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Pre–Post Evaluation of a Community-Based Sleep Training Program for Older Men with Sleep Disorders in Duhok Governorate

Iman Mohammed Mustafa[1*], Shireen Safar Mousa[2]

1. Department of Education and Psychology, College of Education, University of Zakho, Kurdistan Region, Iraq
2. Department of Education and Psychology, College of Education, University of Zakho- Kurdistan Region, Iraq

* Corresponding author: iman.mustafa@uoz.edu.krd

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Abstract: Sleep disorders are a common health concern among older adults and are often associated with reduced physical functioning, impaired cognition, and poorer psychological well-being. This study aimed to conduct a pre–post evaluation of a community-based sleep training program for older men with sleep disorders in Duhok Governorate, Iraq. A single-group pretest–posttest design was employed involving 10 community-dwelling men aged 60–63 years who reported sleep-related difficulties. Participants attended an 8-session training program delivered over four weeks in a community setting. The intervention included sleep hygiene education, relaxation techniques, behavioral strategies, and practical guidance to improve sleep-related habits. Outcome assessment was conducted before and after the intervention using the Pittsburgh Sleep Quality Index (PSQI) as the primary measure, supported by selected indicators of sleep pattern and daytime functioning. The findings showed improvement in overall sleep quality following participation in the program, reflected in lower PSQI scores, reduced sleep onset latency, improved sleep efficiency, and longer total sleep duration. Positive changes were also observed in daytime sleepiness and selected cognitive functioning outcomes. These findings suggest that a structured community-based sleep training program may provide short-term benefits for older men experiencing sleep disturbances. However, the results should be interpreted cautiously, given the small sample size, absence of a control group, and limited follow-up period. Further controlled studies with larger samples are needed to confirm the intervention's effectiveness and generalizability.

Keywords: Sleep quality; older men; sleep disorders; community-based intervention; pre–post study

1. Introduction

Population aging has become a major global demographic and public health reality, and this transition has heightened the urgency of addressing chronic, yet often overlooked, health problems in later life, including sleep disturbance (United Nations Department of Economic and Social Affairs [UN DESA], 2023; World Bank, n.d.). In Iraq, the share of the population aged 65 years and above reached about 3.41% in 2024, a proportion that remains smaller than the global average but is rising in absolute terms and carries important implications for community health planning and geriatric care (World Bank, n.d.). Sleep disturbance is especially significant in older adulthood because sleep is not merely a nighttime behavior but a core marker of physical, psychological, and functional health (Dzierzewski et al., 2023). Aging is associated with reduced ability to initiate and maintain sleep, lighter and more fragmented sleep, and declines in slow-wave and rapid eye movement sleep, all of

which may impair memory, daytime energy, emotional regulation, and quality of life (Mander et al., 2017). Insomnia and other sleep complaints in later life are also closely intertwined with chronic disease, medication use, mood symptoms, and decreased daily functioning, making them a multidimensional rather than isolated clinical problem (Patel et al., 2018). From a social-health perspective, therefore, sleep problems among older adults should be treated as an urgent community issue rather than a minor symptom of aging.

This concern has generated a substantial international literature on sleep in older adults, but the evidence remains uneven in both geographic distribution and intervention design. Reviews and meta-analyses have shown that sleep problems are highly prevalent among community-dwelling older adults worldwide, while poor sleep quality is consistently associated with fatigue, reduced daily functioning, and poorer mental and physical health outcomes (Vanderlinden et al., 2020; Dzierzewski et al., 2023). A major body of work has focused on explanatory and mechanistic issues, including age-related changes in sleep architecture and their neurocognitive consequences (Mander et al., 2017). Another line of scholarship has examined treatment strategies, especially non-pharmacological approaches. Patel et al. (2018) emphasized that behavioral approaches are preferable to routine pharmacological management in many older patients because of the clinical complexity of late-life insomnia. Furukawa et al. (2024), in a large network meta-analysis of 241 trials, found that core components of cognitive-behavioral therapy for insomnia, such as cognitive restructuring, stimulus control, and sleep restriction, remain among the most beneficial treatment elements. Exercise-based approaches have also shown promise: Siu et al. (2021) reported significant improvements in sleep among older adults with insomnia, while Urbanová et al. (2024) found that sleep education combined with light-related guidance and relaxation improved sleep and mood among older participants. Together, these studies confirm that sleep in later life is modifiable, but they do not yet clarify how such interventions should be tailored to culturally specific community settings.

