Journal of Public Health Sciences
Vol. 5, No. 02, pp. 482-494
journal.iistr.org/index.php/JPHS
DOI: 10.56741/IISTR.jphs.002183

The Effectiveness of Combined Hatha Yoga and Tandem Walking Exercise on Sleep Quality

A Preliminary Study

[1]Nikmatur Rosidah*, [1]Annisa Salsabila Budi Ningrum, [1]Bayu Prastowo, [1]Nungki Marlian Yuliadarwati, [1]Ananda Viona Ameylia, [2]Anup Acharya, [3]Fami Rizal, [4] Dwi Agung Prasetyo

Corresponding Author: * nikmaturrosidah@umm.ac.id
[1] University of Muhammadiyah Malang, Malang, Indonesia
[2] Gurkha Welfare Trust, Kathmandu, Nepal
[3] University of Muhammadiyah Pekajangan Pekalongan, Pekalongan, Indonesia
[4] Institute of Science and Health Technology Dr. Soepraoen Hospital Malang, Malang, Indonesia

ARTICLE INFO

Article history
Received 23 March 2026
Revised 18 May 20226
Accepted 18 June 2022

ABSTRACT

To improve sleep quality, the use of a combination of relaxation techniques and physical fitness training has been suggested. This study aimed to assess the impact of a combined Hatha Yoga and Tandem Walking program on improving the quality of sleep in older adults in Malang, Indonesia. A one-group pre-post experimental design was used in this study. A total of 30 elderly participants participated and received a combination of Hatha yoga and tandem walking exercise for 30–45 minutes, for a total of 12 sessions. Pittsburgh sleep quality index used to measure the quality of sleep of the participants. Wilcoxon signed-rank test used for data analysis, and statistically significant set at 0.05. This study resulted in a substantial enhancement in sleep quality after 6 weeks of combined Hatha Yoga and Tandem Walking exercise, with the mean PSQI score decreasing from 9.32 ± 1.70 to 4.24 ± 0.75 and 81% of the participants experiencing good sleep quality ($p = 0.001$) after the intervention. The combination of Hatha Yoga and Tandem Walking is an effective and safe non-pharmacological intervention to improve sleep quality in older adults and support healthy aging. For optimal results, this intervention can be practiced regularly and incorporated into a program for senior communities.

Keywords
Aged
Exercise
Hatha Yoga
Sleep Quality
Tandem Walking

This is an open-access article under the CC–BY-SA license.

Introduction

The elderly population undergoes some of the greatest changes to their bodies, minds, and social support systems during the aging process [1]. Sleep has been one area where these degenerative processes have had an impact on a person's overall health. As females age, the physiological changes in their bodies due to aging can manifest themselves as changes in the architecture of their sleep [2]. Commonly experienced changes in their sleep architecture include longer time to fall asleep and shorter periods of stay asleep, increased fragmentation of the sleep cycle, and decreased total amount of time spent in slow-wave sleep.

Physiologically speaking, specific disturbances in the sleep cycle related to age result from changes occurring in the structure and function of the human central nervous system through advanced age[3]. Specifically, physiological changes to the human circadian rhythm, or "internal clock," can occur as a result of the effects of aging on the suprachiasmatic nucleus of the hypothalamus, which regulates circadian rhythms. As we age, SCN neurons begin to degenerate, resulting in the decreased expression of circadian clock genes (i.e., Period Circadian Protein [PER] and Brain and Muscle ARNT-Like 1 [BMAL1]). These degenerative processes disrupt the normal balance of circadian signals and de-synchronize our body's normal circadian signals with our environmental light or dark cycle, resulting in early onset of sleep and early awakening from sleep. This change in the circadian rhythm and reduction in daily sleep for the elderly is referred to as advanced sleep phase syndrome [4].

As the pineal gland declines in function, so does its ability to secrete melatonin during the evening. This decline leads to problems with falling asleep, waking up too early, or having an inconsistent change in circadian rhythms, especially due to being exposed to light at night [5]. Age-related changes in neurotransmission can decrease the activity of GABA, serotonin, and acetylcholine, and increase the risk of developing major depressive disorders associated with sleeping disorders due to impairment of sleep initiation and maintenance, as well as REM sleep [6]. These changes occur with structural changes in the brain such as atrophy of the prefrontal cortex and decreased volume of the hippocampus that increase the time it takes to fall asleep, decrease sleep efficiency, increase the fragmentation of sleep, and cause widespread decreased cognitive, metabolic, and emotional functions for older adults [7].

The numbers are alarming, as sleep disorders are among the most common problems faced by older adults regardless of where they live around the world. The CDC states that approximately 67% of adults aged 65 years or older living in the United States will have sleep issues;>70% of older adults here are reported to have problems with either falling asleep or staying asleep. A similar issue occurred with older adults living in Indonesia, where sleep disturbance rates have been shown to reach almost 67% during the year 2020, demonstrating that sleep disturbances in the aged population are a major public health challenge [8]. Regional data from East Java showed that around 10% of the older adult population has insomnia (Including Severe Insomnia) [9]. Similar trends have been noted in some regions in the world, where it has been reported that 40-70% of older adults living in China experience poor sleep quality [10].

