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The Effect of a Foot Bath on Sleep Quality in the Elderly: A Single-Blind Randomized Controlled Trial

Ayak Banyosunun Yaşlılarda Uyku Kalitesi Üzerine Etkisi: Tek Kör Randomize Kontrollü Bir Çalışma

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ABSTRACT

Objective: This study was conducted as a single-blind, randomized controlled parallel-group study with 50 elderly individuals to investigate the effect of foot bath on sleep quality.

Methods: The data were collected using the "Elderly Information Form" and the "Pittsburgh Sleep Quality Index (PSQI)" between 1 May 2022-1 July 2022 at a State Hospital in Gümüşhane province. The elderly in the foot bath group were given a foot bath with 41-42°C water for 20 minutes 50 minutes before normal sleep hours. No application was made to the control group except for the administration of data collection tools. The data were analyzed with Chi-square, Friedman, Wilcoxon Sign, and Mann-Whitney U tests.

Results: It was determined that at least one of the total PSQI measurements and median scores of all subcomponents obtained from the elderly in the foot bath group differed depending on time (P<.05). However, it was found that there was no statistically significant difference in the sleep latency (B2), sleep duration (B3), habitual sleep efficiency (B4) and sleep disturbance (B5) component measurements obtained from the elderly in the control group depending on time (P>.05). Again, All PSQI subcomponents and total PSQI scores, except for the subcomponent "Habitual Sleep Efficiency (C4)", decreased throughout the application in the elderly in the foot bath group.

Conclusion: As a result, a foot bath improved sleep quality in the elderly. In line with the findings from this study, it is recommended to compare the foot bath with multiple experimental groups for a longer period of time.

Keywords: Elderly, sleep, foot, complementary therapies

ÖZ

Amaç: Bu çalışma, ayak banyosunun uyku kalitesine etkisini araştırmak amacıyla 50 yaşlı birey ile tek kör, randomize kontrollü paralel gruplu bir çalışma olarak yürütüldü.

Yöntemler: Veriler "Yaşlı Bilgi Formu" ve "Pittsburgh Uyku Kalitesi İndeksi (PUKİ)" kullanılarak 1 Mayıs 2022 - 1 Temmuz 2022 tarihleri arasında Gümüşhane ili bir Devlet Hastanesinde toplandı. Ayak banyosu grubundaki yaşlılara normal uyku saatinden 50 dakika önce 41-42°C su ile 20 dakika ayak banyosu yapıldı. Kontrol grubuna veri toplama araçlarının uygulanması dışında herhangi bir uygulama yapılmadı. Veriler Ki-kare, Friedman, Wilcoxon İşareti ve Mann-Whitney U testleri ile analiz edildi.

Bulgular: Ayak banyosu grubundaki yaşlılardan elde edilen toplam PSQI ölçümlerinden ve tüm alt bileşenlerin medyan puanlarının en az birinin zamana bağlı olarak farklılık gösterdiği belirlendi (P<.05). Ancak kontrol grubundaki yaşlılardan elde edilen uyku latensi (B2), uyku süresi (B3), alışılmış uyku etkinliği (B4) ve uyku bozukluğu (B5) bileşen ölçümlerinde zamana bağlı olarak istatistiksel olarak anlamlı bir fark olmadığı bulundu (P>.05). Ayrıca, ayak banyosu grubundaki yaşlılarda uygulama boyunca "Alışkanlık Uyku Verimliliği (C4)" alt bileşeni dışındaki tüm PUKİ alt bileşenleri ve toplam PUKİ puanları azaldı.

Sonuç: Sonuç olarak ayak banyosunun yaşlılarda uyku kalitesini arttırdığı görüldü. Bu çalışmadan elde edilen bulgular doğrultusunda, ayak banyosunun çoklu deney grupları ile daha uzun süre karşılaştırılması önerilmektedir.

Anahtar Kelimeler: Yaşlı, uyku, ayak, tamamlayıcı tedaviler

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INTRODUCTION

Sleep consists of psychological, physiological, and social dimensions and has an extremely significant function in meeting basic human needs. Sleep affects everyone's daily life and quality of life.[1-3] One of the concepts that have been emphasized and gained importance recently is "*sleep quality".* Sleep quality is defined as "an individual's feeling ready and energetic for a new day after waking up". It is thought that sleep quality also has quantitative aspects such as falling asleep, sleep duration, number of awakenings at night, and subjective aspects such as restfulness or depth of sleep.[4,5]

