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Natural Sounds in Management of Elderly Sleep Quality: A Randomized Controlled Trial

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Abstract

Background: There is no clear consensus on the effect of natural sounds on elderly sleep quality, as one of the most common causes of disability in them. This study aimed to determine the effect of natural sounds on elderly sleep quality.

Material & Methods: In this randomized controlled trial, 100 elderly were selected based on the inclusion criteria from comprehensive health care centers and then divided into two equal groups by simple random sampling method. The intervention group listened to the natural sounds in MP3 format every night for 2 weeks, 30 minutes before going to bed, through mobile phone and hands-free. The control group did not receive any intervention. The PSQI was measured before and after the intervention. Data analysis was done in SPSS software (version 22) applying the Shapiro-Wilk test, Chi-square, and Fisher Exact test, Independent Samples-t test, Wilcoxon Signed Ranks test, and Mann Whitney U test. A confidence level of 95% was considered.

Results: In the intergroup comparison, in the baseline, groups were the same in terms of the total sleep quality score as well as other components (P>0.05). After the intervention, there was a significance difference between the two groups in terms of global sleep quality (P=0.048), sleep latency (P=0.001), habitual sleep efficacy (p= 0.012), and sleep disturbance (p=0.01).

Conclusion: Based on the our results, natural sounds could improve the sleep quality in the elderly.

Keywords: Sleep Qualities, Elderly, Sounds.

Introduction

Along with physical changes, changes in sleep patterns are also part of the natural aging process [1]. About 43% of older persons report having trouble falling asleep and staying asleep as they become older. Older adults also often have early wake times and sleeplessness. They spend the majority of their sleep in light sleep phases. [2]. Researchers found that the prevalence of poor sleep quality was 33.8% in elderly people[3].

Good sleep is necessary for health. Sleep disorders in the elderly are associated with serious negative physical, psychological, and social consequences(4).A recent research shows that insufficient sleep, sleep disturbance, and sleep disorders affect many aspects of human

health, including cognitive decline, Alzheimer's disease risk(5-7) dementia(8) polypharmacy (1), sexual performance [9], and consequently the quality of life [10, 11] and morbidity and mortality rate (1).Also the results of studies showed that other common medical problems in old age, such as high blood pressure, diabetes mellitus, kidney failure, immune system disorders, gastroesophageal reflux disease, respiratory diseases such as asthma, physical disability, depression, and anxiety and dementia are all associated with sleep disorders(12).

Researchers proposed several approaches to deal with sleep disorders in the elderly, such as physiological and pharmacological methods(4).Some of the non-pharmacological interventions are: natural light therapy(13, 14), brain exercise(15)cognitive behavioral(16) physical activity(17) aromatherapy(18)medicinal Plants(19), auditory stimulation(20)like several types of music therapy (21), include analytical music therapy, cognitive behavioral music therapy (CBMT), community music therapy, Benenson music therapy, vocal psychotherapy and Nordoff-Robbins music therapy, (22), and probably natural sounds(23).

Researchers have recently demonstrated that the sounds of nature induce a state of relaxation by modulating the central and autonomic nervous systems (24). Additionally, some participants have reported that listening to music prior to napping enhances both the subjective and objective parameters of their sleep (21, 25, 26). The effect of natural sounds on sleep quality have been studied in limited studies, and most of the available reports are based on the results of studies conducted on the effect of music on sleep quality in hospitalized patients. Limited studies showed that, compared to silence, nature sounds did not show significant effects on patients quality of sleep(27). Regarding conflicting reports about the effects of music therapy on sleep quality, researchers in the results of a systematic review, have recommended more studies in this field(28). This study aimed to determine the effect of natural sounds on elderly sleep quality.

Materials and Methods

The design of this study was a randomized controlled trial performed from May 2022 to August 2022; to determine the effect of natural sounds on elderly sleep quality, Rafsanjan, Iran.

Research Council of Rafsanjan University of Medical Sciences approved the project. The code of ethics (IR.RUMS.REC.1399.133) was adopted by the ethics committee by deputy of the research, and technology at this university, the permission to conduct the study was present in the comprehensive health service centers of Rafsanjan by two of the researchers. With this end in view, first, they prepared a list of elderly people (85 people) who had a history of sleep disorders at health electronic files at the Iranian Health Integrated System (SIB), and then through a phone call. The researchers invited the elderly who satisfied the inclusion criteria and consented to participate in the study to the comprehensive health care facilities after outlining the goal of the investigation. When invited to comprehensive health care facilities, almost all of the individuals consented to take part in the study. The inclusion criteria include age over 60 years(29), no experiencing a life crisis during the last 6 weeks, obtaining a total score higher than 5 from Pittsburgh Sleep Quality Index (PSQI), no hearing problems, having sufficient mental and cognitive ability to answer the questionnaire and to use hands-free, or the presence of family members who can help them play audio through hands-free, no addiction such as alcohol, opium, smoking or tranquilizers and sleeping drugs.