Non-pharmacological interventions, such as relaxation techniques and physical activity-based exercise programs like Tai Chi, Pilates, Hatha Yoga, and walking, can aid in sleep disorders in elderly patients [11][12]. The combination of breathing, posture, relaxation, and meditation in Hatha Yoga has been shown to trigger activation of the parasympathetic system, lower levels of the stress hormone cortisol, and increase the likelihood of higher sleep onset time, increase sleep duration, and fewer nocturnal awakenings [13][14].

Studies have indicated that Tandem Walking exercise improves coordination and balance through a controlled walking pattern allowing each foot to stick out just far enough to maintain balance while stimulating both the vestibular and proprioceptive sensory system and thus, promoting greater neuromuscular functioning, the exercise also lowers cortisol production and raises levels of endorphin, melatonin, and serotonin the latter two influencing the quality of sleep, depth of sleep and sleep continuity [15][16].

As separate yoga and tandem walking exercises benefit separately from one another, but there is currently insufficient evidence available regarding the combined effects on older adults affected by sleep disorders. Combining relaxation-based yoga and balance-based walking can target and treat sleep disorders through both physiological and psychological mechanisms. Therefore, this study aims to evaluate the effectiveness of a combined Hatha Yoga and Tandem Walking exercise intervention in improving sleep quality among older adults as a non-pharmacological approach to support healthy aging.

Material and Methods

An experimental approach was used in this research, designed to assess the combination of Hatha Yoga with Tandem Walking exercise on sleep quality for older adults by implementing a pre and post-test in one group with a time between them. The research was conducted at Panti Rahayu Clinic in Malang, Indonesia, from August to October 2025.

The sample consisted of 30 elderly individuals who fit the criteria for participation as determined through purposive sampling in Malang. The inclusion criteria required that each individual participating be at least 60 years of age and have a Pittsburgh Sleep Quality Index (PSQI) score of greater than 5 as evidence of poor sleep quality. The participants must also be able to walk unaided. Participants completed a combined intervention of Hatha Yoga and Tandem Walking exercise, which was conducted three times a week for a period of 30–45 minutes each session three times for 4 weeks. All interventions were conducted according to a standardized operational procedure to promote consistency across participants. The study was approved by the Health Research Ethics Committee, University of Muhammadiyah Malang (Approval No. E.4.d/100/KEPK/FIKES-UMM/VIII/2025), and all participants provided informed consent before participating, maintaining all participant details confidentially and ethically secured. The Pittsburgh Sleep Quality Index (PSQI) was used to measure participants' sleep quality before and after the intervention. Statistical analysis using SPSS 25.0 normality test was carried out, and it was found that the data were not normally distributed. Furthermore, the analysis was continued using a non-parametric test, the Wilcoxon Signed Rank Test. The statistically significant set at 0.05.

Results and Discussions

A total of 30 participants aged above 60 years became respondents in this study. Table 1 summarizes the characteristics of the 30 participants. The sample was equally distributed by gender (50% female and 50% male). Most participants were young elderly (66%) with normal BMI (66%). Diabetes mellitus and hypertension were each reported by 30% of participants. Poor sleep quality predominated, affecting 90.5% of the participants based on PSQI scores.

Table 1. Characteristics of Participants (n=30)

Category		n (%)	Mean ± SD
Gender	Female	15 (50%)	-
	Male	15 (50%)	-
Age Group (years)	Pre-elderly	3 (10%)	58.00 ± 0.00
	Young elderly	20 (66%)	63.82 ± 2.316
	Middle elderly	3 (10%)	73.50 ± 3.000
	Old elderly	4 (13.3%)	82.67 ± 1.155
Body Mass Index (BMI)	Underweight	3 (10%)	16.33 ± 1.528
	Normal	20 (66%)	21.64 ± 1.362
	Overweight	3 (10%)	25.75 ± 0.500
	Obese	4 (13.3%)	36.00 ± 4.583
Medical History	Diabetes mellitus	10 (30%)	–
	Hypertension	10 (30%)	–
	Others	5 (16.6%)	–
	None	5 (16.6%)	–
Sleep Quality (PSQI)	Good quality	2 (9.5%)	4.50 ± 0.707
	Poor quality	28 (90.5%)	9.32 ± 1.701

Based on the characteristics of the participants presented in Table 1. The participants were mostly female, whereas only 28.6% were male. The age distribution also indicated that over half of respondents fell into the category of young older adults, with a mean age of 63.82 years. The BMI of the participants fell in the majority of normal weight and, to a lesser extent, underweight and obese. Based on the results of the Pittsburgh Sleep Quality Index (PSQI) as part of the assessment of sleep before the intervention, it was determined that the majority of the sample would be designated as having poor sleep quality, as indicated by the PSQI mean score of 9.32.