The population of elderly individuals is increasing day by day worldwide. In the changing age pyramid, the rate of elderly population was 9.7 % (8245124 people) (over 65 years of age) in 2021 and is estimated to be 11.0 % in 2025, 12.9 % in 2030, 16.3 % in 2040, 22.6 % in 2060, and 25.6% in 2080.[6,7] With increasing age, changes occur in normal sleep patterns, complaints of insomnia increase, and satisfaction with sleep quality decreases.[8] According to a literature review, sleep problems rank third among the reasons for visiting a doctor in the elderly, after digestive system problems and headache symptoms.[6] The inability to fall asleep, waking up early in the morning, waking up frequently at night, and sleeping during the day are among the most common sleep-related problems in the elderly.[9]

Sleep problems in the elderly can cause serious problems but are also preventable. In this sense, all health personnel, especially nurses, should apply comprehensive nursing care to minimize sleep problems and improve sleep quality in the elderly. Pharmacological treatment is generally employed in the elimination of sleep problems. However, pharmacological treatment is inadequate in eliminating sleep problems, so the elderly continuously use medication, which can cause side effects. On the other hand, the tendency toward non-pharmacological treatment has recently increased, and developments have been achieved in non-pharmacological treatment methods.[4] It has been reported that methods such as music therapy, eye mask, complementary therapies, massage, aromatherapy, and a foot bath are used to improve the sleep quality of elderly people with sleep problems.[10] Foot baths are reported to facilitate falling asleep by affecting body temperature. Sleep quality may improve in patients whose falling asleep process becomes easier.[11-13] However, there are international studies examining sleep quality [9, 14-19] or sleep latency [20] in the elderly. In Turkey, studies have been conducted on the effect of foot bath on sleep quality in cancer patients,[21] individuals with Chronic Obstructive Pulmonary Disease [22] and university students with premenstrual syndrome,[23] but there has not been a study in which foot bath has been performed in healthy elderly individuals. Within the scope of this information, the effect of foot bath on sleep quality in healthy elderly individuals who grew up with Turkish culture was examined in this study. Within the framework of the positive results obtained from this study, it is expected that foot bath will also increase sleep quality in elderly individuals living in Turkey. In addition, the applicability and effectiveness of a non-pharmacological application such as foot bath on elderly individuals who grew up with Turkish culture was proven with this study.

AIM

The aim of this study was to investigate the effects of foot bath applied for 8 weeks on sleep quality in elderly people living in a rural area in Turkey.

Research hypothesis

H_1: Foot bath has a positive effect on the sleep quality of the elderly.

H_0: Foot bath does not have a positive effect on the sleep quality of the elderly.

METHODS

Type of Research

This study was carried out as a single-blind randomized single-blind, randomized controlled parallel-group study to investigate the effect of a foot bath on sleep quality in the elderly.

Place and Time of the Study

The data were collected between 1 May 2022 and 1 July 2022 in a State Hospital in Gümüşhane.

Population and Sample of the Study

The population consisted of acquaintances of the elderly (such as relatives, neighbors, or friends) aged 65 years and over of the patients who came to the Medical Clinic of a State Hospital in Gümüşhane between 1 May 2022 and 1 July 2022. Power analysis was performed to select the elderly to be sampled. The sample size was calculated as 36 (18 for each group) elderly in total for the two groups (foot bath group, control group) with an effect size of 1,000 and the power of the targeted test was 0.90 (90%) in the G*Power 3.1.9.6 program with the error of α=0.05 and a reference to a previous study on the subject.[24] Considering the cases such as withdrawal from the study or death during the research, each group was increased and a total of 50 elderly individuals, 25 elderly people for each group, were recruited for the study (Figure 1). The study was registered on Clinical Trials (NCT05572554).

