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Sleep Science

The effectiveness of cognitive training on improving cognitive function and sleep quality in community-dwelling elderly in Iran

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ABSTRACT

Background and aim: Given the ever-increasing of the older adults population and in order to achieve healthy and active ageing goals and improvement in the cognitive function and sleep quality in older adult, this study aimed to evaluate the effect of cognitive training program on improving cognitive function and ageing-related sleep quality in community-dwelling elderly in Iran, in 2018. **Methods:** This was an experimental study. The sample comprised 420 older adults who were a member of the comprehensive health center in one of the southern cities of Iran. 164 had a cognitive problem and sleep disorder, of whom 108 were selected by the available method and based on inclusion criteria. Participants were randomly allocated to an experimental group (n=54) and a control group (n=54). Experimental group samples were undergoing the intervention for two months. Data were collected using MMSE questionnaire, Pittsburgh sleep quality, insomnia severity index and Clinical Dementia Rating Scale (CDR). Data were collected one month before-and-after the intervention. Data were analyzed using SPSS software. **Results:** There was no significant difference between the mean score of cognitive function and sleep quality in both the intervention group and the control group before the intervention ($p>0.05$). At the post-test, the mean (SD) of elderly adults' cognitive function in the intervention and control groups were 2.7 (1.3) and 3.44 (1.7), respectively ($p=0.017$). Moreover, the mean (SD) of sleep quality in older adults in the intervention and the control group was 6.76 (2.3) and 9.25 (2.36), respectively ($p<0.001$). **Conclusion:** Given the obtained results in the current study the cognitive training promotes cognitive function and sleep quality in older adults. Therefore, since this program is effective, low-cost and applicable, it can be used to improve cognitive function and sleep disorder in the older adult population.

Keywords: Cognitive Therapy; Memory; Cognitive Dysfunction; Sleep; Health of the Elderly; Iran.

INTRODUCTION

Every person older than 60 years is considered elderly, according to the definition of the World Health Organization (WHO). Individuals in this period of life are prone to various types of diseases and disabilities due to reduced physiological capacities. Today, the significance of old age and geriatric medicine is remarkable because due to the improvement of world health conditions and increase in life expectancy, the world population is ageing rapidly[1].

Mental disorders are considered to be the major contributors to disability and the burden of disease, which their prevalence is on the rise in the older population[2,3]. The prevalence of some Psychiatric disorders including cognitive, dementia, delirium, and oblivion disorders increases with increasing age[4,5]. In cognitive impairment, attention, memory, language, orientation, perform intended actions, executive function, judgment, and problem-solving skills are impaired, the main reason for this is the damage to the brain's memory[6].

The findings of a meta-analyze study showed that various interventions have been done so far in order to improve age-related cognitive function, including lifestyle interventions, mindfulness, group psychological interventions, pharmacological interventions, and cognitive training interventions. Nevertheless, there is no general consensus regarding which of these methods can be more effective in improving older adults cognitive function[7].

On the other hand, with the increase in age, the prevalence of sleep disorders increase. As reported by various studies there is an association between cognitive impairments and sleep disorders, and cognitive impairments in older people with insomnia disorders are higher than those with normal ageing[8,9]. One study conducted a longitudinal cohort study on 6000 older participants over three years and reported the performance of older adults with insomnia decreased on tasks including balance, attention, reaction time and accessibility to information stored as semantic memory[10]. Approximately 50% of older adults with chronic insomnia have underlying psychiatric diseases including depression, anxiety, impaired cognitive functions and dementia. The impact of learning and cognitive interventions on improving sleep performance has been revealed in previous studies[11-14].

According to the published literature, no research has assessed the effect of cognitive interventions on improving the cognitive function and sleep quality of elderly people in Iran. Therefore, this study aimed to investigate the effect of the cognitive training intervention on improving sleep quality and cognitive function in older adults with insomnia and cognitive impairment.

MATERIALS AND METHODS

Study design

This was an experimental study.