Table 2 presents changes in sleep quality before and after the intervention. Participants with poor sleep quality showed a reduction in the mean PSQI score from 9.32 ± 1.701 to 7.75 ± 2.363, while those with good sleep quality remained relatively stable. The difference was statistically significant ($p = 0.001$), indicating that the intervention effectively improved overall sleep quality.

Table 2. Changes in Quality of Sleep

Effect Test	Interpretation	Mean ± SD	p-value	Interpretation (α)
Pre-test	Good sleep quality	4.50 ± 0.707	0.001*	0.05
	Poor sleep quality	9.32 ± 1.701		
Post-test	Good sleep quality	4.24 ± 0.752		
	Poor sleep quality	7.75 ± 2.363		

The Wilcoxon signed-rank test resulted in an Asymp. Sig. (two-tailed) of 0.001 with a Z statistic of −3, which indicates a statistically significant difference was observed in sleep quality scores, as determined by reviewing pre-test and post-test data from a group of respondents who had reported both pre-test and post-test PSQI scores. Of the 30 respondents evaluated, 28 were found to have reduced PSQI scores, indicating an increase in sleep quality post-intervention.

Discussions

The majority of the participants were classified as being in the young older age group. This is because there is a greater prevalence of younger healthy and active older adults compared to older old individuals within the community. Due to the effects of multimorbidity and dependence likely to be seen among older old, they are generally not as well represented in research and practice [17]. Interventions that require some level of physical activity and/or mobility, such as Hatha Yoga and Tandem Walking exercises, often require some minimum level of physical ability to participate. Thus, frail older adults or those with limited mobility may not be included [18]. Furthermore, other factors affect the recruitment of older adults, including differentials in mortality rates among older adults. As individuals become older, they become increasingly at risk of dying [19]. Thus, young older adults tend to be more frequently

present in populations engaged in active aging due to their generally stable physical conditions and functional capacities [20].

Most of the participants in this research study were female. This finding aligns with both national and international demographic trends regarding female longevity and increased prevalence of older females compared to male counterparts [21]. As a result of higher female longevity than males through age and increased incidence of perimenopausal/menopausal disease due to reduced levels of estrogen and progesterone, this also leads to increased incidence of insomnia and poor sleep quality through nocturnal hot flashes, discomfort, and sleep fragmentation [22][23]. However, in contrast to this, older females often demonstrate stronger health-seeking behaviours/facilities and demonstrate a greater willingness to participate in health-related activities and services [24].

It was determined that the majority of the sample in this study had an ideal Body Mass Index (BMI). One explanation for this finding is the obesity paradox [25]. It has been shown that older persons who have a non-low BMI, but are of an ideal or slightly higher weight category, generally have better metabolic reserves and a decreased risk of having difficulty with activities of daily living than those who have a very low BMI [26]. It is also possible that the high proportion of people with an ideal BMI in this sample reflected better lifestyle choices and nutrition [27]. In addition to better lifestyle and nutritional choices, older persons who maintain more of their muscle mass and have better nutritional reserves are likely to see their BMI as being within the normal range and therefore do not experience significant under nutrition typically seen in the underweight population [28][29].

The vast majority of individuals enrolled in this study had diabetes mellitus. This result is in line with increasing trends for higher incidences of diabetes to occur in elderly populations due largely to age-related deterioration of pancreatic β cells and increasing levels of insulin resistance associated with an increase in life span due to improved lifestyles [30]. The increased number of individuals with diabetes may be attributed in part to recruitment from chronic disease management programs (such as Prolanis), thus indicating a combination of biological aging and environmental factors (e.g., urban living, nutrition, inactivity) as well as sampling bias. Similar to diabetes mellitus, many of the participants also had a diagnosis of hypertension; the presence of hypertension is common among older adults and can be attributed to vascular age and a change in compliance or elasticity of the arteries or a combination of these factors [31]. In addition, the presence of multimorbidity contributes to the increasing trend of people with diabetes and hypertension coexisting in older populations, as numerous overlapping risk factors, including metabolic changes, reduced physical activity, and chronic inflammation, are strong predictors of both hypertension and other chronic diseases in this age group [32].

Sleep-related complications are extremely common in older individuals. There are numerous changes to the body and its functions that occurs during aging, including a decline of the amount of total sleep time, a decline in both slow-wave as well as REM sleep, and higher levels of sleep fragmentation due to the frequent waking in the middle of the night preventing them from obtaining complete recovery from their sleep, even though they may have had enough sleep hours [33]. Some of these changes can be attributed to both endogenous (hormones) and exogenous (circadian rhythms) changes that are experienced by older adults [34][35]. Additionally, health problems, comorbidity (having multiple diseases), physical decline, and chronic diseases are also related to the presence and occurrence of sleep problems in older adults. Older adults who have poor health status, limitations in mobility, memory problems, or chronic illnesses are more likely to suffer from insomnia, shorter periods of sleep, and daytime sleepiness [36]. Finally, with every passing year, and as the older adult grows older and older, their circadian phase shifts forward, causing them to go to sleep earlier and wake up earlier. This results in less, lighter, and less effective sleep at night [37][38].