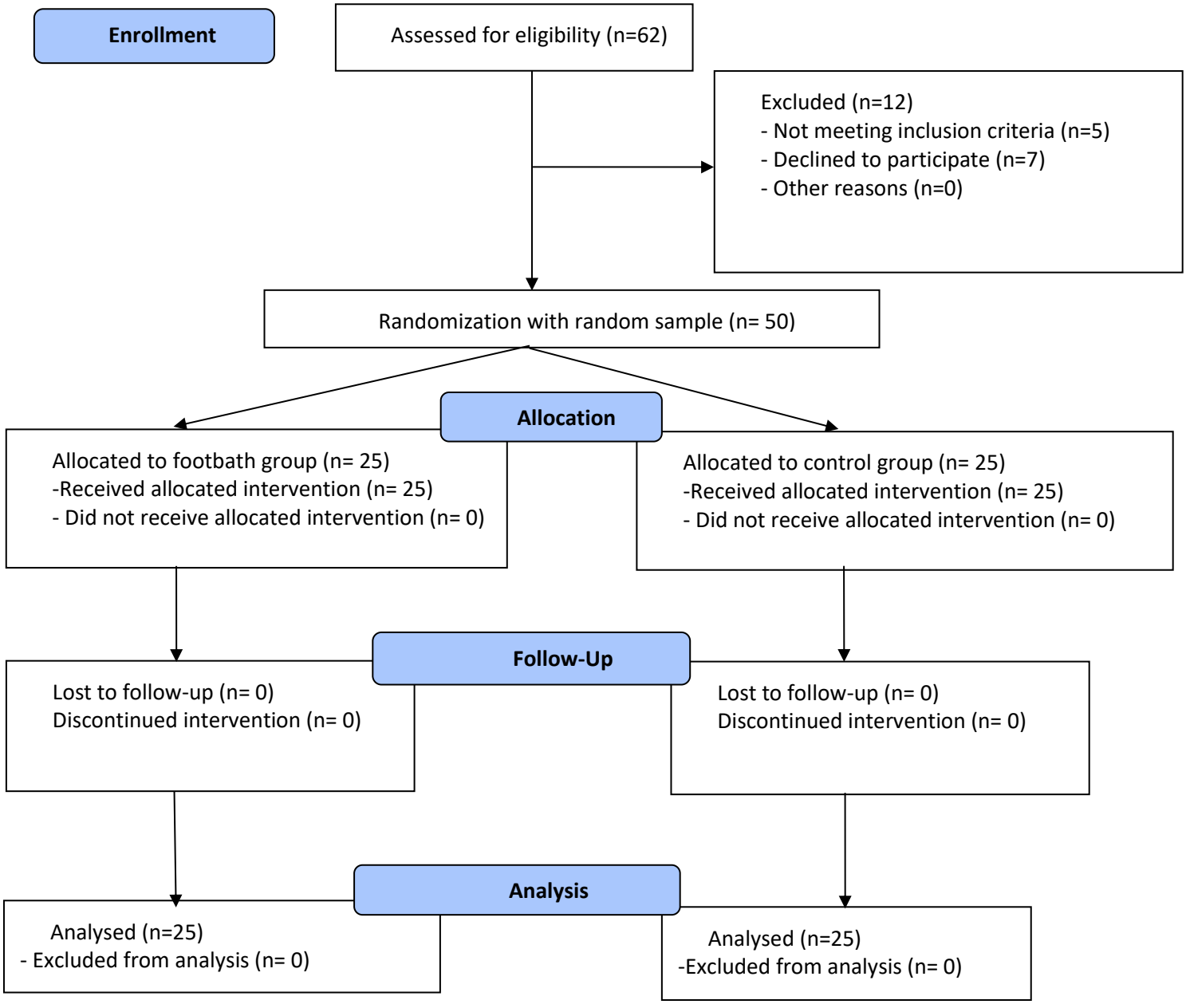

Figure 1. The Study CONSORT Flow Diagram

For patient randomization, the block randomization method was employed to maintain balance between the groups in terms of participant numbers. Given that an equal number of groups and probabilities were required within each block, block sizes of 8 participants were established, with 4 participants in the experimental group and 4 participants in the control group per block, in accordance with established literature. A random number table ranging from 1 to 70 was generated using Microsoft Excel to randomize the blocks. The study concluded once a sufficient number of blocks, corresponding to the total number of sampled patients in the randomized blocks were completed.

In the study, which was planned as *a single-blind randomized controlled clinical trial*, the researcher who applied the data collection tools and the one who randomized the foot bath group, and the control group were different people to reduce bias.

Variables of the Study

Baseline and Independent variables of the study; The descriptive characteristics of the elderly (age, gender,

marital status, education level, occupation, income perception level, presence of chronic disease, presence of pain, health perception level) are the baseline variables and foot bath application is the independent variable.

Dependent variables of the study; The Pittsburgh Sleep Quality Index (PSQI) score of the elderly.

Inclusion Criteria

- Those aged 65 and over,
- Being literate,
- Performing activities of daily living,
- Not having problems with the sense organs (such as eyes, ears, skin),
- Not being paraplegic/hemiplegic,
- Not working the night shift,
- Having a mobile phone that can make video a call or having a relative with such a phone,
- No impairment in mental and cognitive functions (score of 24 or higher on the Standardized Mini Mental Test (SMTT); score of 21 or higher on the Montreal Cognitive Assessment (MOCA) Scale).

Exclusion Criteria

- Refusing to participate in the research,
- Having psychological disorders,
- Using complementary therapy to sleep,
- Having enuresis,
- Being bedridden or using a wheelchair,
- Having more than 10 years of diagnosis of diabetes or diabetes-related neuropathy.

Data Collection Tools

The data were collected using the "Elderly Information Form" and "PSQI".