Study population

The sample consisted of 420 old adults who were a member of the comprehensive health center in one of the southern cities of Iran. 164 had a cognitive problem and sleep disorder, of whom 108 were eligible to enter the study. Samples were randomly divided into an experimental group (n=54) and a control group (n=54).

Eligibility

Inclusion criteria included aged 55 years or over, the obtained score of Mini-Mental State Examination should be between 20- 25, without receiving any cognitive training over the past 3 months, insomnia at least three times per week for a duration of at least six months, consequences of insomnia throughout the day such as fatigue, irritability, difficulty concentrating and having informed consent to participate in the study. Exclusion criteria included the use of a stimulant, tranquillizers/ sedatives and hypnotic medication, lack of cooperation at each stage of the study or absenteeism of more than two sessions in training classes.

At first stage, the screening was performed in order to diagnose sleep disorder using Insomnia Severity Index (ISI) and cognitive impairment using Mini-Mental State Examination (MMSE) with the elder consent, and then eligible samples were selected to enter the study. At the second stage, participants were aware of the study objectives, and then informed consent was signed by participants in order to participate in the study. After random allocation of samples in the experimental group and the control group, pre-test consisting of Pittsburgh Sleep Quality Index (PSQI (and Clinical Dementia Rating scale (CDR) was carried out for both the experimental and control group. Participants' following the pre-test stage, the intervention group participated in an 8-week training program (8 training sessions) consisting of the one-and-a-half hour group sessions for two months.

Intervention

Intervention training consisted of the multi-domain cognitive training program including mnemonic methods, to stop the irrational and unrealistic thoughts, attention training and cognitive exercises. Cognitive exercises were designed for stimulation a specific cognitive function during each session (two sessions focused on memory, two sessions focused on visual-spatial skills, two sessions focused on executive functioning, abstract thinking and problem-solving skill, and two sessions focused on repeating, exercise and assessment of adults' thoughts). A few strategies were performed in order to improve concentration and attention skills in learning and remembering during memory training.

Mnemonic techniques are defined as "intellectual exercises" and used for remembering a series of events by linking illustration, volumize, coding, rhythm and melody techniques. In this technique, vocabulary, poems, images, or anything else are used to learn a variety of subjects, such as educational texts, numbers, or remembering different topics. The method of loci is one of the most versatile mnemonic techniques. Other mnemonic techniques include name Mnemonic, divide (chunking). The content of the training sessions is listed independently in Table 1.

Table 1. The content of the eight-session cognitive training.

Week	Cognitive training program	Activity
1	• Assessment of adults' thought • Assessment of elderly' sleep problems • introducing of cognitive training program stages to the older adults	• Group discussion • Sharing experience regarding sleep and cognitive problems • Watching educational films
2	• Memory training use of mnemonics • Personal Memory Memo System: Includes Awareness of personal and medical information, to note down emergency contacts name	• Writing the reminiscences • Solving a table • Writing a letter • Memorizing a poem • making a calendar and writing a note about the daily activities on it
3	• Memory exercises • Use of name mnemonics • Brain teasers	• training the recall of shopping lists • Chess game
4	• Divide (Chunking), organizing and classification • Participation in group exercises • brain teasers	• Use of the division method for remembering the phone number • Sorting pictures of animals and plants according to various categories.
5	• Participation in class exercises to enhance visual spatial skills • Attention training	• Browsing old photo albums • First, showing two or more pictures to the older people, second, hiding them and then asking them to say the name of the pictures • clapping when a specific number or word was spoken out by the instructor
6	• Use of the Method of Loci in order to strengthen spatial-visual skills • Mental imagery	• Remembering the location of objects in the room • First, showing a combinational image to the elderly people, second, hiding it and then asking questions about the image. • A set of objects is arranged in order and the eyes are closed and the object place is changed, the eyes are opened and the change we want to see.
7	• Problem-solving skill • Abstract thinking • Executive functions	• Group discussion • Expression of a problem on behalf of the elderly and then discussion and providing a method for solving the problem • Expression of proverbs and their interpretation • Executive functions (e.g., following numbers and letters)
8	• Expressing the entire cognitive-behavioural therapy plan • Group discussion • An overview of the topics summary of the previous week	• Implementing the skills learned in the previous sessions properly and using them in daily affairs • Making a daily timetable • Any activity that was not accomplished during the training time

