ACTA FACULTATIS
MEDICAE NAISSENSIS

UDC: 612.821.7-053.9:[636.087.7:546.47
DOI: 10.5937/afmnai39-33101

Original article

Effect of Zinc Supplement on Sleep Quality in Older Adults: A Randomized Clinical Trial Study

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SUMMARY

Introduction/Aim: The use of macronutrient and micronutrient foods is associated with the duration of sleep. This study aimed to determine the effect of zinc supplements on the sleep quality of older adults.
Methods: The current parallel randomized clinical trial study was performed using a convenience sampling method. One hundred and fifty older adults who met the inclusion criteria were assigned to intervention and control group. The participants in the intervention group received a daily dose of 30 mg zinc supplementation pill for 70 days and the control group did not receive any supplement. Sleep quality was measured using the Pittsburgh Sleep Quality Index (PSQI). Serum zinc level in both groups was measured through the auto-analysis method. The questionnaire was completed and the serum level of zinc was measured twice, before the intervention and 70 days after the intervention.
Results: Both groups were homogeneous in terms of demographic variables, sleep quality, and serum zinc level before the intervention. Of all, 73.3% of older adults in the intervention group and 74.7% of older adults in the control group had poor sleep quality. Sleep quality in the intervention group, as compared with the control group, significantly improved after the intervention. Furthermore, serum zinc levels in older adults in the intervention group, as compared with the control group, significantly increased after the intervention.
Conclusion: Based on the results of this study, it is recommended to utilize zinc supplementation as a new therapeutic approach for improving sleep quality in older adults.

Keywords: **complementary medicine, older adult, sleep quality, zinc**

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INTRODUCTION

Sleep quality is a complex phenomenon that is difficult to define. Generally, it can be identified that people think that they sleep well enough, that it lasts long enough, and they feel relaxed. They can also experience their day without falling asleep (1). Aging results in lighter sleep and reduces people's ability to fall asleep (2). A significant percentage of older adults have problems with sleep and generally are not satisfied with their sleep quality (3). Research has shown that sleep problems became one of the most common problems of older adults (4). Poor sleep quality is associated with smoking, high-risk drinking, diabetes, hypertension, obesity, stress, depressive symptoms, and subjective cognitive decline (5). There is insufficient evidence for long-term use of sleeping sedatives for insomnia. Such drugs are limited due to potential side effects, such as cognitive impairment (progressive amnesia), daytime sleepiness, motor imbalances, and the risk of collision with vehicles and falling (6).

Today, many researchers are looking for some useful complementary therapies for sleep disorders (7). The use of dietary supplements as complementary strategies is associated with the improvement in sleep quality (8). More than two billion people in the world are at risk of deficiency of one or more micronutrients, such as calcium, iron, zinc, and vitamins (9 - 11). Zinc is an important mineral that plays a major role in 300 enzymatic reactions in the body. Zinc is an essential factor for proper growth, adjustment of the sensory organs, functioning of the reproductive system, and the maintenance of some parts of the body such as hair, nails, skin, and bone. It also affects the metabolism of carbohydrates, proteins, lipids and alcohol, DNA synthesis, cell regeneration, and other biological functions (12). With aging, the concentration of serum zinc decreases (13). Studies have shown that 35 - 45% of older adults aged 60 or older receive inadequate levels of zinc (14). It has been shown that sleep quality is associated with dietary factors (15). In this regard, the results of the study of Hajianfar et al. showed that sleep quality has a significant relationship with serum zinc levels (16). As an increasing number of people are aging, health problems are increasing. Low sleep quality in older adults is a significant problem that usually remains untreated; on the other hand, many therapeutic approaches have many side effects.

AIM

This study aimed at determining the effect of zinc supplements on sleep quality in community-dwelling older adults in Iran.

PARTICIPANTS AND METHODS

The present study was a parallel randomized clinical trial, registered in the Iranian clinical trial system (Registration code: IRCT2017080635110N2). In this study, the questioners and the analyst were blinded and not informed about enrolling the participants into the intervention and control groups.

Study population

Inclusion criteria

Full consent to participate in the study, being 60 years and older, being Iranian, being able to talk Persian and answer questions, having a low sleep quality (obtaining a score of higher than 5 in Pittsburgh sleep quality questionnaire (PSQI)) (17), not using zinc supplements, not being affected by liver and intestinal diseases (as diagnosed by a physician), and not having a cognitive impairment (in the literate people: a score of 25 and higher in Mini-Mental State Examination (MMSE) questionnaires (18); in illiterate people): a score of 7 and higher in Abbreviated Mental Test as a Screening (AMTS) questionnaire (19).