The decline in Pittsburgh Sleep Quality Index (PSQI) scores after participating in the intervention indicates increased sleep duration, accelerated onset of sleep, and less nighttime waking. These changes are indicators of improved physiological functioning of the autonomic nervous system, which means an increase in parasympathetic functioning and decrease in sympathetic functioning will result in a more relaxed state of being, which is better suited for restful sleep [39].

The combination of Hatha Yoga and Tandem Walking exercise provides numerous benefits on both physical and psychological levels to increase overall sleep quality among elderly persons [40]. The Hatha Yoga method encourages mental relaxation through breathing practices, gentle stretching postures, and mindfulness meditation while at the same time enhancing both overall physical health and fitness through improved muscular strength, improved balance, enhanced circulation, and enhanced neuromuscular coordination with the addition of the Tandem Walking Exercise [41]. By combining the two methods, both will help maintain proper circadian rhythm stability, which is necessary to support optimal sleep patterns in elderly adults.

Hatha Yoga benefits sleep quality through increased electrical activity of the parasympathetic nervous system resulting from prolonged periods of slow deep abdominal breathing, thus decreasing both heart rate and blood pressure, decreased levels of cortisol, and decreased stress response [42]. Furthermore, the Hatha Yoga practice has been shown to stimulate melatonin production, which is a major hormone involved in the regulation of the body's circadian rhythms. This increases both the time spent asleep and the aggregate amount of sleep per night [43]. Gentle stretching and holding yoga postures increases blood flow to

muscles that are tightened by stress, decrease muscle tension, and decrease stress hormone activity [44].

The exercise of tandem walking emphasizes postural control, balance, and coordination through the use of vestibular and proprioceptive systems. Tandem Walking is a structured walking activity that improves neuromuscular functioning, decreases muscle tension, and promotes relaxation after exercise, allowing for easier access to deep non-REM stages of sleep [45]. Exercise through walking improves psychological well-being by improving concentration, decreasing stress levels, and thereby resulting in improved sleep (lower cortisol levels) and improved sleep initiation.

Through this combination of Hatha Yoga and Tandem Walking, participants receive both types of stimuli that can simultaneously reduce psychological stress, improve physical fitness levels, and produce a greater overall effect on sleep quality. The combined effect of these two mechanisms will decrease sympathetic dominance and increase parasympathetic regulation and ultimately produce an overall "holistic" relaxation response; therefore, users experience improved sleep onset and deeper sleeping patterns, which leads to an improved quality of sleep [46]. Supporting evidence shows how regular exercise using the modalities of relaxation will help to improve the physiology of the body involved with regulating sleep [47][48].

The improvement in PSQI scores for this study correlates to previous research which supports Hatha Yoga and Tandem Walking exercise to help improve the sleep quality in older adults. These studies have reported improvement in sleep efficiency, sleep latency, and PSQI scores following structured yoga-based exercise interventions [49][50] and structured walking programs [51]. These benefits are mediated through improved autonomic balance, increased homeostatic sleep pressure, enhanced circadian regulation, and reduced physiological hyperarousal [52].

Overall, the findings confirm that the combined Hatha Yoga and Tandem Walking exercise intervention is an effective, safe, and integrative non-pharmacological strategy for improving sleep quality among older adults by simultaneously targeting physiological, psychological, and neuroendocrine mechanisms.

Conclusion

In conclusion, our findings indicate that both Hatha Yoga and Tandem Walking training have a positive effect on the quality of sleep of the elderly population (older adults) in Malang, Indonesia, based on changes observed on the Pittsburgh Sleep Quality Index (PSQI) after participating in either training program. Combined training alone has resulted in significant improvements in four of the five main components measuring sleep, such as increased time spent asleep, improved efficiency of time in bed asleep to time spent awake in bed, decreased

latency to fall asleep, and decreased night-time disturbances. This suggests that both training programs may contribute to better quality sleep through mechanisms involving enhanced relaxation and regulation of the autonomic nervous system, improved postural stability due to better balance during tandem walking, and improvements in the physical functioning of the trained individuals. Thus, our data support the use of combined Hatha Yoga and Tandem Walking training as effective non-pharmacological sleep-enhancing strategies for older adults.

Limitation and Suggestions

The sample size utilized for this research was quite small, which limits the application of this research's results to the larger population of older adults. Furthermore, the sample consisted of older adults from only one geographical location in Malang City; thus, external validity is limited. Many subjects in the sample also had comorbidities, e.g., diabetes and hypertension, that could affect the quality of their sleep and were not examined in depth; therefore, they create confounding variables that were not accounted for.

Conflict of Interest

The authors declare no conflict of interest.

References

[1] R. Sakamoto, "Aging in Southeast Asia and Japan: Challenges and opportunities," *Geriatr. Gerontol. Int.*, vol. 25, no. 7, pp. 837–854, Jul. 2025, doi: 10.1111/ggi.70062.