Although prior scholarship has established the importance of non-pharmacological sleep interventions, several gaps remain that are directly relevant to the present study. First, much of the stronger evidence comes from randomized trials or clinical programs conducted in East Asia, Europe, or high-income settings, whereas evidence from Iraq and comparable Middle Eastern community contexts remains limited (Siu et al., 2021; Urbanová et al., 2024). Second, the literature often focuses on either broad mixed-sex older populations or on single modalities such as exercise alone, rather than on community-based, multimodal programs designed for older men with sleep difficulties in everyday non-institutional settings (Karimi et al., 2016; Vanderlinden et al., 2020). Third, while previous studies have shown that behavioral and exercise-related interventions can improve sleep, fewer studies have examined whether short, structured, community-delivered training programs can produce changes not only in sleep quality but also in selected aspects of daytime functioning among older men in culturally specific local environments (Furukawa et al., 2024; Urbanová et al., 2024). The present study addresses this gap by conducting a pre–post evaluation of a community-based sleep training program for older men with sleep disorders in Duhok Governorate, Iraq. More specifically, it examines whether participation in an 8-session structured program is associated with improvement in overall sleep quality, sleep pattern indicators, and selected daytime functioning outcomes in a community-dwelling sample.

The argument underpinning this study is that sleep problems in later life are shaped by behavioral habits, circadian regulation, cognitive-emotional arousal, and daily routines; therefore, interventions that combine sleep hygiene education, relaxation practice, and practical behavioral guidance may be especially suitable for community-dwelling older adults (Patel et al., 2018; Furukawa et al., 2024). This argument is also consistent with the National Sleep Foundation's emphasis on regular sleep schedules, environmental optimization, light exposure, physical activity, and meal timing as core elements of healthy sleep in older age (Dzierzewski et al., 2023). The present study therefore proceeds on the expectation that a structured community-based program can generate measurable short-term improvements in sleep quality among older men with sleep disorders in Duhok Governorate. It further assumes that better sleep may be associated with improvements in selected daytime outcomes, given the well-established link between sleep continuity, alertness, and cognitive functioning in older adults (Mander et al., 2017; Siu et al., 2021). Based on this reasoning, the study hypothesizes that participants will show lower post-intervention sleep disturbance scores and better sleep-related functioning after completing the training program. At the same time, because the design is a single-group pre–post evaluation with a small sample, the study is framed as a preliminary investigation intended to generate context-specific evidence and inform future larger controlled studies.

2. Literature Review

2.1. Sleep Quality, Aging, and Health Consequences in Older Adults

Sleep quality in later life has been widely recognized as a central indicator of healthy aging because sleep is closely linked to cognitive resilience, emotional stability, metabolic regulation, and daily functioning in older adults. Mander et al. (2017) argue that aging is accompanied by marked alterations in sleep quantity and sleep architecture, especially reductions in slow-wave sleep, fragmented non-rapid eye movement sleep, and impaired sleep continuity, all of which are associated with weaker memory consolidation and poorer daytime performance. Patel et al. (2018) similarly note that insomnia is one of the most common sleep disorders in geriatric populations, often presenting as difficulty initiating sleep, difficulty maintaining sleep, or non-restorative sleep with significant daytime consequences. These changes are not simply subjective complaints but reflect broader neurobiological and psychosocial processes that accompany later life, including comorbidity burden, medication use, circadian phase advance, and reduced homeostatic sleep drive (Patel et al., 2018; Riemann et al., 2022). Dzierzewski et al. (2023) further emphasize that older adults' sleep health is shaped not only by biology but also by modifiable behavioral and environmental factors, such as light exposure, activity patterns, mealtimes, and sleep schedules. Taken together, the literature consistently shows that poor sleep in older adulthood should not be treated as a trivial consequence of aging, but as a clinically meaningful and socially relevant health issue that requires structured intervention.

The health implications of poor sleep in older adults extend well beyond nighttime discomfort, because disturbed sleep has been linked to lower quality of life, depressive symptoms, fatigue, poorer concentration, and reduced capacity for independent daily living. Reid et al. (2006) showed that sleep complaints in elderly populations predict both physical and mental health-related quality of life, suggesting that sleep problems are embedded within broader patterns of vulnerability rather than

isolated symptoms. Mander et al. (2017) also demonstrated that age-related sleep disruption is associated with neurocognitive impairment, particularly in learning and memory processes, because reductions in deep sleep weaken hippocampal–cortical communication. At the clinical level, Patel et al. (2018) point out that insomnia in older adults frequently coexists with chronic pain, cardiovascular disease, psychiatric symptoms, and polypharmacy, making assessment and treatment inherently multidimensional. This complexity is why recent consensus-oriented work no longer treats sleep merely as an outcome variable but increasingly as a modifiable determinant of healthy aging itself (Dzierzewski et al., 2023). The Pittsburgh Sleep Quality Index, developed by Buysse et al. (1989), has therefore remained influential because it captures the multifaceted character of sleep quality, including subjective quality, latency, duration, efficiency, disturbance, medication use, and daytime dysfunction. In summary, the literature strongly supports the position that improving sleep quality among older adults may yield benefits across several interrelated domains of health and functioning.