Exclusion criteria

Lack of cooperation and refusal of older adults to continue the use of zinc supplements, the use of zinc supplements by the subject in the control group during 70 days of intervention, the occurrence of any severe stressful condition such as hospitalization or death of one of the close relatives of the subjects in the two groups during the study, starting taking sleep medications after the initiation of the intervention during the 70 days of the study in the subjects who previously did not take such medications before the onset of the intervention.

Study design

In order to calculate the sampling size, in line with a study by Abdollahzadeh and Naji, the confidence interval of 95% and power of 80% were con-

sidered and the total sample size was calculated as 120 people, with 60 persons for each group (20). In order to increase the efficiency and generalizability of the study results and consider the probable loss of the samples, the total sample size was set at 150, with 75 persons for each subgroup.

In order to carry out the sampling at the city, first we clustered the health centers in Kashan, Isfahan province, Iran that covered different population groups. Then, four health centers were selected from each cluster based on their socioeconomic status and consistent with the statistical data provided by the health deputy of Kashan. Then, stratified sampling was performed taking into account the ratio of older adults in each cluster. Using software, a statistical consultant randomly assigned the subjects into quadruple blocks. The participants were divided into group A (intervention) and group B (control). The randomization was carried out secretly; accordingly, 38 envelopes with four codes were utilized to perform this step. After proving the eligibility of each person to participate in the study, the researcher selected an envelope and carried out the steps mentioned in the envelope. The first author performed the registration of the participants and assigned them to the groups.

Data collection tools and method of application

In this study, the required data were collected via a demographics questionnaire, PSQI questionnaire, interviews with the subjects for assessing the cognitive status, and measurement of the serum zinc level using blood sampling and sending the samples to the laboratory.

The demographics questionnaire collected data on age, sex, marital status, education level, and income level.

In order to assess sleep quality in older adults, we used the PSQI questionnaire developed by Boysse et al. (1989) at the Pittsburgh Psychiatric Institute. The designers measured the validity and reliability of the questionnaire and its Cronbach alpha was 83%. The questionnaire has nine items in its original form, but since the 5th question contains 10 subfields, the entire questionnaire has 19 items that are scored in a 4-point Likert scale from 0 to 3. The questionnaire has seven subscales, including the following: subjective sleep quality, sleep latency, sleep duration, habitual sleep efficiency, sleep disturbances, use of sleeping medication, and daytime dysfunction. The sum of the seven subscores will be from 0 to 21. A score of more than 5 in the entire questionnaire indicates poor sleep quality (17). In a study by Farrahi et al., psychometric properties of the Persian version of this questionnaire were assessed and its validity and reliability are verified (sensitivity of 100%, specificity of 93%, and Cronbach's alpha coefficient of 89% for the questionnaire) (21). The current study assessed the reliability by internal consistency (based on Cronbach's alpha coefficient) ($\alpha = 0.84$).

According to the laboratory references, normal serum zinc level is 72.6 - 127 μg/dL for males and 70 - 114 μg/dL for females (22). Serum level of zinc was measured using an auto-analyzer model OLYMPUS AU400, manufactured in Japan, using the Audit Diagnostics laboratory kit, manufactured in Ireland. When measuring zinc using the selected kit, zinc reacts with the chemical detector of 2-(5-Brom-2-pyridylazo)-5-(N-propyl-N-sulfopropylamino) and forms a red complex which increases the absorption in the measurements; the increase in the absorption is proportional to the zinc concentration.

Procedure

After identifying older adults who were eligible for the study, the first author drew the envelopes one by one as specified; taking into account the group specified in the envelope, the patients were assigned into intervention and control groups. Then, after determining the participants' cognitive status, demographics questionnaire and PSQI questionnaire were completed using the interview guide. Afterward, 5cc of venous blood samples were collected from older adults in both groups to measure serum zinc levels. Blood sampling was performed between 9 – 10 AM. Preserving proper storage condition, the clotted samples were sent to a laboratory to separate the serum and measure serum zinc level. Zinc was measured via auto-analysis. After these steps, zinc supplements containing 30 mg of zinc (Nature Made nutritional supplements) (23) were administered to older adults in the intervention group for 10 weeks (24).