Exclusion criteria included: forgetting more than three days to implement the intervention, withdrawing from continuing to attend the study, and occurrence of any problem that implements the intervention impossible.

The sample size considering $\alpha \leq 0.05$, the $\beta=0.90$ and S1=2.91 and S2=3.03 for control and intervention groups respectively, and d= 3 for the 1 hour per day for 1week intervention(30) and using the following equation is approximately 41 people calculated. But we considered 50 people for each group.

Formula 1.

$$n = 2(z_{1-\alpha} + z_{1-\beta})^2 (S_1^2+S_2^2)/ d^2$$

At the beginning of study, the samples were selected purposefully, and based on the inclusion criteria, using the SIB system then the eligible samples were then allocated into two groups of the intervention (natural sound) and control (without intervention), by a simple random lottery method.

The data collection tool consists of two parts. The first was the demographic characteristics (including age, sex, level of education, job, income, and sleep disorder duration), and the second part was the PSQI. PSQI is a standard scale that has 19 items and 7 subscales (sleep quality, sleep delay, and sleep duration, normal sleep efficiency, sleep disorders, using sleeping pills, and daily functioning disorders). Each component is scored from 0 to 3 (not in the past month = 0; less than once a week = 1, once or twice a week = 2, and three or more times a week = 3). The minimum is 0 and the maximum is 21 variables. Higher scores indicate lower sleep quality. The total sleep score of 5 or less is considered "good"(31). In the Persian version the Cronbach's Alpha Coefficient of 0.77 was reported for all subjects. The psychometric properties of the Persian version of the PSQI were approved (32).

To reduce the interfering effects of environmental factors on sleep, before going to sleep, the elderly of both groups were advised to be in a calm, quiet, low-light environment with a suitable temperature, where, they feel comfortable, wear light, and comfortable clothes, lie down in their bed and a comfortable position. The samples were advised to observe the following instructions, before listening to the audio file. They should close their eyes and concentrate on the sound. Then, while maintaining regular respiration, they should adjust the volume of the sound to a level that is suitable for them. They should not be concerned with turning off their mobile phone. Except for preliminary recommendations at the beginning of sleep, no other intervention was implemented for the control group.

The intervention group, listened to the natural sounds in MP4 format every night for 2 weeks, 30 minutes before going to sleep, through mobile phone and hands-free. The nature sounds in this study were the artwork "Sounds of Nature" which was recorded by Dr. Arendt Stein in 2011. These sounds included the chirping of birds, the roar of the sea, the sounds of river and the forest, and the sound of rain. It was recommended that the volume of sounds be adjusted to a level that, feels comfortable.

For all participants in this study, PSQI was measured the day before the start of the intervention, and the morning after the last night of the intervention. The baseline measurement was done through a face–to–face interview and the second time measurement was done at least 8 hours after the last intervention (at 10:00 am), through a phone call interview. Both measurements were done by the researcher's colleague who was blind about the sample allocation.

Ethical considerations were upheld, including the following: voluntary participation and termination of the study at will; acquisition of informed written consent prior to study commencement; and protection of information confidentiality. The samples were assured that the intervention is not associated with any physical, psychological, spiritual, or financial complications to them.

Data were analyzed by SPSS software version 22 by using a descriptive statistic, Shapiro -Wilk test (for normality) Chi-square and Fisher Exact test (to compare ratios), Independent samples-t test, and Wilcoxon Signed Ranks test (For intragroup comparisons) Mann Whitney U test (For intergroup comparisons). A confidence level of 95% was considered

Results

Based on Shapiro-Wilk test, except for the age variable, the quantitative data distribution was not normal. Data analysis results showed that, in terms of gender, 52 (52%) of the samples were male and 42 (425) were female, the mean ± SD of the elderly age was 68.66 ± 5.37 with a maximum of 82 and a minimum of 60 years. The independent samples-t test showed that the mean ± SD of age in intervention and control groups were respectively 68.06± 5.66 and 69.26±5.046. Regarding age, no statistically significant difference existed between the groups under investigation (p=0.266). Additional demographic factors, including sleep disorder duration, occupation, gender, and occupation, did not exhibit any statistically significant variations among the study groups. Table 1 shows the study groups' similarity in terms of these features.