2.2. Non-Pharmacological Interventions for Sleep Problems in Older Adults

Because pharmacological treatment in older adults often raises concerns regarding adverse effects, tolerance, falls, residual sedation, and drug interactions, non-pharmacological approaches have become increasingly central in the treatment of late-life sleep disturbance. Patel et al. (2018) underline that behavioral treatment is generally preferable as a first-line strategy for many older patients, especially when insomnia is chronic and embedded in everyday routines. This position is reinforced by Riemann et al. (2022), who describe insomnia disorder as a condition best understood through cognitive-behavioral and psychobiological models rather than through symptom suppression alone. Furukawa et al. (2024), in a large component network meta-analysis of 241 trials, found that key elements of cognitive behavioral therapy for insomnia—particularly cognitive restructuring, stimulus control, sleep restriction, and third-wave components—are among the most beneficial intervention components for chronic insomnia. Yet the literature also shows that more accessible and less intensive interventions can play a practical role, especially where specialist treatment is unavailable. Chung et al. (2018) found that sleep hygiene education can improve sleep-related outcomes, although its effects are generally smaller and less consistent than full CBT-I packages. This distinction is important because it suggests that educational and behavioral strategies may still be clinically useful when delivered in structured formats. Thus, the evidence base supports non-pharmacological intervention as both theoretically justified and pragmatically necessary in older populations.

Beyond formal CBT-I, several intervention studies have shown that sleep in older adulthood can also be improved through exercise, relaxation, and mindfulness-based programs, particularly when these are adapted to the capacities of later-life populations. Vanderlinden et al. (2020), in a systematic review of physical activity programs in older adults, concluded that exercise-based interventions can improve sleep outcomes, although the magnitude of benefit varies by program type, intensity, and outcome measure. Siu et al. (2021) offered stronger experimental evidence by showing, in a randomized clinical trial, that both Tai Chi and conventional exercise improved sleep in older adults with insomnia, including objective sleep indicators. Black et al. (2015) further demonstrated that mindfulness meditation improved sleep quality and daytime impairment in older adults with moderate sleep disturbance, supporting the idea that hyperarousal and stress-related mechanisms

can be modified through mind–body interventions. In a more targeted study involving elderly men, Karimi et al. (2016) found that a scheduled exercise program significantly improved sleep quality, indicating that male older populations also respond favorably to structured behavioral programs. More recently, Urbanová et al. (2024) reported that sleep education combined with light intervention and relaxation improved sleep and mood in older adults, thereby supporting multimodal intervention logic. Collectively, these studies indicate that non-pharmacological sleep interventions are most promising when they do not rely on a single mechanism, but instead combine behavioral education, regulation of daily rhythms, and practical self-management strategies.

2.3. Community-Based and Multimodal Sleep Programs: Relevance and Research Gap

An important development in recent sleep-intervention research is the growing recognition that community-based delivery matters, particularly for older adults who may face barriers to accessing specialist services or may prefer practical programs embedded in familiar settings. Dzierzewski et al. (2023) explicitly recommend that sleep health promotion for older adults should include tailored messaging and community support, implying that intervention effectiveness depends not only on content but also on how and where support is delivered. This insight is especially important in ageing populations because adherence to sleep recommendations often depends on routine, social reinforcement, and environmental fit rather than on information alone (Dzierzewski et al., 2023; Chung et al., 2018). Community-accessible formats have also been supported indirectly by Black et al. (2015), whose mindfulness-based trial showed that relatively low-cost, non-specialist programs can improve sleep-related outcomes in older adults, and by McCrae et al. (2023), who demonstrated the feasibility of web-based CBT-I adaptation in underserved caregiving populations. These studies do not imply that all community programs are equally effective, but they do suggest that accessible, behaviorally oriented interventions can reduce the gap between evidence and real-world implementation. For this reason, a community-based model is not merely a logistical choice; it is a theoretically meaningful response to the practical realities of sleep care in later life, especially in settings where clinical sleep services are limited or underused.

Despite this progress, the literature still shows a clear gap that justifies focused study on community-based sleep training for older men in underrepresented regional settings. First, much of the strongest intervention evidence comes from East Asia, North America, or Europe, while research from Iraq and comparable Middle Eastern contexts remains sparse in indexed international journals (Siu et al., 2021; Urbanová et al., 2024). Second, the older-adult literature frequently combines men and women into broad samples, even though gendered patterns of health behavior, help-seeking, and daily routine may shape sleep experience and intervention uptake differently in later life (Karimi et al., 2016). Third, many studies test single-component interventions such as exercise alone, while fewer examine short, structured, multimodal programs that combine sleep hygiene education, relaxation, and behavioral guidance in a community setting. Furukawa et al. (2024) show that multiple components of insomnia treatment may contribute meaningful benefit, and Urbanová et al. (2024) similarly suggest that education, relaxation, and light-related behavioral guidance can work synergistically. These findings make a strong case for testing a concise, community-delivered, multimodal program in a specific local population. Accordingly, the present study is positioned within an important but still insufficiently explored area of research: the preliminary evaluation of a community-based sleep training program for older men with sleep disorders in Duhok Governorate.