Study instrument

The first section of the data collection instrument was the Clinical Dementia Rating Scale (CDR). CDR is a global clinical score to assess the severity of dementia, as well as a sensitive and accurate instrument to quantify cognitive status in older adults. The instrument includes 75 questions in six fields: memory, time and space orientation, judgment and problem solving, social affairs, home and recreations, and personal matters. The score of each field is determined based on responsiveness a few questions. Each field is separately rated from 0 to 3 (0, 0.5, 1, 2, 3). Higher scores are indicative of worsening of one's cognitive status[15,16]. The reliability and validity of the instrument have already been investigated by Sadeghi et al. The validity and the reliability of the instrument were confirmed through formal validity and content in a qualitative manner, and Cronbach's Alpha coefficient %73, respectively[17].

The second section of the data collection instrument was the Pittsburgh Sleep Quality Index. The questionnaire was developed by Buysse et al. and assesses the patient's attitude regarding sleep quality over a 1-month time interval[18]. PSQI consists of 19 questions and seven components, Each question scored from 0-3. The 7 component scores are added to obtain a total score ranging from 0-21, with higher scores indicating worse sleep quality. Score >6 indicates undesirable sleep quality. The reliability and validity of the Persian version of the instrument have been evaluated by Ahmadi et al., and the Cronbach's Alpha coefficient and the correlation coefficient was 89.6 and 0.88, respectively[19].

Post-test was carried out one month following completing the training classes using PSQI and CDR's questionnaires from participants. In addition to, all ethical considerations including obtaining permission from the Ethics Committee (i.medilam.rec.1397.070), obtaining informed consent, protecting recorded Information and observing the trusteeship about the use of resources were carefully considered in this study. After the end of the research, the educational content was provided to the control group.

Statistical analysis

The data were analyzed using SPSS version 22 (SPSS Inc., Chicago, IL). Descriptive statistics such as percent, mean and standard deviation were used summarize demographic and clinical characteristics of study participants. Independent and paired *t*-tests were used to examine experiment and control group differences (sleep quality and cognitive function) from baseline to post-tests. Chi-square test was used to examine

demographic variables such as age, marital status, etc. between experiment and control groups. Alpha was set at 0.05.

RESULTS

A total of 108 older adults were studied, of whom 4 and 3 participants from the experimental group and the control group were excluded owing to absenteeism in the intervention program more than one session and travelling and non-attendance in the area, respectively. Finally, 101 older adults consisting of 50 in the intervention group and 51 in the control group were analyzed. The mean (SD) age of the elderly in the intervention group and the control group estimated at 63.42 (4.42) and 64.47 (5.65) years, respectively. Analyses revealed no significant differences in terms of age between the two groups ($p>0.05$). Other demographic and disease-related characteristics of participants are represented in Table 2.

The sleep quality in older population for both groups before and after the intervention is shown in Table 3. The total mean (SD) difference score of sleep quality from baseline to follow-up in the experimental group and the control group was 3.74 (1.60) and 0.36 (0.96), respectively, which indicates the sleep quality in elderly people in the experimental group improved significantly compared to the control group ($p<0.001$). In each of sleep quality dimensions, a significant difference was observed between the mean difference of the experimental group and the intervention group before and after the intervention ($p<0.001$).

Besides, there was a significant difference in all dimensions of sleep quality in the experimental group before and after the intervention ($p<0.001$).

Table 4 shows the mean of the elderly cognitive score for both groups before and after the implementation of the cognitive program. The total mean (SD) difference score of CDR from baseline to follow-up was 1.44 (0.78) and 0.108 (0.61) in the experimental group and the control group, respectively, which indicates the elderly cognitive status in the experimental group improved significantly compared to the control group ($p<0.001$). A significant difference was detected in the mean difference of each dimension of CDR in the experimental group and the control group before and after the intervention ($p<0.001$). Furthermore, a significant difference was found in all dimensions of CDR in the experimental group before and after the intervention ($p<0.001$).