[2] M. Casagrande, G. Forte, F. Favieri, and I. Corbo, "Sleep Quality and Aging: A Systematic Review on Healthy Older People, Mild Cognitive Impairment and Alzheimer's Disease," *Int. J. Environ. Res. Public Health*, vol. 19, no. 14, Jul. 2022, doi: 10.3390/ijerph19148457.

[3] R. G. Foster, "Introduction and reflections on the comparative physiology of sleep and circadian rhythms," *J. Comp. Physiol. B*, vol. 194, no. 3, pp. 225–231, Jun. 2024, doi: 10.1007/s00360-024-01567-z.

[4] A. K. Patel, V. Reddy, K. R. Shumway, and J. F. Araujo, "Physiology, Sleep Stages," *StatPearls*, Jan. 2024, Accessed: Mar. 23, 2026. [Online]. Available: https://www.ncbi.nlm.nih.gov/books/NBK526132/

[5] T. van Hattem *et al.*, "Targeting Sleep Physiology to Modulate Glymphatic Brain Clearance," *Physiology (Bethesda)*, vol. 40, no. 3, pp. 271–290, May 2025, doi: 10.1152/physiol.00019.2024.

[6] N. Baranwal, P. K. Yu, and N. S. Siegel, "Sleep physiology, pathophysiology, and sleep hygiene," *Prog. Cardiovasc. Dis.*, vol. 77, pp. 59–69, Mar. 2023, doi: 10.1016/j.pcad.2023.02.005.

[7] J. P. Chaput *et al.*, "The role of insufficient sleep and circadian misalignment in obesity," *Nat. Rev. Endocrinol.*, vol. 19, no. 2, pp. 82–97, Feb. 2023, doi: 10.1038/s41574-022-00747-7.

[8] J. Zitser *et al.*, "Pittsburgh Sleep Quality Index (PSQI) responses are modulated by total sleep time and wake after sleep onset in healthy older adults," *PLoS One*, vol. 17, no. 6, Jun. 2022, doi: 10.1371/journal.pone.0270095.

[9] K. Dwitya Widi Adnyani, L. Gede Pradnyawati, and A. Eka Pratiwi, "Hubungan antara Kebiasaan Latihan Yoga terhadap Kualitas Tidur pada Komunitas Lansia Widya Werda Sentana Santi," *Aesculapius Medical Journal |*, vol. 3, no. 1, Feb. 2023, doi: 10.22225/amj.3.1.2023.56-65. *[Eng Trans: The relationship between Yoga exercise and Sleep Quality in the Widya Werda Sentana Santi Elderly Community]*

[10] R. Ding, X.-Y. Liu, Y. Ding, M.-M. Leng, L.-J. Yang, and A.-H. Zhang, "Correlation analysis between sleep quality and depressive symptoms among rural elderly in China: An observational study," *World J. Psychiatry*, vol. 15, no. 12, p. 112672, Dec. 2025, doi: 10.5498/wjp.v15.i12.112672.