3. Methods

3.1. Research Design

This study employed a **single-group pretest-posttest design** to examine short-term changes in sleep-related outcomes following participation in a community-based sleep training program for older men with sleep disorders in Duhok Governorate, Iraq (Peterson et al., 2006; Grove et al., 2016). A one-group pretest-posttest approach is commonly used in preliminary intervention research when the main purpose is to observe change over time within the same participants under real-world conditions rather than to establish definitive causal inference through randomization and a control group (Peterson et al., 2006; Reichardt, 2023). At the same time, this design is recognized as methodologically limited because it remains vulnerable to threats such as history, maturation, testing effects, and regression to the mean, and therefore its findings must be interpreted with caution (Grove et al., 2016; Reichardt, 2023). For that reason, the present study was framed as a **preliminary pilot evaluation** intended to generate context-specific evidence and inform future controlled research rather than to claim conclusive intervention effectiveness (Eldridge et al., 2016; Moore et al., 2025). The study was conducted prospectively over a four-week period in 2025, with assessment carried out at baseline and again immediately after completion of the intervention, a procedure consistent with repeated-measures evaluation in small-scale behavioral studies (Lakens, 2013; Peterson et al., 2006).

3.2. Study Setting and Participants

The study was conducted in the **Faida district of Duhok Governorate, Iraq**, and the intervention was delivered in a community-based setting intended to reflect the everyday environment in which older adults typically manage sleep-related difficulties (Dzierzewski et al., 2023; Patel et al., 2018). A community-based setting was considered appropriate because sleep in later life is shaped not only by clinical factors but also by daily routines, environmental conditions, social context, and behavioral habits that are often best addressed outside institutional care (Dzierzewski et al., 2023; Patel et al., 2018). The target population consisted of **community-dwelling older men** who reported persistent sleep-related difficulties, because sleep disturbance among older adults is highly prevalent and frequently associated with impaired daytime functioning, poorer health status, and reduced quality of life (Patel et al., 2018; Dzierzewski et al., 2023). A **purposive sampling strategy** was used to recruit participants who matched the study criteria, which is acceptable in preliminary and feasibility-oriented research when the objective is to identify participants with characteristics directly relevant to the intervention being evaluated (Campbell et al., 2020; Memon et al., 2025). The final sample included **10 men aged 60–63 years**, all of whom were living independently in the study area and were able to participate in the intervention procedures. Participants were included if they reported poor sleep quality or sleep-related complaints such as difficulty initiating sleep, chronic insomnia symptoms, or frequent nocturnal awakenings, because such complaints represent core features of late-life sleep disturbance described in the geriatric sleep literature (Patel et al., 2018; Buysse et al., 1989). Participants were excluded if they had severe cognitive impairment, acute medical instability, recent use of sleep medication, current participation in another sleep-focused intervention, or a diagnosed sleep disorder requiring specialist treatment, because these factors could confound

interpretation of change following a behavioral sleep program (Patel et al., 2018; Riemann et al., 2022).

3.3. Intervention Program

The intervention consisted of an **8-session sleep training program** delivered over **four weeks**, with **two sessions per week**, because structured repetition and short-cycle reinforcement are often used in behavioral sleep interventions to promote retention and practical habit change (Furukawa et al., 2024; Chung et al., 2018). Each session lasted approximately **45 minutes**, a duration that is generally suitable for older adult group-based programs because it allows adequate instruction and practice without imposing excessive cognitive or physical burden on participants (Black et al., 2015; Dzierzewski et al., 2023). The program was designed as a **multimodal community-based intervention**, combining sleep hygiene education, relaxation techniques, behavioral guidance, and discussion of everyday routines that may influence sleep quality, because sleep problems in older adults are shaped by multiple interacting behavioral and physiological processes rather than by a single factor alone (Patel et al., 2018; Furukawa et al., 2024). Sleep hygiene education was included because evidence suggests that regular sleep schedules, environmental optimization, and modification of maladaptive sleep-related habits can contribute to improved sleep-related outcomes, particularly when these strategies are delivered in a structured format (Chung et al., 2018; Dzierzewski et al., 2023). Relaxation-based components were incorporated because cognitive-emotional arousal and stress frequently contribute to insomnia symptoms in older adults, and mind–body approaches have shown benefits for sleep and daytime functioning in this population (Black et al., 2015; Riemann et al., 2022). The group format was used because community-delivered programs may enhance accessibility, acceptability, and peer reinforcement, especially in settings where specialist sleep services are limited (Dzierzewski et al., 2023; McCrae et al., 2023).

3.4. Outcome Measures

The **primary outcome** of the study was **overall sleep quality**, assessed using the **Pittsburgh Sleep Quality Index (PSQI)**, which remains one of the most widely used self-report instruments for evaluating sleep quality and sleep disturbance in both clinical and research contexts (Buysse et al., 1989; Mollayeva et al., 2016). The PSQI was selected because it measures several clinically relevant dimensions of sleep over the previous month, including subjective sleep quality, sleep latency, sleep duration, habitual sleep efficiency, sleep disturbance, use of sleep medication, and daytime dysfunction (Buysse et al., 1989). Higher global PSQI scores indicate poorer sleep quality, and the instrument has shown broad usefulness across adult and older-adult populations, including applications in intervention research (Buysse et al., 1989; Mollayeva et al., 2016). In the present study, the PSQI was administered at baseline and again after completion of the intervention in order to capture short-term change in perceived sleep quality across the training period (Buysse et al., 1989; Lakens, 2013).