The Elderly Information Form: The form, created in line with the literature, includes 9 questions about the descriptive characteristics of the elderly (age, gender, marital status, education level, occupation, income perception level, presence of chronic disease, presence of pain, and health perception level).[1-10]

The Pittsburgh Sleep Quality Index (PSQI): PSQI is an index that questions sleep quality, type, and severity of sleep disturbance in the last month in adults. 19 questions are answered by the person himself/herself, and 5 questions are answered by the person's bedmate or people sleeping in the same room. The questions answered by the person to whom the index is applied are taken into consideration in the scoring, while the others answered by the bed/roommate are not taken into consideration. Seven subcomponents are assessed with 19 questions answered by the respondent: "subjective sleep quality (Component (C)1)", "sleep latency (C2)", "sleep duration (C3)", "habitual sleep efficiency (C4)", "sleep disturbances (C5)", "use of sleeping medication (C6)" and "daytime dysfunction (C7)". Each item in the index takes a value between 0 (no distress) and 3 (severe distress). The sum of the scores related to the seven sub-dimensions gives the total PSQI score. The score of each sub-dimension varies between 0 and 3, and the total PSQI score varies between 0-21. Sleep quality of those with a total score of 5 and below is considered "good".[25--26] The Turkish validity and reliability study of the PSQI was performed by Ağargün et al. and the internal consistency coefficient was reported to be 0.80.[27] In this study, the test-retest Cronbach alpha value of the PSQI was calculated as 0.903.

Data collection method

All the participants in the study were contacted by telephone and invited to the study. The data collection method of the study is presented below for all two groups.

Foot Bath Group

The elderly in this group were taught the foot bath practically one by one by the researcher at the pre-study meeting and were also given the "Foot Bath Information Brochure" and a "Personalized Water Thermometer". The information/teaching continued until all the elderly in the group performed the foot bath correctly. The other researcher administered the "Elderly Information Form" and "PSQI" to all elderly people before the study using individual interviews lasting approximately 15 minutes and pen and paper method. The elderly were asked to soak their feet in the water in a marked plastic container with a depth of 10 centimeters and a temperature of 41-42°C for 20 minutes up to their ankles 50 minutes before normal sleeping hours every night for 8 weeks. Each elderly person was video-called by the researcher once a week to monitor their foot bath practices and to monitor whether the foot bath practice was performed correctly. In addition, the PSQI, which provides information about sleep quality, type, and severity of sleep disturbance, was applied to the elderly before the study (pretest), 4th week (interim measurement/1st measurement), and at the end of the study (8th week) for a total of 3 times during 8 weeks.

The Foot Bath Information Brochure: This brochure was created by the researcher and included information on the benefits of a foot bath and how to perform a foot bath (50 minutes before bedtime each night, the participants were to immerse their feet up to their ankles in a marked plastic container of water 10 centimeters deep and 41-42°C, measured with a water thermometer, for 20 minutes).

A Water Thermometer: It is a "Robitshop TP101" brand

thermometer used to measure the degree of water used in the foot bath application of the elderly. The measurement range of the thermometer is -50 to +300 °C and works with a 1.5 Volt button battery.

Control Group

No application was made to the elderly in this group. Only the PSQI, which gives information about sleep quality, type, and severity of sleep disturbance, was administered to the elderly before the study (pretest), at the 4th week (interim measurement/1st measurement), and at the end of the study (8th week) for a total of 3 times for 8 weeks.

Strengths and Limitations of the Study

Strengths of the Study: In our study, the application of foot bath with 41-42°C water for 8 weeks is the longest compared to the studies conducted with the same water temperature. This methodological difference is the strength of the study.

Ethical Considerations

Written institutional permission was obtained from Gümüşhane Provincial Health Directorate (dated 29/04/2022 and numbered E-51020271-044), and ethics committee permission was obtained from Gümüşhane University Scientific Research and Publication Ethics Committee (dated 27/04/2022 and numbered 2022/03) for a State Hospital. Verbal and written informed consent was obtained from the elderly involved in the study.

Data Analysis

The data were evaluated with the licensed *SPSS (Statistical Package for Social Sciences)* 23.0 package program. It is reported in the literature that non-parametric tests should be used in experimental studies when the number of subjects in the groups is less than 30 because the probability of fitting the data to the normal distribution will decrease.[28] Since the number of subjects in the groups (foot bath group=25, control group=25) was less than 30, the Chi-square test was used to compare categorical variables according to groups, and the Mann-Whitney U test was used to compare numerical variables according to groups. Friedman test in dependent groups and Wilcoxon Sign Test with Bonferroni correction were performed to evaluate changes over time. The Mann-Whitney U test with Bonferroni correction was used to determine the difference between the groups. The results were evaluated at a 95% confidence interval and significance level of $P<.05$.

RESULTS

In this study, the effect of a foot bath on sleep quality in elderly people aged 65 years and older was investigated.