DISCUSSION

The current study evaluated the effect of cognitive training on improving cognitive function and sleep quality in older people with cognitive and sleep disorders. Given the published literature, this study was one of the first studies among Iranian older adults. Since the findings of our study showed cognitive training program was effective in improving cognitive function and sleep quality in older adults with cognitive impairment and insomnia, this comprises a topic worthy of further studies.

Table 2. Socio-demographic and disease-related characteristics of participants in both groups.

Variable		Experimental group		Control group		*p* value
		Frequency	Percent	Frequency	Percent	
Gender	Male	21	42	20	39	0.776
	Female	29	58	31	61	
Age	55-60	14	28	16	31.37	0.880
	61-65	19	38	14	27.45	
	66-70	11	22	11	21.56	
	>71	6	12	10	19.60	
Marital status	Single	1	2	2	9.3	0.792
	Married	43	86	46	90.2	
	Widow	5	10	2	3.9	
	Divorced	1	2	1	2	
Education status	Illiterate	0	0	0	0	0.976
	Literacy movement	10	20	11	21.56	
	Elementary school	17	34	21	41.17	
	Secondary school	7	14	5	9.80	
	High school	14	28	12	23.52	
	College education	2	4	2	3.92	
Suffering from another disease	Yes	39	78	37	72.5	0.526
	No	11	14	22	11	
Cognitive impairment	Low	42	84	44	86.27	0.784
	Moderate	8	16	7	13.73	
Sleep quality	Moderate	29	58	35	63.6	0.519
	Mild	19	38	14	27.45	
	Very mild	2	4	2	4	

Table 3. Comparing the sleep quality in the older adults in the intervention group and the control group before and after the implementation of the cognitive training program.

Sleep quality dimensions	Control (n=51)		experiment (n=50)		p-value
	Baseline	12 Weeks	Baseline	12 Weeks	
Subjective sleep quality	1.98±0.62	1.88±0.55	1/9±0.67	1/4±0.64**	
Change from baseline to follow-up	0.099±0.36		0.50±0.61		<0.001
Sleep latency	1.8±0.72	1.74±0.74	1.9±0.78	1.28±0.70**	
Change from baseline to follow-up	0.05±0.23		0.62±0.53		<0.001
Sleep duration	1.54±0.75	1.52±0.78	1.92±0.75	1.18±0.71**	
Change from baseline to follow-up	0.019±0.14		0.74±0.56		<0.001
Sleep efficiency	1.65±0.66	1.58±0.60	1.96±0.75	1.1±0.71**	
Change from baseline to follow-up	0.06±0.23		0.86±0.67		<0.001
Sleep disturbances	1.35±0.52	1.33±0.4	1.4±0.64	0.92±0.49**	
Change from baseline to follow-up	0.02±0.14		0.52±0.61		<0.001
Daytime dysfunction	1.29±0.73	1.12±0.74	1.38±0.75	0.88±0.72**	
Change from baseline to follow-up	0.17±0.38		0.52±0.57		<0.001
(total) PSQI	9.52±2.43	9.25±2.36	10.5±2.8	6.76±2.3**	
Change from baseline to follow-up	0.36±0.96		3.74±1.60		<0.001

** *p*<0.001 compared with baseline within the group.

Table 4. Comparing the elderly cognitive function in the intervention group and the control group before and after the implementation of the cognitive training program.