In addition to the PSQI, the study included **selected secondary outcomes** related to sleep pattern and daytime functioning, because sleep interventions in older adults are often expected to influence not only night-time symptoms but also functional outcomes during waking hours (Dzierzewski et al., 2023; Mander et al., 2017). These secondary indicators included **sleep onset latency**, **sleep efficiency**, and **total sleep time**, which are commonly used parameters in sleep research because they provide

interpretable information about sleep initiation, sleep continuity, and sleep quantity (Buysse et al., 1989; Patel et al., 2018). The evaluation also included selected measures of **daytime sleepiness** and **cognitive functioning**, because disturbed sleep in older adults has consistently been associated with reduced alertness, attention, memory performance, and broader daytime impairment (Mander et al., 2017; Reid et al., 2006). To preserve coherence between the methods and the reported findings, the present methodological framing prioritizes the primary sleep outcome and a limited set of clearly interpretable secondary outcomes rather than overextending the analysis across too many exploratory domains in a very small sample (Moore et al., 2025; Lakens, 2013).

3.5. Data Collection Procedure

Data collection was conducted at **two time points**, namely **before the intervention** and **immediately after the final session**, because pretest-posttest assessment is the defining structure of within-subject intervention evaluation in one-group quasi-experimental designs (Peterson et al., 2006; Reichardt, 2023). At baseline, participants completed the core study measures and provided the information necessary to characterize their pre-intervention sleep-related status (Buysse et al., 1989; Patel et al., 2018). After the 8-session program had been completed, the same core measures were administered again so that post-intervention scores could be compared with pre-intervention scores within the same individuals, which is the standard analytic logic of repeated-measures designs (Lakens, 2013; Peterson et al., 2006). To reduce unnecessary procedural variation, assessments were administered in a consistent manner across both time points, because standardization of assessment procedures is important for minimizing avoidable measurement bias in behavioral intervention research (Peterson et al., 2006; Riemann et al., 2022). Participants were assisted as needed during questionnaire completion, because older adults may vary in reading speed, comprehension, and response pace even when they remain fully capable of informed participation (Dzierzewski et al., 2023; Patel et al., 2018). The final manuscript should ideally state the language version of each instrument and whether validated translated versions were used, because linguistic validity is essential for interpretability in cross-cultural and non-English-speaking settings (Mollayeva et al., 2016; Dzierzewski et al., 2023).

3.5. Data Analysis

Data were analyzed using **descriptive statistics** and **within-subject inferential procedures** appropriate for a pretest-posttest design, because the same participants were measured at two time points and the main analytical interest was the direction and magnitude of change over time (Peterson et al., 2006; Lakens, 2013). Means and standard deviations were calculated for each main outcome at baseline and post-intervention, because summary statistics are necessary for describing central tendency and dispersion in repeated-measures data (Lakens, 2013). Prior to parametric testing, the distribution of the data was assessed using standard normality procedures, because the validity of parametric inference depends in part on the distributional behavior of the data, especially in small samples (Ghasemi & Zahediasl, 2012). For outcomes that met parametric assumptions, **paired-samples t-tests** were used to compare pre-intervention and post-intervention scores, because the paired t-test is the conventional procedure for testing mean differences between two related measurements from the same participants (Lakens, 2013; Langenberg et al., 2023). When assumptions were not adequately met, a non-parametric paired alternative such as the **Wilcoxon**

signed-rank test is methodologically appropriate, because it does not rely on the same normality assumptions as the paired t-test for dependent observations (Ghasemi & Zahediasl, 2012). In addition to p values, **effect sizes** should be reported because standardized estimates of magnitude improve interpretability and facilitate comparison with future studies and meta-analytic work (Lakens, 2013). Given the small sample and exploratory character of the study, the results should be interpreted as **preliminary evidence of potential benefit** rather than conclusive proof of intervention effectiveness (Eldridge et al., 2016; Moore et al., 2025).

3.6. Ethical Considerations

The study involved human participants and therefore should be understood within the ethical framework of respect for autonomy, informed consent, confidentiality, and minimization of participant burden, particularly because older adults may be considered a population requiring careful procedural protection in health-related research (World Medical Association, 2013). Participation was voluntary, and all participants were required to provide informed consent before enrollment and data collection, because informed decision-making is a core ethical principle in research involving human subjects (World Medical Association, 2013). Participant information was treated confidentially, and the assessment and intervention procedures were conducted in a manner intended to protect privacy and dignity throughout the study process (World Medical Association, 2013). For publication in an international journal, the manuscript should explicitly report the name of the approving ethics committee or institutional review board, together with the approval number and date of approval, because transparent ethical reporting is an essential component of research integrity (World Medical Association, 2013).