At first, seven pills were delivered to older adults in the intervention group. All of the older adults in the intervention group were requested to come in the health center at the end of the first week

and asked about their possible complications (based on references, a list of possible side effects of zinc supplements was prepared and all participants were asked about these complications). None of the participants in the intervention group had any problems or complications. After ensuring no side effects, the rest of the pills were delivered to older adults in this group. Moreover, older adults in the intervention group received a checklist to record the use or non-use of zinc supplements in the relevant table. In this study, we used Zinc Naturemade Supplement, which contains 30 mg of zinc in the form of zinc gluconate, manufactured in the United States. To conduct the intervention, 30 minutes after lunch, a 30-milligram pill of zinc supplement together with a glass of water was given to older adults in the inter-

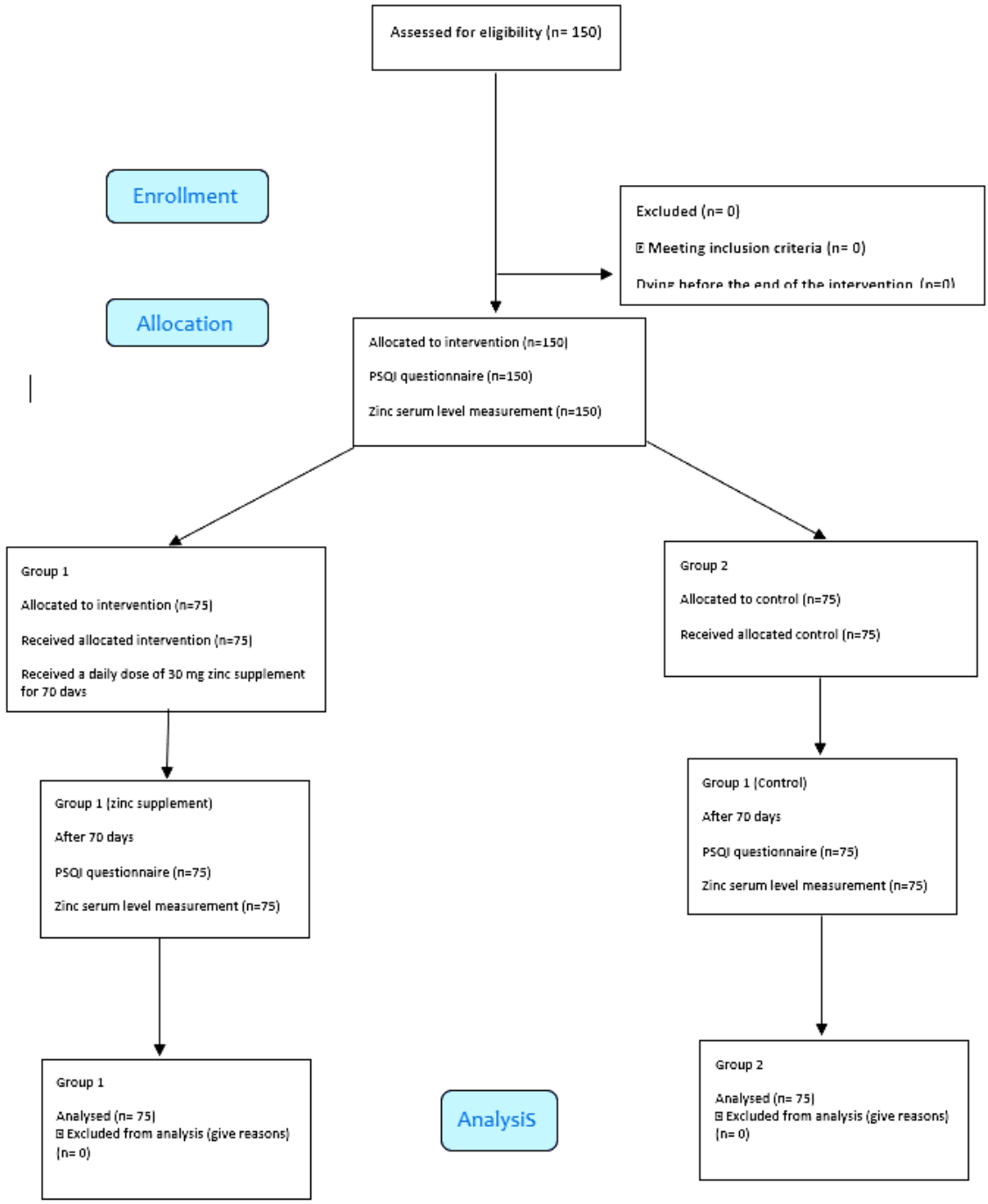

Figure 1. *Flow chart of the study*

vention group. The control group received only routine care (such as measuring the blood pressure, FBS, and if necessary Fecal Immunochemical Test). After the end of the 10-week zinc supplementation, serum zinc level was re-measured one day after the last supplement using the mentioned method and the sleep quality index questionnaire was completed for the subjects in both groups i.e. intervention and control group (Figure 1).

In order to comply with ethical principles, the subjects in the intervention and control group with a serum zinc level below the average level after 70 days of intervention were referred to a nutritionist to receive therapeutic interventions to increase their serum level of zinc. Older adults in each group who had a low sleep quality score, based on the PSQI questionnaire after 70 days, were trained about relaxation exercises.

Statistical analysis

In order to categorize and summarize the findings, descriptive statistics including mean, standard deviation, and absolute and relative frequency were used. Then, in order to achieve the objectives of the study, inferential statistics, Chi-square test, independent t-test (for the comparison of mean differences), analysis of variance (for the comparison between control and intervention groups), and Pearson's correlation test (for the evaluation of the relationship between some of the demographic variables) were used. The normality distribution of the data was evaluated based on the Kolmogorov-Smirnov test, which demonstrated that all variables had a normal distribution. The significance level was considered as $p < 0.05$.