Table 1. Distribution of Baseline Variables of The Elderly According to Groups (n=50)

Descriptive characteristics		Foot Bath Group (n=25)*	Control Group (n=25)*	Test Statistics; *P*
Age	x̄±SS	68.68±3.69	68.76±3.30	Z=-0.383[b]; .702
	Median (Min-Max)	68 (65-81)	69 (65-81)	
Gender	Male	15 (60.0)	12 (48.0)	χ2=0.725[a]; .395
	Female	10(40.0)	13(52.0)	
Marital status	Married	13 (52.0)	18 (72.0)	χ2=2.122[a]; .145
	Single (Widow(er)/ Divorced)	12 (48.0)	7(28.0)	
Education level	Primary school/ Literate	9 (36.0)	12 (48.0)	χ2=0.781[a]; .677
	Secondary/High school	8 (32.0)	6 (24.0)	
	Undergraduate and over	8 (32.0)	7 (28.0)	
Occupation	Housewife	7 (28.0)	10 (40.0)	χ2=0.868[a]; .648
	Retired	10 (40.0)	9 (36.0)	
	Employed	8 (32.0)	6 (24.0)	
Perception of income	Income less than expenditure	10 (40.0)	7 (28.0)	χ2=1.001[a]; .606
	Income equal to expenditure	8 (32.0)	11 (44.0)	
	Income more than expenditure	7 (28.0)	7 (28.0)	
Chronic disease	Yes	18 (72.0)	19 (76.0)	χ2=0.104[a]; .747
	No	7 (28.0)	6 (24.0)	
Pain	Yes	15 (60.0)	16 (64.0)	χ2=0.085[a]; .771
	No	10 (40.0)	6 (36.0)	
Health perception level	Good	9 (36.0)	5 (20.0)	χ2=2.476[a]; .290
	Moderate	12 (48.0)	12 (48.0)	
	Bad	4 (16.0)	8 (32.0)	

*Percentage of columns was taken, [a]Chi-square test p<0.05, [b]Mann-Whitney U test p<0.05, Med; Median, Min; Minimum, Max; Maximum

Table 1 shows the distribution of the descriptive information about the elderly according to the groups. There was no statistically significant difference between the foot bath group and the control group in terms of gender, marital status, education level, occupation, income perception level, presence of chronic disease, presence of pain, health perception level, and mean age (*P*>.05) (Table 1).

Table 2 shows that as a result of the Friedman test, at least one of the median scores of subjective sleep quality (C1), use of sleeping medication (C6), daytime dysfunction (C7) components, and total PSQI measurements differed between the foot bath and control groups (*P*<.05).

As a result of the Friedman test, it was found that at least one of the median scores of sleep latency (C2), sleep duration (C3), habitual sleep efficiency (C4) and sleep disturbance (C5) component measurements in the foot bath group differed depending on time (*P*<.05), but there was no statistically significant difference in the control group (*P*>.05) (Table 2).

Table 2. The Time-Dependent Differences in Pittsburgh Sleep Quality Index (PSQI) and Subcomponent Mean Scores of the Foot Bath and Control Group Elderly (n=50)

Component (C)		Foot bath group (n=25) Median (25.-75. Percentile)	Control Group (n=25) Median (25.-75. Percentile)
C1: Subjective sleep quality	Pretest	2.0 (2.0-3.0)	2.0 (1.5-3.0)
	1st measurement	2.0 (1.0-2.0)	2.0 (2.0-3.0)
	Posttest	1.0 (1.0-1.0)	2.0 (2.0-3.0)
	χ2; *P*	χ2=35.343; **<.001***	χ2=6.703; **.035***
C2: Sleep latency	Pretest	2.0 (2.0-3.0)	2.0 (1.5-3.0)
	1st measurement	2.0 (1.0-2.0)	2.0 (2.0-3.0)
	Posttest	1.0 (0.5-1.0)	2.0 (2.0-3.0)
	χ2; *P*	χ2=38.675; **<.001***	χ2=1.786; *P*=0.409
C3: Sleep duration	Pretest	2.0 (2.0-3.0)	2.0 (2.0-3.0)
	1st measurement	2.0 (1.0-2.0)	2.0 (2.0-3.0)
	Posttest	1.0 (0-1.0)	2.0 (2.0-3.0)
	χ2; *P*	χ2=37.520; **<.001***	χ2=0.080; *P*=0.961
C4: Habitual sleep efficiency	Pretest	2.0 (1.0-2.5)	2.0 (2.0-3.0)
	1st measurement	3.0 (3.0-3.0)	2.0 (2.0-3.0)
	Posttest	1.0 (0-1.5)	2.0 (2.0-3.0)
	χ2; *P*	χ2=35.086; **<.001***	χ2=2.545; *P*=0.280
C5: Sleep disturbances	Pretest	2.0 (1.0-2.0)	1.0 (1.0-2.0)
	1st measurement	1.0 (1.0-1.0)	2.0 (1.0-2.0)
	Posttest	1.0 (1.0-1.0)	2.0 (1.0-2.0)
	χ2; *P*	χ2=23.286; **<.001***	χ2=0.889; *P*=0.641
C6: Use of sleeping medication	Pretest	1.0 (0-2.0)	1.0 (0-2.0)
	1st measurement	0 (0-1.0)	1.0 (1.0-2.0)
	Posttest	0 (0-1.0)	2.0 (1.0-3.0)
	χ2; *P*	χ2=15.872; **<.001***	χ2=11.231; **.004***
C7: Daytime dysfunction	Pretest	2.0 (2.0-3.0)	2.0 (2.0-3.0)
	1st measurement	1.0 (1.0-2.0)	3.0 (2.0-3.0)
	Posttest	1.0 (0-1.0)	3.0 (2.0-3.0)
	χ2; *P*	χ2=32.909; **<.001***	χ2=13.400; **.001***
Total PSQI score	Pretest	14.0 (13.0-15.0)	13.0 (12.0-16.0)
	1st measurement	9.0 (8.0-11.5)	15.0 (13.5-16.0)
	Posttest	5.0 (4.0-8.0)	15.0 (14.0-17.0)
	χ2; *P*	χ2=50.000; **<.001***	χ2=15.564; **<.001***

