autogenic phrases and asking subjects to repeat and experience them; receiving feedback; out-of-class exercises to increase peripheral blood flow and skin temperature;

Session 6: Relaxation by reminding that it does not require muscle contraction (By imagining any muscle group in the mind, the subject eliminated the tension or contraction at any point in the muscle and relaxed his muscle group);

Session 7: Subjects tried to provide quick muscle relaxation and create heat in their hands and then observed the results;

Session 8: Reviewing the effects and results of education and exercises during the course

Data analysis

Collected data were analyzed in SPSS 23 software by using descriptive statistics (mean and standard deviation) and statistical tests (ANCOVA, Bonferroni test).

Results

Mean and standard deviation of tinnitus and sleep quality in samples before and after intervention are presented in Tables 1 and 2. Results reported the significant effect of CBT ($F(2,42) = 167.21, p < 0.001$) and relaxation therapy ($F(2,42) = 124.94, p < 0.001$) on improving sleep quality and reducing tinnitus of patients.

The $F(2,42)$ value for the functional dimension of THI was 66.84 and its effect size was 0.73 which was statistically significant ($p < 0.001$). For emotional dimension, $F(2,42) = 51.03$ and effect size = 0.67 ($p < 0.001$); and for catastrophic dimension, $F(2,42) = 9.81$ and effect size = 0.28 ($p < 0.004$).

Table 1. Mean (standard deviation), minimum and maximum score of tinnitus handicap inventory before (pretest) and after (post-test and follow up) intervention in three studied groups (n = 15 each)

Group	THI subscales	Pretest score			Post-test score			Follow-up score		
		Mean (SD)	Min	Max	Mean (SD)	Min	Max	Mean (SD)	Min	Max
Cognitive behavioral therapy	Performance reaction	16.13 (3.96)	10	22	5.86 (2.55)	2	10	7.12 (3.15)	0	11
	Emotional reaction	20.27 (4.76)	18	24	11.60 (3.31)	4	18	10.21 (3.11)	4	18
	Catastrophic reaction	14.93 (4.39)	8	22	4.53 (2.87)	0	10	5.13 (2.38)	2	9
	Total	58.27 (9.13)	23	74	22 (4.20)	12	34	23.31 (4.41)	14	36
Relaxation	Performance reaction	10.40 (3.71)	4	20	8.66 (3.97)	4	16	8.35 (3.68)	6	13
	Emotional reaction	20 (6.59)	10	30	16.66 (4.38)	12	24	14.15 (3.65)	12	24
	Catastrophic reaction	12.13 (4.10)	4	18	8.26 (3.01)	4	12	9.06 (3.69)	5	15
	Total	42.53 (9.11)	16	60	33.60 (9.50)	17	45	32.54 (9.33)	19	42
Control	Performance reaction	14.80 (3.52)	10	22	14.53 (3.66)	10	22	19.12 (4.54)	15	28
	Emotional reaction	26.66 (5.98)	16	36	25.20 (5.69)	14	34	23.06 (5.19)	25	32
	Catastrophic reaction	13.60 (3.31)	8	20	12.80 (2.80)	8	18	18.80 (4.17)	12	25
	Total	55.07 (3.99)	21	67	52.53 (4.30)	33	71	51.73 (9.75)	35	75

THI; Tinnitus Handicap Inventory

Based on the results of Bonferroni test, there was a significant difference between CBT and relaxation therapy in terms of reduced tinnitus (for functional reaction $p < 0.001$; for emotional reaction $p < 0.002$; and for catastrophic reaction $p < 0.003$), and improved sleep quality ($p < 0.001$). By comparing the mean values, it was found out that CBT was more effective than relaxation therapy in reducing tinnitus and improving sleep quality

Discussion

This study was conducted to examine the effect of CBT and relaxation therapy on tinnitus degree and sleep quality in patients with tinnitus. ANCOVA test result showed that CBT had a significant effect on post-test scores of tinnitus in patients. Based on its mean score, it can be said that tinnitus degree was reduced

after intervention with CBT which is consistent with the results of Veldova and Procházka [8] and McKenna et al. [11] who used a scientific cognitive-behavioral model of tinnitus with logical and deductive reasoning. The symptoms of tinnitus are annoying to the patient and disrupts his/her daily life, and unfortunately, no definitive treatment has been found yet [7]. CBT is a type of psychotherapy that helps patients to understand the thoughts and feelings that affect their behavior. It is currently used to treat a large number of disorders, including phobias, addiction, depression and anxiety. CBT is generally a short-term treatment and focuses on helping patients address a particular problem. During therapy courses, the person learns how to identify and modify the maladaptive or disturbing mental patterns that have negative effects on their behavior with the help of psychologists