Table 1. Comparison of demographic characteristics between the study groups

		Intervention n=50 (100%)	**Control n=50 (100%)**	**Pearson chi-square test P-value**
Gender	**Male**	26(52)	32(64)	0.224*
	Female	24(48)	18(36)	
Education	**Illiterate**	21(42)	20(40)	0.085*
	Diploma & under diploma	11 (22)	20(40)	
	Academic	18(36)	10 (20)	
Job	**Unemployed**	21(42)	20(40)	0.500**
	Retired	28(56)	26(52)	
	Employed	1(2)	4(8)	
History of sleep disorder	**Less than one month**	9(18)	16(32)	0.106*
	More than one month	41(82)	34(68)	

* Chi-square test
**Fisher Exact test

The mean and standard deviation of total sleep score of the intervention group, in the pre-intervention phase was 10.24±3.47 and reached in the post-intervention phase to 8.44±3.86. In this group, in within-group comparison, a significant reduction in global quality of sleep score (p=0.001), subjective sleep score (p=0.001), and sleep latency (p=0.001) showed in results of the Wilcoxon Signed Rank test. In other components of sleep quality, no statistically significant difference was observed (P>0.05) (Table 2).

Table2. The intra-group comparison of global quality of sleep score and other components in the intervention group

	Pre-test Mean±SD	Post-test Mean±SD	Pre-test Median±IQR	Post-test Median±IQR	*P-value
Global sleep score	10.24±3.47	8.44±3.86	5.25±9	7.50±5.25	0.001
Subjective sleep quality	1.68±0.84	1.20±0.94	2±1	1±1	0.001
Sleep latency	2.44±0.61	1.70±0.83	2.50±1	2±1	0.001
Sleep duration	2.10±0.99	1.90±1.01	2±1	2±2	0.057
Habitual sleep efficacy	0.8±0.92	0.72±1.05	1±1	0±1.25	0.432
Sleep disturbance	1.52±0.58	1.40±0.53	1±1	1±1	0.058
Use of sleep medication	0.76±1.20	0.72±1.17	0±1	0±1	0.317
Daytime dysfunction	0.96±0.85	0.84±0.88	1±2	1±2	0.058

*Wilcoxon Signed the Rank test

The mean ± SD of the global quality of sleep score of the control group in the pre-intervention phase was 10.18±3.70 and in the post-intervention phase reached 9.88±3.57. Results of the Wilcoxon Signed Rank test showed that, except for the sleep latency, there was no significant difference between the global quality of sleep score and scores of the other components in the pre-and post-measurement phases(P>0.05). In the control group, the mean ± SD of the sleep latency in the pre-intervention phase was 2.46±0.73 and reached in the post-intervention phase to 2.26±0.92, which was statistically significance (P=0.029).

In the intergroup comparison, in the pre-intervention phase, both groups were similar in terms of the global quality of sleep score and other subscales (P>0.05). In post post-intervention phase, there was a statistical significance difference between study groups in terms of PSQI score (P=0.048), sleep latency (P=0.001), habitual sleep efficacy (p= 0.012), and sleep disturbance (p=0.01). Other components' scores were the same between the two groups (P>0.05) (Table 3). Due to the use of non-parametric tests, comparisons with median and quartile ranges are also reported in this table.

Table 3. The inter-group comparison of global quality of sleep score and other components across study groups

		Intervention group Mean±SD	Control group Mean±SD	Intervention group Median±IQR	Control group Median± IQR	*P-value
Global sleep score	Pre-test	10.24±3.47	10.18±3.70	9±5.25	10.00±	0.805
	Post-test	8.44±3.86	9.88±3.57	7.25±5.25	9.50±5.25	0.048
Subjective sleep quality	Pre-test	1.68±0.84	1.48±0.73	2±1	1±1	0.231
	Post-test	1.20±0.94	1.38±0.63	1±1	1±1	0.124
Sleep latency	Pre-test	2.44±0.61	2.46±0.73	2.50±1	3±1	0.600
	Post-test	1.70±0.83	2.26±0.92	2±1	3±1	0.001
Sleep duration	Pre-test	2.10±0.99	1.92±1.00	2±2	2±2	0.345
	Post-test	1.90±1.01	2.00±0.85	2±2	2±2	0.685
Habitual sleep efficacy	Pre-test	0.8±0.92	0.92±0.85	1±1	1±1	0.325
	Post-test	0.72±1.05	1.04±0.83	0±1.25	1±0.25	0.012
Sleep disturbance	Pre-test	1.52±0.58	1.72±0.57	1±1	2±1	0.075
	Post-test	1.40±0.53	1.72±0.62	1±1	2±1	0.010
Use of sleep medication	Pre-test	0.76±1.20	0.74±1.08	0±1	0±1.25	0.869
	Post-test	0.72±1.17	0.74±1.06	0±1	0±2	0.724
Daytime dysfunction	Pre-test	0.96±0.85	0.96±1.02	1±2	1±1	0.704
	Post-test	0.84±0.88	0.86±0.92	1±2	1±1	0.971