*Friedman test *P*<0.05

According to the nonparametric Wilcoxon test pairwise to determine whether there was a significant difference between the Subjective Sleep Quality (C1) in the foot bath and control groups in Table 3, a statistically significant difference was found between the pretest and 1st measurement (Z=-3.464; *P*=.001), 1st measurement and posttest (Z=-4.179; *P*<.001), and 1st measurement and posttest (Z=-4.000; *P*<.001) in the foot bath group (Bonferroni corrected *P*<.017). In the control group, there

was no statistically significant difference between the mean ranks of the Subjective Sleep Quality (C1) of pretest and 1st measurement (Z=-1.667; *P*=.096), pretest and posttest (Z=-2.138; *P*=.033), 1st measurement and posttest (Z=-1.342; *P*=.180) (Bonferroni corrected *P*>.017) (Table 3).

Table 3. The Time-Dependent Differences in Pittsburgh Sleep Quality Index (PSQI) And Subcomponent Scores Between The Foot Bath and Control Groups (n=50)

Subcomponent		Foot bath group (n=25)		Control Group (n=25)		MWU		
		Z	*P*	Z	*P*	Measurement Difference	U	*P*
C1: Subjective Sleep Quality	Pretest-1.measurement	-3.464[b]	**.001***	-1.667[c]	.096	-	-	-
	Pretest-Posttest	-4.179[b]	**<.001***	-2.138[c]	.033	-	-	-
	1.measurement-Posttest	-4.000[b]	**<.001***	-1.342[c]	.180	-	-	-
C6: Use of sleeping medication	Pretest-1. measurement	-3.162[b]	**.002***	-1.155[c]	.248	-	-	-
	Pretest-Posttest	-2.961[b]	**.003***	-2.461[c]	**.014***	(PRT-POT)	140.5	**<.001****
	1.measurement-Posttest	-1.897[b]	.058	-3.051[c]	**.002***	-	-	-
C7: Daytime Dysfunction	Pretest-1. measurement	-4.146[b]	**<.001***	-3.000[c]	**.003***	(PRT-1)	56.0	**<.001****
	Pretest-Posttest	-4.045[b]	**<.001***	-2.646[c]	**.008***	(PRT-POT)	57.5	**<.001****
	1.measurement-Posttest	-3.578[b]	**<.001***	-1.000[b]	.317	-	-	-
Total PSQI score	Pretest-1. measurement	-4.391[b]	**<.001***	-1.712[c]	.087	-	-	-
	Pretest-Posttest	-4.384[b]	**<.001***	-3.119[c]	**.002***	(PRT-POT)	1.5	**<.001****
	1.measurement-Posttest	-4.387[b]	**<.001***	-2.754[c]	**.006***	(1-POT)	3.0	**<.001****

*Wilcoxon test (Bonferroni corrected *P*<0.017); MWU: Mann-Whitney U; **Mann-Whitney U test and p<0.05; b: Negative rankings; c: Positive rankings; PRT: Pretest; POT: Posttest

According to the results of the nonparametric Wilcoxon test pairwise comparison, a statistically significant difference was found between the mean ranks of the pretest and 1st measurement (Z=-3.162; *P*=.002), and pretest and posttest (Z=-2.961; *P*=<.003) of the Use of Sleeping Medication (C6) in the foot bath group (Bonferroni corrected *P*<.017); however, no statistically significant difference was found between the mean ranks of the 1st measurement and posttest (Z=-1.897; *P*=.058) (Bonferroni corrected *P*>.017). In the control group, there was a statistically significant difference between the mean ranks of the pretest and posttest (Z=-2.461; *P*=.014), 1st measurement and posttest (Z=-3.051; *P*=.002) of the Use of Sleeping Medication (C6) (Bonferroni corrected *P*<.017), but there was no statistically significant difference between the mean ranks of the pretest and 1st measurement (Z=-1.155; *P*=.248) (Bonferroni corrected *P*>.017) (Table 3). The result of the nonparametric Mann-Whitney U test, which was applied to determine whether the Use of Sleeping Medication (C6) scores of the elderly differed significantly according to the foot bath and control groups, showed a statistically significant difference between the groups at *P*<.05 level in favor of the foot bath group (Table 3).