[11] J. He, S. H. W. Chan, R. C. K. Chung, and H. W. H. Tsang, "Effect of combined Tai Chi and repetitive transcranial magnetic stimulation for sleep disturbance in older adults: A randomized controlled trial," *J. Psychiatr. Res.*, vol. 180, pp. 281–290, Dec. 2024, doi: 10.1016/j.jpsychires.2024.10.025.
[12] Z. Liu *et al.*, "Repetitive Transcranial Magnetic Stimulation and Tai Chi Chuan for Older Adults With Sleep Disorders and Mild Cognitive Impairment: A Randomized Clinical Trial," *JAMA Netw. Open*, vol. 8, no. 1, Jan. 2025, doi: 10.1001/jamanetworkopen.2024.54307.
[13] A. J. Huang, H. E. Jenny, M. A. Chesney, M. Schembri, and L. L. Subak, "A group-based yoga therapy intervention for urinary incontinence in women: A pilot randomized trial," *Female Pelvic Med. Reconstr. Surg.*, vol. 20, no. 3, pp. 147–154, 2014, doi: 10.1097/SPV.0000000000000072.
[14] H. Tankha *et al.*, "Effectiveness of Virtual Yoga for Chronic Low Back Pain: A Randomized Clinical Trial," *JAMA Netw. Open*, vol. 7, no. 11, p. e2442339, Nov. 2024, doi: 10.1001/jamanetworkopen.2024.42339.
[15] A. Chatutain, J. Pattana, T. Parinsarum, and S. Lapanantasin, "Walking meditation promotes ankle proprioception and balance performance among elderly women," *J. Bodyw. Mov. Ther.*, vol. 23, no. 3, pp. 652–657, Jul. 2019, doi: 10.1016/j.jbmt.2018.09.152.
[16] H. S. Cohen, H. Sangi-Haghpeykar, and S. P. Williams, "Prediction of Functional Limitations in Balance after Tests of Tandem Walking and Standing Balance in Older Adults," *South. Med. J.*, vol. 113, no. 9, pp. 423–426, Sep. 2020, doi: 10.14423/SMJ.0000000000001138.
[17] M. Casagrande, G. Forte, F. Favieri, and I. Corbo, "Sleep Quality and Aging: A Systematic Review on Healthy Older People, Mild Cognitive Impairment and Alzheimer's Disease," *Int. J. Environ. Res. Public Health*, vol. 19, no. 14, Jul. 2022, doi: 10.3390/ijerph19148457.
[18] C. Di Lorito *et al.*, "Exercise interventions for older adults: A systematic review of meta-analyses," *J. Sport Health Sci.*, vol. 10, no. 1, pp. 29–47, Jan. 2021, doi: 10.1016/j.jshs.2020.06.003.
[19] J. Guo *et al.*, "Aging and aging-related diseases: from molecular mechanisms to interventions and treatments," *Signal Transduct. Target. Ther.*, vol. 7, no. 1, Dec. 2022, doi: 10.1038/s41392-022-01251-0.
[20] V. Gianfredi, D. Nucci, F. Pennisi, S. Maggi, N. Veronese, and P. Soysal, "Aging, longevity, and healthy aging: the public health approach," *Aging Clin. Exp. Res.*, vol. 37, no. 1, Dec. 2025, doi: 10.1007/s40520-025-03021-8.
[21] E. M. Crimmins, H. Shim, Y. S. Zhang, and J. K. Kim, "Differences between Men and Women in Mortality and the Health Dimensions of the Morbidity Process," *Clin. Chem.*, vol. 65, no. 1, pp. 135–145, Jan. 2019, doi: 10.1373/clinchem.2018.288332.
[22] S. Jehan *et al.*, "Sleep Disorders in Postmenopausal Women," *J. Sleep Disord. Ther.*, vol. 4, no. 5, p. 212, 2015, Accessed: Mar. 23, 2026. [Online]. Available: https://pmc.ncbi.nlm.nih.gov/articles/PMC4621258/
[23] S. Jehan *et al.*, "Sleep, Melatonin, and the Menopausal Transition: What Are the Links?," *Sleep Sci.*, vol. 10, no. 1, pp. 11–18, 2017, doi: 10.5935/1984-0063.20170003.
[24] A. E. Thompson, Y. Anisimowicz, B. Miedema, W. Hogg, W. P. Wodchis, and K. Aubrey-Bassler, "The influence of gender and other patient characteristics on health care-seeking behaviour: a QUALICOPC study," *BMC Fam. Pract.*, vol. 17, no. 1, 2016, doi: 10.1186/s12875-016-0440-0.
[25] M. Dramé and L. Godaert, "The Obesity Paradox and Mortality in Older Adults: A Systematic Review," *Nutrients*, vol. 15, no. 7, Apr. 2023, doi: 10.3390/nu15071780.
[26] D. F. Estrella-Castillo and L. Gómez-De-Regil, "Comparison of body mass index range criteria and their association with cognition, functioning and depression: a cross-sectional study in Mexican older adults," *BMC Geriatr.*, vol. 19, no. 1, Dec. 2019, doi: 10.1186/s12877-019-1363-0.
[27] Y. Muroga *et al.*, "Dietary characteristics of urban community-dwelling older adults with low muscle mass: the bunkyo health study: a cross-sectional study," *BMC Geriatr.*, vol. 24, no. 1, Dec. 2024, doi: 10.1186/s12877-024-05218-4.
[28] T. Roenneberg, K. V. Allebrandt, M. Merrow, and C. Vetter, "Social jetlag and obesity," *Curr. Biol.*, vol. 22, no. 10, pp. 939–943, May 2012, doi: 10.1016/j.cub.2012.03.038.
[29] M. A. Albqoor and A. M. Shaheen, "Sleep quality, sleep latency, and sleep duration: a national comparative study of university students in Jordan," *Sleep Breath.*, vol. 25, no. 2, pp. 1147–1154, Jun. 2021, doi: 10.1007/s11325-020-02188-w.
[30] U. Das and N. Kar, "Prevalence and risk factor of diabetes among the elderly people in West Bengal: evidence-based LASI 1st wave," *BMC Endocr. Disord.*, vol. 23, no. 1, Dec. 2023, doi: 10.1186/s12902-023-01421-3.