Ethical considerations

This study was approved by the Ethics Committee of Shahroud University of Medical Sciences (registration number: IR.SHMU.REC.1396.80). The aim of the study was explained and informed consent was obtained from all older adults.

RESULTS

In this study, 150 eligible older adults were selected and randomly divided into intervention and control group. The mean and standard deviation of the age of participants in the intervention and control group were 66.8 ± 7.1 and 66.1 ± 5.8 years, respectively. Most of the aged people in both intervention (61.3%) and control (76%) group were female. The mean and standard deviation of the years of education in the intervention and control group were 3.6 ± 3 and 2.9 ± 3.4, respectively. Most of the

Table 1. *Distribution of absolute and relative frequency of older adults based on demographic variables*

Variable		Intervention	Control	P
		(Mean ± SD)	(Mean ± SD)	
Age, year		66.8 ±7.1	66.1 ±5.8	0.48
Education, year		3.6±3	3.4 ±2.9	0.20
Serum zinc level, μg/dL		65.1 ±17.1	68.6 ±10.1	0.12
BMI		23.26 ±4.80	22.38 ±5.02	0.27
		N (%)	**N (%)**	
Sex	Male	29 (38.7)	18 (24)	0.05
	Female	46 (61.3)	57 (76)	
Marital status	Married	61 (81.3)	65 (86.7)	0.37
	Wife or husband died	14 (18.7)	10 (13.3)	
	Retirement	23 (30.6)	19 (25.3)	
Source of income	Subsidy	12 (16)	12 (16)	0.38
	Spouse	29 (38.7)	38 (50.7)	
	Free job	11 (14.7)	6 (8)	
Smoking	Yes	9 (12)	13 (17)	0.35
	No	66 (88)	62 (83)	

P: Pvalue; SD: Standard deviation; N: Number; %: Percent

Table 2. *Mean scores and mean difference of sleep quality scores in both intervention and control group before and after intervention*

Variables		Groups		P
		Intervention (Mean ± SD)	Control (Mean ± SD)	
Mean scores	Baseline	9.16±4.55	9.22±4.62	0.92
	Post intervention	5.64±3.740	9.56±4.79	< 0.001
Mean difference scores		-3.52±4.83	0.33±0.74	< 0.001

P: Pvalue; SD: Standard deviation

Table 3. *Comparison of mean and standard deviation of sleep quality domains of older adults before and after intervention*