* Mann-Whitney U test

Discussion

The results of the study stated that, in the intervention group, the natural sounds were able to improve significantly the sleep quality score compared to the baseline, and compared to the control group. This results were similar to study by Afshar et al., on sleep quality management by white noise in CCU patients, on the third day after admission. Results of this study showed that white noise in the intervention group, could improve the quality of sleep, compared to the before intervention and the control group(33). Similar to the work of Afshar and colleagues, Nasari et al., conducted a study in the coronary care patients, by the natural sounds, and adding a third group (silence group). The researchers reached the conclusion that the quality of sleep was enhanced in both the silence and natural sounds intervention groups in comparison to the control group. However, no significant difference was observed

between the silence and natural sounds group. These researchers concluded that based on the patients' preference, silence or nature sounds can be used to improve the quality of sleep of the patients(27).In other studies, person-preferred music therapy was introduced as a painless, safe, affordable treatment method without any side effects intervention to improve sleep quality(34-36). Also, the results of Lan and colleagues' study showed that the speed of ventilation, and noise of ventilation are the influencing factors on the quality of sleep of patients hospitalized in ICU(37). Undoubtedly, the environment of the intensive care units, and the contextual causes of sleep quality reduction in patients hospitalized in these units are different from the elderly own living environments. However, it should be kept in mind that, most of the patients hospitalized in these units are elderly. The results of these studies showed that environmental noises were an important factor to reduce the sleep quality of patients who were hospitalized in intensive care units, so that, the elimination of these sounds in the silence group could improve the sleep quality of the patients as well as in the natural sounds group. Although the problem of these patients can be different in nature from the elderly who have suffered a long-term loss of sleep quality in their real-life environment. Therefore, finding the appropriate strategies for the management of their sleep quality can be critical. Based on the results of this study, besides the adjusting of environmental factors (such as temperature, light, and noise), at home and in a personal and regular bed, the natural sounds could improve the sleep quality of the elderly. The positive impact of natural music on sleep quality can be ascribed to its calming and tranquilizing properties, which serve to divert attention away from negative thoughts. A study's findings indicate that music therapy has the capacity to decrease anxiety, pulse, and respiration rate, while also maintaining systolic and diastolic blood pressure within the expected range (38).Apart from the score of sleep quality, although the sleep latency score (the duration of falling asleep) was improved in both groups at post-intervention, but in the music therapy group, the sleep latency score was shorter and better than the control group. Moreover, the efficiency of sleep (times of going to bed and morning waking up and actual sleep duration habits), and sleep disturbance (waking up in the middle of the night or early in the morning) were significantly improved in the intervention group. The results of some other studies, including a systematic review meta-analysis study showed continuous improvements in sleep quality, in global PSQI score compared to the baseline, and three consecutive months after the music intervention, also, the score of sleep quality in the intervention group compared to the control group had improved more in each measurement time. Three subscale scores including sleep efficiency, sleep latency, and daytime dysfunction were improved in intervention groups (21, 39, 40).

Scientists believe that the sounds of nature, inspired by music and poetry, create powerful reactions in humans and connect them to nature by creating a sense of place (41). Hence, it can improve the health and well-being of humans, increase positive affect, and reduce stress and anxiety(42),all of which can be beneficial in providing healthy sleep and improving sleep quality.

Despite trying to design of the study to obtain valid results by eliminating environmental factors, removing anthropogenic sounds in order to provide pure biological sounds, and maintaining blinding in data collection, but, some limitations of this study, such as the effect of frequent therapist calls on the feeling of attention, security, and peace of the elderly in the intervention group and how seniors answer skill questions. Thus, the effect of the patient's lifestyle such as activity level, feeding style, daily events, and their housemate's conditions that, could affect on their quality of sleep was beyond our precise control. Further investigation is recommended in order to provide a rationale for the restricted efficacy of interventions such as nature sounds and music therapy with regard to other facets of sleep. Furthermore, further research is warranted to ascertain the precise populations and contexts in which this approach may prove to be therapeutically beneficial.

Conclusion

Based on the results of this study, natural sounds improve sleep quality in the elderly. This effect is the result of changes in the fields of sleep latency score, also, the efficiency of sleep, and sleep disturbance. But, other aspects of sleep did not change. Nurses and other health care professionals can implement these interventions as a possible effective method for the quality of sleep, taking into account cultural contexts for the elderly, to improve their quality of sleep.

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