[31] J. Leszczak, E. Czenczek-Lewandowska, M. Asif, J. Baran, A. Mazur, and J. Wyszyńska, "Risk factors and prevalence of hypertension in older adults from south-eastern Poland: an observational study," *Sci. Rep.*, vol. 14, no. 1, Dec. 2024, doi: 10.1038/s41598-024-52009-3.
[32] E. Ji, S. Ahn, J. Y. Choi, C. H. Kim, and K. il Kim, "Effect of multimorbidity on hypertension management," *Sci. Rep.*, vol. 13, no. 1, Dec. 2023, doi: 10.1038/s41598-023-44813-0.
[33] C. J. Lavoie, M. R. Zeidler, and J. L. Martin, "Sleep and aging," *Sleep Science and Practice 2018 2:1*, vol. 2, no. 1, pp. 3-, Feb. 2018, doi: 10.1186/s41606-018-0021-3.
[34] C. Alessi *et al.*, "Cognitive behavioral therapy for insomnia in older veterans using nonclinician sleep coaches: randomized controlled trial," *J Am Geriatr Soc*, vol. 64, no. 9, pp. 1830–1838, Sep. 2016, doi: 10.1111/jgs.14304.
[35] C. Schmidt, P. Peigneux, and C. Cajochen, "Age-Related Changes in Sleep and Circadian Rhythms: Impact on Cognitive Performance and Underlying Neuroanatomical Networks," *Front. Neurol.*, vol. 3, p. 118, 2012, doi: 10.3389/fneur.2012.00118.
[36] N. P. Gordon, J. H. Yao, L. A. Brickner, and J. C. Lo, "Prevalence of sleep-related problems and risks in a community-dwelling older adult population: a cross-sectional survey-based study," *BMC Public Health*, vol. 22, no. 1, Dec. 2022, doi: 10.1186/s12889-022-14443-8.
[37] J. Taillard, C. Gronfier, S. Bioulac, P. Philip, and P. Sagaspe, "Sleep in Normal Aging, Homeostatic and Circadian Regulation and Vulnerability to Sleep Deprivation," *Brain Sci.*, vol. 11, no. 8, Aug. 2021, doi: 10.3390/brainsci11081003.
[38] N. L. Bragazzi *et al.*, "The Complex Interplay Between Sleep and Healthy Aging: A Scoping Review," *Nat. Sci. Sleep*, vol. 17, pp. 3085–3100, Nov. 2025, doi: 10.2147/NSS.S555177.
[39] V. R. Hariprasad *et al.*, "Effects of yoga intervention on sleep and quality-of-life in elderly: A randomized controlled trial," *Indian J. Psychiatry*, vol. 55, no. Suppl 3, p. S364, Jul. 2013, doi: 10.4103/0019-5545.116310.
[40] M. de M. Nascimento *et al.*, "Effects of 12 Weeks of Physical-Cognitive Dual-Task Training on Executive Functions, Depression, Sleep Quality, and Quality of Life in Older Adult Women: A Randomized Pilot Study," *Sustainability 2023, Vol. 15,* vol. 15, no. 1, Dec. 2022, doi: 10.3390/su15010097.
[41] I. Made *et al.*, "Tandem walking exercise to improve cognitive function in the elderly," *Jurnal Keolahragaan*, vol. 11, no. 2, pp. 171–179, Sep. 2023, doi: 10.21831/jk.v11i2.58001.
[42] A. Zaccaro *et al.*, "How Breath-Control Can Change Your Life: A Systematic Review on Psycho-Physiological Correlates of Slow Breathing," *Front. Hum. Neurosci.*, vol. 12, p. 409421, Sep. 2018, doi: 10.3389/fnhum.2018.00353.
[43] S. Khanjani, A. Shamabadi, S. Akhondzadeh, and A. A. Malekirad, "Melatonin for Sleep Quality and Occupational Cognitive Performance in Shift Workers with Low Sleep Quality: A Randomized, Double-Blind, Placebo-Controlled Clinical Trial," *J. Clin. Pharm. Ther.*, vol. 2024, 2024, doi: 10.1155/2024/8869707.
[44] N. Eda, H. Ito, and T. Akama, "Beneficial Effects of Yoga Stretching on Salivary Stress Hormones and Parasympathetic Nerve Activity," *J. Sports Sci. Med.*, vol. 19, no. 4, p. 695, Dec. 2020, Accessed: Mar. 23, 2026. [Online]. Available: https://pmc.ncbi.nlm.nih.gov/articles/PMC7675619/
[45] M. A. Alnawwar, M. I. Alraddadi, R. A. Algethmi, G. A. Salem, M. A. Salem, and A. A. Alharbi, "The Effect of Physical Activity on Sleep Quality and Sleep Disorder: A Systematic Review," *Cureus*, vol. 15, no. 8, Aug. 2023, doi: 10.7759/cureus.43595.
[46] S. Prashanth, V. Nalini, K. Maheshkumar, J. Thanalakshmi, and S. Priyanka, "Effects of yoga on sleep quality among the geriatric population: Systematic review and meta-analysis," *Brain Behavior and Immunity Integrative*, vol. 6, p. 100058, Apr. 2024, doi: 10.1016/j.bbii.2024.100058.
[47] N. Bandyopadhyay, T. Das, A. Biswas, and A. Koley, "Effects of Yogic Intervention on Sleep Quality of Healthy Elderly: A Systematic Review," *Univers. J. Public Health*, vol. 11, no. 1, pp. 78–88, Feb. 2023, doi: 10.13189/ujph.2023.110109.
[48] M. A. Bankar, S. K. Chaudhari, and K. D. Chaudhari, "Impact of long-term Yoga practice on sleep quality and quality of life in the elderly," *J. Ayurveda Integr. Med.*, vol. 4, no. 1, pp. 28–32, 2013, doi: 10.4103/0975-9476.109548.
[49] E. Garrote-Caparrós, M. Bellosta-Batalla, L. Moya-Albiol, and A. Cebolla, "Effectiveness of mindfulness-based interventions on psychotherapy processes: A systematic review," *Clin. Psychol. Psychother.*, vol. 29, no. 3, pp. 783–798, May 2022, doi: 10.1002/cpp.2676.