4. Result

The results of this study are presented in relation to the main research problem, namely whether participation in a community-based sleep training program was followed by measurable changes in sleep quality and selected daytime functioning outcomes among older men with sleep disorders in Duhok Governorate. All 10 participants completed the intervention and contributed complete pre-intervention and post-intervention data for the outcomes reported in the manuscript, resulting in a 100% retention rate. In line with the study objectives, the results are organized into two parts: first, changes in sleep quality and sleep architecture parameters; and second, changes in daytime sleepiness and selected cognitive functioning outcomes.

The first set of findings addresses the primary outcome of the study, namely overall sleep quality, together with related sleep indicators. As shown in Table 1, the mean Pittsburgh Sleep Quality Index (PSQI) global score decreased from 12.4 ± 2.1 before the intervention to 8.2 ± 1.8 after the intervention, with a mean difference of −4.2 and a reported p-value of < .001. Since higher PSQI scores indicate poorer sleep quality, this pre–post pattern shows that post-intervention scores were lower than baseline scores on the main sleep-quality measure used in the study. A similar direction of change was reported for other sleep-related indicators. Sleep onset latency decreased from 45.6 ± 12.3 minutes to 28.4 ± 8.7 minutes, while sleep efficiency increased from 68.2 ± 9.4% to 82.7 ± 6.2%. Total sleep time increased from 5.8 ± 1.2 hours to 7.1 ± 0.9 hours, and both REM sleep duration and deep sleep (N3) duration were higher after the intervention than before it. Across the sleep variables

presented in the manuscript, the reported pre–post comparisons were statistically significant, with large effect sizes.

Table 1

Sleep Quality and Architecture Parameters: Pre- and Post-Intervention Comparison

Sleep Parameter	Pre-Intervention Mean ± SD	Post-Intervention Mean ± SD	Mean Difference (95% CI)	t-statistic	p-value	Cohen's d
PSQI Global Score	12.4 ± 2.1	8.2 ± 1.8	-4.2 (-5.8, -2.6)	-5.82	< .001	2.15 (Large)
Sleep Onset Latency (min)	45.6 ± 12.3	28.4 ± 8.7	-17.2 (-25.4, -9.0)	-4.62	< .01	1.63 (Large)
Sleep Efficiency (%)	68.2 ± 9.4	82.7 ± 6.2	+14.5 (8.2, 20.8)	5.24	< .01	1.82 (Large)
Total Sleep Time (hours)	5.8 ± 1.2	7.1 ± 0.9	+1.3 (0.6, 2.0)	4.15	< .01	1.25 (Large)
REM Sleep Duration (min)	78.2 ± 15.4	96.7 ± 12.8	+18.5 (9.2, 27.8)	4.32	< .01	1.31 (Large)
Deep Sleep (N3) Duration (min)	52.1 ± 11.7	68.9 ± 9.3	+16.8 (8.4, 25.2)	4.51	< .01	1.58 (Large)

The second set of findings concerns daytime functioning after completion of the program. As presented in Table 2, the Epworth Sleepiness Scale score decreased from 14.8 ± 3.2 at baseline to 8.6 ± 2.4 after the intervention, with a mean difference of −6.2 and a reported p-value of < .001. The manuscript also reported higher post-intervention scores on the selected cognitive outcomes included in the study. The Cognitive Performance Index increased from 18.4 ± 4.1 to 24.7 ± 3.2, attention span increased from 12.3 ± 2.8 minutes to 18.9 ± 3.1 minutes, memory recall score increased from 19.2 ± 3.4 to 25.8 ± 2.9, and executive function score increased from 24.1 ± 4.7 to 31.6 ± 3.8. For all of these variables, the manuscript reported statistically significant pre–post differences with large effect sizes. Within the limits of the outcomes displayed in the manuscript, these results indicate that the observed changes after the intervention were not confined to night-time sleep indicators alone, but were also reflected in daytime sleepiness and selected cognitive measures.

Table 2

Daytime Functioning and Cognitive Performance Outcomes

Functional Domain	Pre-Intervention Mean ± SD	Post-Intervention Mean ± SD	Mean Difference (95% CI)	t-statistic	p-value	Cohen's d
Epworth Sleepiness Scale	14.8 ± 3.2	8.6 ± 2.4	-6.2 (-8.7, -3.7)	-5.94	< .001	2.24 (Large)
Cognitive Performance Index	18.4 ± 4.1	24.7 ± 3.2	+6.3 (3.8, 8.8)	5.68	< .001	1.71 (Large)
Attention Span Test (minutes)	12.3 ± 2.8	18.9 ± 3.1	+6.6 (4.2, 9.0)	6.12	< .001	2.21 (Large)
Memory Recall Score (0–30)	19.2 ± 3.4	25.8 ± 2.9	+6.6 (4.1, 9.1)	5.89	< .001	2.09 (Large)
Executive Function Score	24.1 ± 4.7	31.6 ± 3.8	+7.5 (4.3, 10.7)	5.45	< .001	1.77 (Large)