Sleep domains	Before intervention			After intervention		
	Intervention group (Mean ±SD)	Control group (Mean ±SD)	P	Intervention group (Mean ±SD)	Control group (Mean ±SD)	P
Subjective sleep quality	1.49±0.72	1.42±0.53	0.91	0.89 ±0.58	1.58 ±0.77	< 0.001
Sleep latency	1.98±1.12	2.01 ±1.10	0.94	1.25 ±1.15	2.09 ±1.06	< 0.001
Sleep duration	1.64±1.20	1.41 ±1.26	0.25	0.97 ±1.05	1.46 ±1.26	0.02
Sleep efficiency	1.12±1.27	1.13 ±1.24	0.82	0.62 ±0.95	1.18 ±1.25	0.004
Sleep disturbances	1.62±0.58	1.64 ±0.53	0.79	1.22 ±0.45	1.66 ±0.55	< 0.001
Use of sleep medication	0.69±1.20	1.02 ±1.38	0.17	0.52 ±1.03	1.02 ±1.38	0.032
Daytime dysfunction	0.60±0.77	0.50 ±0.68	0.50	0.14 ±0.45	0.53 ±0.72	< 0.001

P: Pvalue; SD: Standard deviation

Table 4. *Mean and mean difference of level zinc serum in both intervention and control group before and after intervention*

Variables		Groups		P
		Intervention (Mean ± SD)	Control (Mean ± SD)	
The mean level of zinc serum	Baseline	65.1 ±17.1	68.65 ±10.11	0.12
	Post intervention	79.33 ±10.75	68.08 ±8.99	< 0.001
Mean difference in level of zinc serum		14.22 ±15.48	-0.57 ±1.79	<0.001

P: Pvalue; SD: Standard deviation

participants in both intervention (81.3%) and control (86.7%) group were married. Most of the older adults in both intervention (38.7%) and control (50.7%) group depended on their spouse's income. BMI's mean and standard deviation in the intervention and control group were 23.26 ± 4.80 and 22.38 ± 5.02, respectively. The smoking rate in the intervention and control group was 12% and 17%, respectively. The mean serum zinc level before and after the intervention in both intervention and con-

trol group was 65.1 ± 17.1 and 68.6 ± 10.1, respectively, lower than the normal range based on the laboratory references. Based on the t-test and Chi-square test results, there was no significant difference in the demographic variables before the intervention in both groups, and the two groups were homogeneous (Table 1).

Most of the older adults in the intervention (73.3%) and control (74.7%) group had poor sleep quality before the intervention. In addition, serum zinc level was abnormal and below the normal range in 62.7% and 48% of older adults in the intervention and control group, respectively.

Table 2 presents the mean score and the difference in the mean sleep quality score in both intervention and control group before and after the intervention, based on the independent t-test (2). According to the results presented in this table, there was no significant difference between the two groups in terms of sleep quality before the intervention; however, the mean score of sleep quality in the two groups after the intervention and the difference between the mean sleep quality scores were significant before and after the intervention. In other words, as shown in Table (2), zinc supplementation intervention significantly improved sleep quality in the intervention group.

According to the PSQI questionnaire, the study results showed that all domains of sleep quality before the intervention were not significantly different between the two groups, but after the intervention, all domains of sleep quality improved in the zinc supplement group compared to the control group (Table 3).

Table 4 presents the mean serum zinc level and the differences in mean serum zinc level between intervention and control group before and after the intervention. According to the results presented in this study, there was no significant difference between the serum zinc levels in the two groups before the intervention. However, the mean serum zinc level in the two groups after intervention and also the difference in mean serum zinc level before and after the intervention were significantly different and the serum zinc level in the intervention group was significantly increased. In the intervention group, there was no significant difference between serum levels of zinc in smokers and non-smokers before the intervention, but after the intervention, serum zinc level in smokers was lower than usual and lower than in non-smokers (P = 0.01). However, the sleep quality of smokers and non-smokers in the intervention group was not significantly different (P = 0.12).

Based on the Pearson's correlation test and the results presented in Table 5 before the intervention, there was no significant correlation between sleep quality scores and serum zinc levels. However, there was a significant and negative correlation between sleep quality scores and serum zinc levels after the intervention.