[50] D. Kanchibhotla, S. Subramanian, and D. Singh, "Management of dysmenorrhea through yoga: A narrative review," *Frontiers in Pain Research*, vol. 4, p. 1107669, Mar. 2023, doi: 10.3389/fpain.2023.1107669.
[51] A. Oktaviatama, D. Mirawati, and C. Setiawan, "Pengaruh Walking Morning Exercise Terhadap Peningkatan Kualitas Tidur pada Lansia," *Jurnal Kesehatan Andalas*, vol. 12, no. 2, pp. 82–86, Mar. 2023, doi: 10.25077/jka.v12i2.2233.
[52] C. R. Bellenger, J. T. Fuller, R. L. Thomson, K. Davison, E. Y. Robertson, and J. D. Buckley, "Monitoring Athletic Training Status Through Autonomic Heart Rate Regulation: A Systematic Review and Meta-Analysis," *Sports Med.*, vol. 46, no. 10, pp. 1461–1486, Oct. 2016, doi: 10.1007/s40279-016-0484-2.

Authors



Nikmatur Rosidah is a lecturer in Physiotherapy at the University of Muhammadiyah Malang with an MSc in Physical Therapy from Mahidol University, Thailand. Work integrates teaching, research, and clinical practice, focusing on geriatric and musculoskeletal physiotherapy, particularly fall prevention, knee osteoarthritis, balance training, and promoting physical activity to enhance quality of life. Committed to integrating evidence-based practice with meaningful community impact to support healthier aging and stronger communities. (email: nikmaturrosidah@umm.ac.id).



Annisa Salsabila Budi Ningrum is a graduate of the Bachelor of Physiotherapy program who is currently pursuing her professional physiotherapy education. She has a strong interest in geriatric care, particularly in improving the quality of life of the elderly. Passionate about continuous learning, she actively engages in volunteer work within elderly communities, gaining hands-on experience and contributing to their well-being. (email: annisalsabila101@gmail.com).



Bayu Prastowo is a lecturer in the Physiotherapy Department at the Universitas Muhammadiyah Malang. He specializes in musculoskeletal physiotherapy, with research interests covering areas such as pain and injury, manual therapy, and physical rehabilitation. In addition to his academic and research roles, he is actively involved in promoting innovative and creative learning approaches, encouraging students to develop critical thinking and practical problem-solving skills in physiotherapy (email: bayuprastowo@umm.ac.id).



Nungki Marlian Yuliadarwati is a lecturer in the Physiotherapy Department at the University of Muhammadiyah Malang, with expertise in elderly physiotherapy and community-based health services. Her work focuses on promoting healthy aging, improving functional independence among older adults, and enhancing community wellbeing through physiotherapy education, prevention programs, and rehabilitation initiatives. She is actively involved in academic development, research, and community engagement to support evidence-based physiotherapy for diverse populations (email: nungki@umm.ac.id).



Ananda Viona Ameylia is a Bachelor of Physiotherapy graduate who is currently continuing her studies in the professional physiotherapy program. She is an enthusiastic learner with a particular interest in physical activity, balance, and fall prevention in the elderly. Her focus reflects a commitment to supporting healthy aging and improving functional independence among older adults. (email: vionaameylia@gmail.com).



Anup Acharya is a master's graduate and a physiotherapist currently working with the Gurkha Trust in Nepal. He specializes in geriatrics and community-based physiotherapy, with a strong focus on improving healthcare access and quality of life for older adults. Actively engaged in professional development, he contributes to research and regularly attends conferences related to physiotherapy and community-based geriatric care. (email: aanupacharya@gmail.com).



Fami Rizal is a lecturer in the Physiotherapy Department at University of Muhammadiyah Pekajangan Pekalongan, Indonesia. His expertise lies in public health, with a focus on healthcare service quality and patient satisfaction, particularly in hospital and medical service settings. (email: fahmirizal.physio@gmail.com).



Dwi Agung Prasetyo is a lecturer in physiotherapy at Institut Teknologi Sains dan Kesehatan RS dr. Soepraoen, Malang, Indonesia. His research broadly focuses on rehabilitation science and physiotherapy, particularly in the management of osteoarthritis, exercise-based interventions, and the role of inflammation and pain modulation in musculoskeletal disorders. (email: dwi-agung-prasetyo@itsk-soepraoen.ac.id).