CDR dimensions	Control (n=51)		experiment (n=50)		p-value
	Baseline	12 Weeks	Baseline	12 Weeks	
Memory	0.85±0.49	0.85±0.49	0.99±0.45	0.58±0.45**	
Change from baseline to follow-up	0.001±0.20		0.41±0.35		<0.001
Orientation	0.69±0.50	0.66±0.47	0.75±0.43	0.51±0.21**	
Change from baseline to follow-up	0.029±0.15		0.24±0.32		<0.001
Community Affairs	0.55±0.36	0.55±0.35	0.61±0.45	0.47±0.27**	
Change from baseline to follow-up	0.009±0.70		0.14±0.30		<0.001
Judgment & Problem Solving	0.66±0.50	0.60±0.44	0.95±0.66	0.59±0.45**	
Change from baseline to follow-up	0.058±0.21		0.36±0.41		<0.001
Home Hobbies	0.57±0.42	0.53±0.39	0.57±0.36	0.38±0.28**	
Change from baseline to follow-up	0.039±0.16		0.19±0.30		<0.001
Personal care	0.235±0.32	0.233±0.33	0.23±0.32	0.16±0.26**	
Change from baseline to follow-up	0.001±0.10		0.11±0.21		<0.001
CDR (total)	3.55±1.9	3.44±1.7	4.14±1.85	2.7±1.3**	
Change from baseline to follow-up	0.108±0.61		1.44±0.78		<0.001

**p*<0.001 compared with baseline within the group.

Before the study, no significant difference was found in terms of cognitive status, the overall sleep quality and its dimensions in both groups. Most of the elderly adults in the two groups had low cognitive impairment and moderate sleep quality.

Our results also showed that cognitive training can be a proper method to treat insomnia disorder. The cognitive training program improved significantly the overall sleep quality and all subscales of nighttime sleep after the intervention onset over the twelve weeks' interval. Iris Haimov and Shatil[8] showed that cognitive training improved the initiation and maintenance of sleep in older adults with insomnia, which is in accordance with our results.

Jacobs et al. study[20] showed that cognitive behavioural therapy improved sleep-onset latency and sleep efficacy, but no significant difference was observed in actual sleep time in the placebo group and the cognitive behavioural group. Furthermore, the results of the current study demonstrated that cognitive training was effective in improvement of cognitive function and its subscales including memory, time and space orientation, judgment and problem-solving, social affairs, home, recreations and personal matters. Hwang et al.[21] assessed the effect of cognitive training in patients with mild cognitive impairment and early Alzheimer's disease and showed cognitive program training was effective in patients with amnestic mild cognitive

impairment or early Alzheimer's disease, and cognitive training might delay the conversion from AMCI to dementia.

According to the findings of previous studies, cognitive training should be continually followed to improve cognitive health and prevent dementia, and also should be as a part of routine training for older adults' residents in the community. Also in this regard, necessary training should be given to the elderly' families and their caregivers.

Likewise, our results also revealed that cognitive therapy improves sleep quality, meaning that cognitive training program results in a tangible and significant improvement in older adults' cognitive function and consequently sleep quality improvement. Since poor sleep quality is the third most common health problem of the elderly people, ranking behind headaches and gastrointestinal disorders, the most common treatment for this problem is the use of hypnotic medication[22].

Moreover, the results demonstrated that interventions such as cognitive behavioural therapy, along with other non-pharmacological treatments, can improve sleep quality and reduce the use of sedative medication in addition to cognitive function improvement, which is in agreement with other relevant studies.

Further, since promoting health level requires a change in individual lifestyles and a part of this change takes place through education, in this study attendance of older adults at training sessions causes they feel they were able to express their depression and problems through interaction, togetherness and consultation, and undertake a more active role in life and self-care.

There are some limitations to the present study. Despite the beneficial effects demonstrated, the study sample size was limited. There were temporal and spatial constraints concerning the implementation of the cognitive training program in health-care centers, and samples were analyzed merely in the one-month interval after the intervention. A long-term follow-up (6 or 12 months) can lead to better assessment of long-term effects of these programs. Moreover, in this study only patients with sleep disorder such as insomnia included, and other sleep disorders excluded. Due to the fact that the current study conducted only in the elderly population in one of the southern cities of Iran, caution should be used when attempting to generalize the current findings to the elderly people of other cities in Iran. It is suggested that future studies investigate the effectiveness of cognitive group therapy on other psychological variables such as anxiety, aggression and self-efficacy in the older adults, and also the effectiveness of these programs to be studied within older adults residents in nursing homes.

Acknowledgements

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