Table 5. *The correlation between the sleep quality score and serum zinc level in older adults before and after intervention*

	Serum zinc level	
	Before intervention	After intervention
Sleep quality score	R = -0.08 P = 0.28	R = -0.29 P = < 0.001

R: Correlation coefficient; P: P value
Significant statistical relationships in this study P < 0.05; CI = 95%
Statistical test used: Pearson correlation

DISCUSSION

According to the results of this study, the majority of older adults (74%) had poor sleep quality before the intervention. In a study conducted in Sweden that aimed at investigating the prevalence of sleep disorders and pain in older adults, 70% of the participants were suffering from sleep problems; their finding is consistent with the results of the present study (25). Also, in another study, the researchers examined sleep quality and its related factors among older adults, residents of Kahrizak nursing home. They found that 88.4% of the subjects had poor sleep quality (26). The higher prevalence of

sleep disorder among older adults living in Kahrizak nursing home than in older adults in our study is due to living conditions in nursing homes that keep older adults away from family and community.

In the present study, serum zinc level in 55.3% of older adults was below the normal range. In another study that investigated serum zinc levels in employees working in Firoozgar Hospital, 47.1% of the subjects had zinc deficiency; this finding is consistent with the result of the present study (27). In a study conducted on European older adults that assessed the risk of malnutrition and zinc deficiency, 10.1% of older adults were suffering from zinc deficiency, which is not in line with the results of our study. The lower prevalence of zinc deficiency in the mentioned study may be due to older adults' better nutritional and socioeconomic status in Europe (28).

In the present study, zinc supplements significantly improved the quality of sleep in the intervention group. In addition, there was a significant difference between the two groups in terms of the mean score of sleep quality before and after the intervention. Mariangela Rondanelli et al. conducted a study to investigate the effect of melatonin, magnesium, and zinc on primary insomnia in residents of a long-term care center in Italy, and the results showed that the quality of sleep was improved in the group receiving the supplement, as compared with the placebo group; it is consistent with the results of the present study (29). Results of a study conducted in Iran that investigated the effect of zinc supplements on the sleep quality of ICU nurses, showed that zinc supplementation improves sleep quality and increases serum zinc level in the intervention group compared with the control group (30).

Consistent with the present study results, Luojus et al. reported a significant and direct correlation between serum zinc levels and participants' sleep hours (31). Also, the results of another study showed that administration of zinc-containing yeast extract to mice increased the total amount of non-rapid eye movement sleep and decreased the locomotor activity (32). In addition to the study by Satio et al. following 12 weeks of administration of the zinc-rich food, the time necessary to fall asleep efficiently decreased and sleep efficiency improved, while the sleep onset latency significantly improved after consumption zinc-enriched yeast and astaxanthin oil (33). Moreover, zinc deficiency is seen in acute inflammatory responses and infection (34). In a study conducted to investigate the effect of zinc supplementation on the mood of women, results showed that serum zinc level in the zinc supplementation group was increased compared to pre-intervention but did not change in the placebo group. In addition, depression and anger were decreased in the intervention group compared to the placebo group. This study showed that zinc supplementation was effective in the intervention group despite using a placebo (having a placebo group) (24). According to the study results of Samad et al., obese patients with sleep deficits had significantly lower levels of serum zinc than non-obese subjects with standard sleep patterns (35). In one cohort study that aimed to investigate the relationship between serum zinc concentrations and the quality of sleep in childhood, it was found that low serum zinc concentrations were associated with poor sleep quality of children aged 11 - 15 years. Moreover, the longitudinal analysis showed that low zinc concentrations in children aged 3 - 5 years was a predictor of poor sleep quality in children aged 11 - 15 years (36). It should be noted that Grandner et al. showed differences in habitual zinc intake according to sleep duration. Therefore, the decrease in dietary zinc was associated with a significant decrease in very short sleep but not sleep quality (37). There is no explicit knowledge about zinc's precise mechanism of action in the CNS that improves sleep quality. Many studies have investigated the activity of Zn^{2+} in the brain, and a majority of them have focused on zinc interaction with the glutamatergic receptors; it might be attributed to the fact that Zn^{2+} exists mainly in the presynaptic vesicles of glutamatergic neurons to be co-released with glutamate. In addition, a number of other receptors have interaction with zinc. Furthermore, Zn^{2+} exists in glutamatergic axon terminals and is present in some inhibitory axon terminals, possibly glycinergic, of the cerebellum and the spinal cord (38).

The present study showed that 30 mg of zinc supplement significantly improved and increased serum zinc level in the intervention group. A previous study observed that the mean serum zinc level after 15 days of zinc supplementation (120 mg) was significantly increased in the intervention group and reached the normal range (39). This finding is also consistent with the results of our study. El-Shazly et al. conducted a study to investigate the effect of zinc supplements on body mass index and serum levels of zinc and leptin in hemodialysis children. In line with our findings, after 90 days of intervention using

22 mg of zinc, serum zinc levels in the intervention group showed a significant increase, while there was no significant difference in the control group (40).