According to the nonparametric Wilcoxon test pairwise comparison results in Table 3, there was a statistically significant difference between the mean ranks of Daytime Dysfunction (C7) in the pretest and 1st measurement (Z=-4.146; *P*<.001), pretest and posttest (Z=-4.045; *P*<.001), 1st measurement and posttest (Z=-3.578; *P*<.001) in the foot bath group (Bonferroni corrected *P*<.017). In the control group, there was a statistically significant difference (Bonferroni corrected *P*<.017) between pretest and 1st measurement (Z=-3.000; *P*=.003), pretest and posttest (Z=-2.646; *P*=.008) of Daytime Dysfunction (C7) rank means, however, there was no statistically significant difference between the 1st measurement and posttest (Z=-1.000; *P*=.317) Daytime Dysfunction (C7) mean scores (Bonferroni corrected *P*>.017) (Table 3). According to the result of the nonparametric Mann-Whitney U test applied to determine whether the Daytime Dysfunction (C7) scores differed significantly between the groups, a statistically significant difference was found at the *P*<.05 level in favor of the foot bath group (Table 3).

According to the pairwise comparison results of the nonparametric Wilcoxon test, a statistically significant difference was found between the mean ranks of the total PSQI score of the pretest and 1st measurement (Z=-4.391; *P*<.001), pretest and posttest (Z=-4.384; *P*<.001), 1st measurement and posttest (Z=-4.387; *P*<.001) of the foot bath group (Bonferroni corrected *P*<.017). While there was a statistically significant difference between the mean ranks of the total PSQI score of the control group in the pretest and posttest (Z=-3.119; *P*=.002), 1st measurement and posttest (Z=-2.754; *P*=.006) (Bonferroni corrected *P*<.017), there was no statistically significant difference

between the mean ranks of the pretest and 1st measurement (Z=-1.712; *P*=.087) (Bonferroni corrected *P*>.017) (Table 3). According to the result of the nonparametric Mann-Whitney U test applied to determine whether the Total PSQI scores differed significantly between the groups, a statistically significant difference was found at the p<0.05 level in favor of the foot bath group (Table 3).

DISCUSSION

In this study, sleep quality scores were similar before foot bath application. This is thought to be due to the normal distribution of the data. In the literature, foot baths are reported to facilitate falling asleep by affecting body temperature. There is a negative relationship between core body temperature and sleep. The decrease in core body temperature before sleep caused by a foot bath promotes the sleep process and improves sleep quality. A foot bath may indirectly improve sleep quality by improving the parameters required for a comfortable sleep (blood pressure, heart rate, sympathetic activity, decreased anxiety, etc.).[11-13] In our study, the sleep quality of the elderly who underwent a foot bath increased significantly for 8 weeks and the PSQI score decreased. In an experimental study by Armat et al., it was reported that sleep quality increased without any difference between the elderly groups who received foot baths for 10 minutes (min) every day for 2 weeks with 37°C and 40°C water,[16] which is consistent with our study. Likewise, in two studies conducted in Iran, it was found that a foot bath significantly decreased the PSQI score in the elderly.[9, 29] It was determined with polysomnographic results in the study by Morin et al.[30] that nonpharmacological applications led to a decrease in the duration of falling asleep and the number of awakenings. A randomized controlled study conducted on 69 elderly men found that foot baths at 41-42 degrees for 6 weeks improved sleep quality.[9] In a study, it was determined that a foot bath applied for 20 minutes with 40-degree water on 2 evenings for 1 week improved the sleep quality of 20 female Filipino elderly.[15] In another semi-experimental study, the effectiveness of foot bath on sleep quality was investigated in 60 elderly individuals. Patients were given foot baths with hot water (43-46 degrees) for 10 minutes per day for 7 days. As a result of the aforementioned study, it was reported that foot baths with hot water increased sleep quality in elderly individuals.[19] Again, it is thought that sleep quality differed in the control group patients as expected in our study and this is due to the fact that the majority of the married elderly in the control group engaged in activities that could affect their sleep.