Taken together, the results directly respond to the study objective by showing that, within this single-group pre–post sample, participation in the 8-session community-based sleep training program was followed by lower post-intervention scores on the principal indicators of sleep difficulty and daytime sleepiness, as well as higher post-intervention scores on the reported indicators of sleep efficiency, total sleep time, and selected cognitive functioning outcomes. In reporting terms, the findings therefore show a consistent direction of change from baseline to post-intervention across the primary outcome and the selected secondary outcomes that were actually presented in the manuscript. Because the study used a one-group repeated-measures design, these findings are most appropriately presented as observed pre–post changes within the sample rather than as comparative effects against a control condition.

5. Discussion

The findings of this study show that participation in the 8-session community-based sleep training program was followed by improvement in the primary outcome, namely overall sleep quality, as reflected in the reduction of the mean Pittsburgh Sleep Quality Index (PSQI) score from 12.4 at baseline to 8.2 after the intervention. This pattern is consistent with the broader literature indicating that sleep problems in later life remain responsive to structured non-pharmacological interventions, especially those that combine education, behavioral regulation, and routine adjustment (Dzierzewski et al., 2023; Patel et al., 2018). At the same time, the present finding should be interpreted as an observed pre–post change within the sample rather than definitive proof of treatment efficacy, because a one-group pretest–posttest design cannot adequately rule out alternative explanations such as expectancy effects, testing effects, or regression to the mean (Grove et al., 2016; Peterson & Finkelstein, 2006). For this reason, the contribution of the present study lies

more in providing preliminary local evidence than in establishing conclusive causal effectiveness (Eldridge et al., 2016; Moore et al., 2025).

The sleep-related parameters reported in the study further strengthen the descriptive pattern of improvement, because reductions in sleep onset latency and increases in sleep efficiency, total sleep time, REM sleep duration, and deep sleep duration suggest that post-intervention change was not confined to a single subjective indicator alone. This finding is plausible in light of gerontological sleep research showing that ageing is commonly associated with fragmented sleep, reduced sleep continuity, lower slow-wave sleep, and broader disruption in sleep architecture (Mander et al., 2017; Patel et al., 2018). In that context, the direction of change observed in the present study is aligned with the theoretical understanding that sleep difficulties in older adults are shaped by modifiable behavioral and environmental factors, rather than being an unavoidable and untreatable feature of ageing itself (Dzierzewski et al., 2023; Riemann et al., 2022). Even so, the post-intervention PSQI mean remained above the conventional threshold often used to indicate poor sleep quality, which suggests that although participants improved, their sleep difficulties may not have been fully resolved by the end of the intervention period (Buysse et al., 1989; Mollayeva et al., 2016). This point is important because it positions the intervention as potentially beneficial for reducing symptom burden, while also indicating that a short-term program may not be sufficient to normalize sleep completely among older adults with established sleep problems (Patel et al., 2018; Siu et al., 2021).

The changes in daytime sleepiness and selected cognitive outcomes are also notable because the international literature has repeatedly shown that poor sleep in older adults is associated with reduced alertness, poorer attention, weaker memory performance, and broader daytime impairment (Mander et al., 2017; Reid et al., 2006). In the present study, the Epworth Sleepiness Scale score declined from 14.8 to 8.6, while the reported indicators of attention span, memory recall, executive functioning, and overall cognitive performance all improved after the intervention. This pattern is compatible with previous findings suggesting that improved sleep continuity may be accompanied by better daytime functioning and, in some cases, measurable cognitive benefit among older adults with insomnia or sleep disturbance (Black et al., 2015; Siu et al., 2021). However, the cognitive findings should still be interpreted with caution, because repeated testing over a short period can itself contribute to better post-test scores, especially in small pilot studies without a comparison group (Grove et al., 2016; Peterson & Finkelstein, 2006). Accordingly, the present study supports the practical relevance of the intervention for both night-time and daytime functioning, while not going so far as to claim that the program independently caused cognitive enhancement (Lakens, 2013; Moore et al., 2025).

From an intervention perspective, the observed pattern of change is coherent with the growing body of evidence supporting multimodal non-pharmacological approaches to sleep problems in older adults. The program in this study combined sleep hygiene education, relaxation practice, and behavioral guidance, and this structure reflects the wider understanding that insomnia in later life is maintained by an interaction of habits, cognitive-emotional arousal, daily routine, and environmental conditions (Furukawa et al., 2024; Riemann et al., 2022). Sleep hygiene education is relevant because regular sleep schedules, light exposure, environmental adjustment, and reduction of maladaptive bedtime habits are all recognized as important components of healthy sleep promotion in older age (Chung et al., 2018; Dzierzewski et al., 2023). Relaxation-oriented elements are likewise relevant because stress, somatic tension, and pre-sleep arousal often contribute to sleep disruption, and

mind–body interventions have shown beneficial effects on sleep quality and daytime impairment in older adults (Black et al., 2015; Patel et al., 2018). In this regard, the present findings fit within a wider international evidence base suggesting that accessible, structured, community-delivered behavioral programs may offer meaningful short-term benefits for sleep in later life (Karimi et al., 2016; Vanderlinden et al., 2020).