The results of current research revealed that older adults with higher levels of zinc reported higher levels of sleep quality after the intervention, knowing that the pill consumption for sleep in the intervention group can affect their sleep quality; thus, the lack of placebo group is a limitation of our study. Since the zinc content of the diet has not been measured in this study, consuming foods rich in zinc at the time of the study could affect serum zinc. Therefore, it was not possible for researchers to control this limitation. Moreover, the placebo group has been suggested in the initial proposal, but the ethics council approved the non-intervention group. Since this paper is the result of a master's thesis, due to time constraints, it was not possible to measure sleep in a laboratory setting. Also, in the present study, some variables (e.g. physical activity or physical illness) that could affect sleep quality were not evaluated. In connection with some sleep-related disorders (such as sleep apnea, sleep rhythm disorders, restless legs syndrome, obesity and etc.), if a physician previously diagnosed these disorders, older adults with these disorders were not included in the study. However, since the present study results from a geriatric nursing dissertation, the researcher has faced a time limit during sampling. Therefore, no screening was performed to identify these disorders during the sampling.

CONCLUSION

Given the increasing population of older adults in different parts of the world, especially Iran, the prevalence of sleep problems in older adults is high and poor sleep quality is one of the most common problems in this population group. Therapeutic strategies adopted to improve sleep quality are often inefficient and associated with side effects. The present study showed that zinc supplements improve the quality of sleep in older adults. Therefore, given the nurse's role in the prevention and treatment of diseases, the use of zinc supplements is recommended as a new therapeutic approach to improve sleep quality in older adults.

Acknowledgements

The present paper was extracted from a master thesis in nursing conducted at Shahroud University of Medical Sciences. This university approved this research under the code 9671 and registered in the Iranian clinical trial system with code IRCT2017080635110N2. The authors would like to thank the Deputy of Research and Technology of this university and all older adults and staff of the health center of Kashan city who helped us in this research.

Conflict of interest statement

The authors declare that they have no conflict of interest.

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Received: July 12, 2021
Revised: March 6, 2022
Accepted: April 3, 2022
Online first: June 2, 2022

Efekat suplemenata cinka na kvalitet sna kod starijih: randomizovana klinička studija

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SAŽETAK

Uvod/Cilj. Upotreba makronutritivne i mikronutritivne hrane dovodi se u vezu sa dužinom spavanja. Cilj ove studije bilo je određivanje efekata suplemenata cinka na kvalitet sna starijih osoba.
Metode. Paralelna randomizovana klinička studija sprovedena je primenom prigodne metode uzorkovanja. Sto pedeset starijih osoba, koje su ispunile kriterijume uključivanja, podeljene su interventnu i kontrolnu grupu. Učesnici interventne grupe primali su dnevnu dozu od 30 mg suplementa cinka u trajanju od 70 dana, dok ispitanici kontrolne grupe nisu primali nikakav suplement. Kvalitet sna meren je primenom Pittsburgh Sleep Quality Index (PSQI). Nivo cinka u serumu kod ispitanika obeju grupa meren je metodom autoanalize. Popunjen je upitnik, a nivo cinka u serumu izmeren dva puta, pre intervencije i 70 dana nakon intervencije.
Rezultati. Ispitanici obe grupe bile su homogeni u pogledu demografskih varijabli, kvaliteta sna i nivoa cinka u serumu pre intervencije. Loš kvalitet sna zabeležen je kod 73,3% starije populacije interventne grupe i 74,7 % kontrolne grupe. Kvalitet sna ispitanika interventne grupe, u poređenju sa ispitanicima kontrolne grupe, značajno se poboljšao nakon intervencije. Štaviše, nivoi cinka u serumu kod starije populacije interventne grupe, u poređenju sa populacijom kontrolne grupe, značajno su porasli nakon intervencije.
Zaključak. Na osnovu rezultata ove studije preporučuje se primena suplemenata cinka, kao novog terapeutskog pristupa za poboljšanje kvaliteta sna kod starijih ososba.

Ključne reči: **komplementarna medicina, starije osobe, kvalitet sna, cink**