In the reviewed literature, two studies with different scales were found in which the effect of a foot bath on sleep quality was evaluated.[20, 31] Rahmani et al.[31] also reported that a foot bath (with 40 °C water) provided improvement in the "Verran and Snyder-Halpern Sleep Scale" and improved sleep quality in their experimental study in elderly people over 60 years of age.[31] Using actigraphy to measure sleep quality, Jo Kim et al.[20] found that a foot bath applied at different temperatures (40◦C for the experimental group and 36.5◦C for the placebo group) for 30 min per day improved sleep quality in South Korean elderly living in nursing homes, but the effect of a foot bath decreased after the 3rd week.[20] We speculate that the reason for this result may be due to the wheelchair or bed-dependent elderly people or different factors that may trigger insomnia in their study.[20]

In this study, foot baths decreased sleep latency throughout the application in the elderly. In two literature studies analyzed, unlike our study, it was reported that foot baths did not make any change in sleep latency.[20, 32] In the study of Jung,[32] the lack of a difference in sleep latency may have been due to the fact that the elderly waited for one hour after a foot bath.

In another study, it was reported that sleep latency decreased similar to our study.[17] Sung and Tochihara[33] noted that nonpharmacological methods increased the sleep quality of individuals and decreased the time to fall asleep, and there were differences between the groups between the 2nd and 3rd stages of sleep.[33]

In old age, sleep duration decreases to 5-7 hours, falling asleep time prolongs, and phases 3 and 4 shorten.[34] In our study, foot baths caused a reduction in the sleep duration of the elderly contrary to what was expected. In the studies reviewed, it was reported that foot baths[18, 24] and whole-body baths[35, 36] did not increase slow wave sleep in the elderly with insomnia. In our study, the decrease in sleep duration in the elderly may have resulted from the fact that they woke up rested in a shorter time due to improved sleep quality. In a study conducted by Namba et al.[37] with elderly intensive care patients, it was stated that the elderly slept more in the evening when a foot bath was performed in accordance with the literature. However, it was found that there was no significant difference in "Rapid Eye Movement" sleep on the days of a foot bath.[37]

In our study, foot baths decreased sleep disturbance in the elderly. In a relevant study, it was reported that there was no significant change in sleep disturbance scores although the sleep quality of the elderly increased with foot bath application, which was explained by the fact that the

elderly could not give correct answers as they had difficulty evaluating the scale questions.[20] In another study, it was found that sleep disturbance decreased like our study.[24] In an experimental study, 46 elderly people were given a foot bath with water at 41-42 degrees for 6 weeks, and as a result of the study, a significant improvement was reported in the elderly's sleep duration and total sleep quality.[14]

Limitations of the Study

Limitations of the study include the fact that the intervention, although supervised, was implemented by the subjects and the characteristics of the data collection (based on self-reporting).

In light of the findings of the study, it was concluded that foot baths had a positive effect on the sleep quality of the elderly, increased subjective sleep quality, decreased sleep latency, sleep duration, use of sleeping medication, and daytime dysfunction. However, a foot bath increased the habitual sleep efficiency in the elderly up to the 4th week but lost its effect after the 4th week and decreased. Within the framework of the results obtained from this study, it may be recommended that sleep quality be monitored for a longer period in elderly individuals and compared with other non-pharmacological treatment methods. However, it is recommended that the effectiveness of foot baths be tested in other sample groups, at different water temperatures, in healthy or patient groups and even compared with different applications.

Etik Komite Onayı: Etik kurul onayı Gümüşhane Üniversitesi Bilimsel Araştirma ve Yayin Etiği Kurulu'ndan (Tarih: 27.04.2022, Sayı: 2022/3) alınmıştır.
Hasta Onamı: Çalışmaya katılan yaşlılardan sözlü ve yazılı aydınlatılmış onam alındı.
Hakem Değerlendirmesi: Dış bağımsız.
Yazar Katkıları: Fikir- HD,AC,SH; Tasarım-HD,AC,SH; Denetleme-SH; Kaynaklar-HD,AC,SH; Veri Toplanması ve/veya İşlemesi-HD,AC; Analiz ve/ veya Yorum-HD,AC,SH; Literatür Taraması-HD,AC,SH; Yazıyı Yazan-HD,AC; Eleştirel İnceleme-SH.
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Ethics Committee Approval: Ethics committee approval was received from Gümüşhane University Scientific Research and Publication Ethics Committee (Date: 27.04.2022, Number: 2022/3).
Informed Consent: Verbal and written informed consent was obtained from the elderly involved in the study.
Peer-review: Externally peer-reviewed.
Author Contributions: Concept -HD,AC,SH; Design-HD,AC,SH; Supervision-SH; Resources-HD,AC,SH; Data Collection and/or Processing-HD,AC; Analysis and/or Interpretation-HD,AC,SH; Literature Search-HD,AC,SH; Writing Manuscript-HD,AC; Critical Review-SH.
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