The community-based format of the program also deserves attention because all 10 participants completed the intervention, suggesting that the program was acceptable and manageable within this small purposively selected group. This observation is relevant because current sleep-health recommendations for older adults increasingly emphasize the value of practical and context-sensitive interventions that can be delivered in everyday environments rather than depending entirely on specialist sleep clinics (Dzierzewski et al., 2023; McCrae et al., 2023). Community-based delivery may be particularly important in settings where older adults face logistical, cultural, or structural barriers to formal sleep treatment, and where group-based education may be more feasible than specialist individualized therapy (McCrae et al., 2023; Vanderlinden et al., 2020). Nevertheless, the high completion rate in this study should not be generalized too broadly, because full retention in a sample of 10 participants does not guarantee that the same level of feasibility or adherence would be observed in a larger, more diverse, or less selected population (Campbell et al., 2020; Moore et al., 2025). What the present study demonstrates, more cautiously, is that a short community-based sleep training program can be implemented and completed in this local context, and that such implementation may have practical relevance for future intervention development in underrepresented settings (Eldridge et al., 2016; McCrae et al., 2023).

Several limitations remain central to the interpretation of these findings. First, the single-group pretest–posttest design restricts causal inference, because the study did not include a control group against which the observed changes could be compared (Grove et al., 2016; Peterson & Finkelstein, 2006). Second, the very small sample size limits statistical stability and reduces the generalizability of the results beyond the specific participants who took part in the program (Lakens, 2013; Moore et al., 2025). Third, the uniformly large effects reported across the displayed outcomes should be approached cautiously, because effect sizes in small pilot studies can be unstable or inflated and may not replicate in larger trials (Lakens, 2013; Moore et al., 2025). Fourth, the absence of medium- or long-term follow-up means that the durability of the observed improvements cannot be determined from the present data (Eldridge et al., 2016; Siu et al., 2021). These limitations do not negate the observed findings, but they do indicate that the study should be read as an initial context-specific investigation rather than as definitive evidence for the effectiveness of the intervention (Eldridge et al., 2016; Moore et al., 2025).

Overall, the discussion of the present findings supports a measured conclusion: within this small community sample, participation in the program was followed by improvement in the principal indicators of sleep difficulty, daytime sleepiness, and selected daytime cognitive outcomes reported in the study. These findings are broadly consistent with the international literature on behavioral and multimodal sleep interventions in older adults, particularly studies emphasizing education, exercise, relaxation, and structured routine change as relevant mechanisms of benefit (Black et al., 2015; Furukawa et al., 2024; Siu et al., 2021). At the same time, the main value of this study lies not in offering definitive proof, but in providing preliminary evidence that such an intervention may be both practicable and potentially useful in a local community setting that remains underrepresented in the

indexed literature on sleep intervention in later life (Dzierzewski et al., 2023; McCrae et al., 2023). In that sense, the study offers an empirical starting point for future controlled research on culturally and contextually appropriate non-pharmacological sleep programs for older adults in Iraq and comparable settings (Patel et al., 2018; Vanderlinden et al., 2020).

6. Conclusion

This study provides preliminary evidence that participation in a community-based sleep training program was followed by improvement in overall sleep quality among older men with sleep disorders in Duhok Governorate, as reflected in the reduction of PSQI scores and the favorable direction of change in the reported sleep parameters. Such a finding is consistent with the broader literature showing that sleep problems in later life can be improved through structured non-pharmacological interventions that target sleep-related behavior, daily routines, and self-management strategies. The study also found that the observed post-intervention changes were not limited to night-time sleep indicators alone, because lower daytime sleepiness scores and higher scores on selected cognitive outcomes were also reported after the program. This pattern is in line with previous studies suggesting that better sleep in older adults may be accompanied by better daytime functioning, although the extent and durability of such change vary across interventions and study designs.

At the same time, the contribution of the present study should be interpreted cautiously because the findings were generated from a single-group pretest-posttest design with a very small purposive sample and without a control condition. Under these methodological conditions, the reported improvements are best understood as observed pre–post changes within the sample rather than definitive evidence of intervention effectiveness or causal impact. The study therefore contributes most meaningfully as an initial, context-specific evaluation showing that a short community-based sleep training program may be feasible and potentially beneficial in a local setting that remains underrepresented in the indexed literature on sleep intervention in older adults.

Future research should build on this preliminary work by using larger samples, controlled designs, clearer outcome prioritization, and longer follow-up periods in order to determine the strength, stability, and generalizability of the intervention's effects.

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