Table 2. Mean (standard deviation), minimum and maximum score of sleep quality questionnaire before (pretest) and after (post-test and follow up) intervention in three studied groups (n = 15 each)

Group	Pretest score			Post-test score			Follow-up score		
	Mean (SD)	Min	Max	Mean (SD)	Min	Max	Mean (SD)	Min	Max
Cognitive behavioral therapy	32.06 (3.23)	24	35	10.26 (3.21)	3	16	11.17 (3.09)	5	17
Relaxation	28.13 (3.44)	21	34	14.06 (1.86)	12	19	13.31 (1.36)	11	20
Control	30.40 (3.79)	25	38	24.86 (2.97)	16	28	29.18 (3.29)	18	32

and special exercises [28].

Results of this study also showed that CBT significantly increased the sleep quality of patients which is consistent with the findings of Mottaghi et al. [14] and Berger et al. [15] who used chemotherapy (as a CBT method) to improve sleep quality of women with breast cancer which included muscle relaxation techniques. For explaining this result, it can be argued that since sleep disorder has the highest comorbidity with other psychiatric disorders, only CBT has a beneficial and lasting effects on the disorder. However, the coping skills of this treatment require continuous effort that some patients may not have the required motivation to do this treatment. Sleep is not affected only by the time of day and the processes of homeostasis, but environmental factors, psychosocial factors, diseases and lifestyle factors have also profound effects on sleep [29,30]. Sleep/wake cycle disorders affect other physiological functions of the body such as loss of appetite, fatigue, lack of concentration, exacerbation of diseases and physical problems [31].

The present study also reported that relaxation therapy had significant effect on post-test results of tinnitus, and reduced its mean score. This result is in agreement with the results of Weber et al. [32]. Relaxation therapy also significantly improved the sleep quality of patients with tinnitus which is consistent with results of Saedi et al. [22]. By comparing CBT and relaxation therapy, it was found out that both had effects on tinnitus but the CBT can motivate them more. The reasons for more effectiveness of this intervention is the regular structure of sessions

and the commitment of participants. The use of relaxation technique as a component of CBT can lead to better treatment of tinnitus and therefore improve it. When these two interventions are applied together, not only the therapeutic effects increase, but also the quality of sleep and mental health are improved. Therefore, CBT and muscle relaxation are both effective in reducing tinnitus, improving sleep quality and general health. These treatments were able to reduce the symptoms of tinnitus in these patients and thereby help improve the quality of sleep and promote mental health in them. The difference that may be found between our results and those of other studies is perhaps due to the influence of uncontrolled confounding variables, the degree of competence and expertise of the therapist in performing the intervention correctly, difference in moderator variables, environmental conditions, and difference in mean age, probable biases, patient intelligence, education level and culture.

One of the limitations of this study is that it is possible that the statistical population may not be the same in terms of the type of sleep problems and tinnitus before intervention. Another limitation was the time limitation for a long-term follow-up of 6–12 months so that we can have better argument about the effects of methods. In this regard, a follow-up period of 45 days was considered whose results showed the stability of post-test results. Therefore, it is suggested that in future studies, prior to the intervention, the subjects should be matched in terms of the type of sleep problems and the degree of tinnitus. It is also recommended that further

study should be done by considering a longer follow-up period. Studies on tinnitus and its pathophysiology are still ongoing. It is hoped that with a better understanding of these methods, more effective treatment and management strategies be provided to people with tinnitus.

Conclusion

Cognitive-behavioral therapy combined with muscle relaxation is an effective intervention for reducing tinnitus and improving sleep quality. These treatments were able to reduce the symptoms of tinnitus in patients and thereby help improve sleep quality in them. The main mechanism involved in effectiveness of CBT is its profound effect on thoughts, false beliefs, and modification of inappropriate behaviors of tinnitus sufferers. It is a useful, convenient and safe method, and has no side effects. Hence, this technique can be taught as a useful way to improve sleep quality and reduce tinnitus in patients with tinnitus.

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Conflict of interest

The authors declare that there is no conflict of interests regarding the publication of this paper.

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