

Physical activity in the treatment of primary insomnia

Kamal MEZIAN¹, Laura HREHOVÁ²

¹ Department of Rehabilitation Medicine, First Faculty of Medicine, Charles University and General University Hospital in Prague, Prague, Czech Republic

² Institute of General Practice, First Faculty of Medicine, Charles University, Prague, Czech Republic

Corresponding Author: Laura HREHOVÁ

E-mail: laura.hrehova@lf1.cuni.cz

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ABSTRACT

Insomnia is commonplace in the general population. Poor sleep quality leads to various health dysfunctions and compromises the well-being of the affected individuals. Non-pharmacologic approaches should be considered the first-line treatment as suggested by various guidelines. Among others (e.g., sleep hygiene, cognitive-behavioral therapy, light therapy), appropriate physical activity seems to be promising in treating and preventing sleep disturbance development. We found that improvement in a particular objective and subjective sleep quality parameters may be attributed to appropriate physical activity. When further analyzing the activity, light-intensity aerobic exercises and resistance training reduced insomnia symptoms. High-intensity interval training also showed a positive effect on the improvement in depressive symptoms. Regarding mind-body practices, current evidence is insufficient to conclude. However, it was documented that stress, depression, and anxiety reduction, can improve well-being.

Keywords: Exercise, Insomnia, Physical activity, Sleep quality

1. INTRODUCTION

Insomnia is characterized by difficulty falling asleep, interrupted sleep, and/or early awakening. The International Classification of Sleep Disorders, 3rd edition (ICSD 3) divides insomnia into acute and chronic (> three months, at least three times a week) [1]. The prevalence of sleep induction or retention disorders is estimated at 30% – 48% [2]. Good sleep quality is associated with better performance, physical and psychological well-being [3]. Primary insomnia cannot be attributed to an existing medical, psychiatric, or environmental cause. Psychological symptoms such as irritability, anxiety, and depression are more common in people with insomnia. A decreased concentration, less productivity, and poorer health are also observed [4]. Conversely, sleep disturbances may result in various dysfunctions, e.g., hypertension [5], weakened immunity [6], cognitive decline [7], and other different health problems [8].

In light of the potential side effects of commonly used sleep-promoting medications, increased attention is paid to non-pharmacologic approaches [9]. One of the promising non-pharmacologic approaches to improving sleep quality is physical exercise [10]. WHO guidelines address regular physical activity as an indisputable part of a 'healthy lifestyle'. It may improve health in patients presenting with various chronic disorders, such as obesity, cardiovascular diseases, diabetes, cancer, anxiety, and depression [11]. Physical activity can also contribute to the maintenance of physical and mental well-being [12]. Despite the variety of proven and potential health benefits of exercise, the 'pandemic of physical inactivity' has become a reality as a consequence of a sedentary lifestyle. A recent meta-analysis by Li and coworkers, including 23 trials with 1269 patients who received exercise therapy, reported a significant effect on the treatment of primary insomnia [13].

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Sleep and exercise show a mutual relationship in terms of sleep quality and physical performance. Various descriptions of how regular exercise influences sleep comprise effects on endocrine, metabolic and immune systems, and thermoregulatory changes [14]. Recently, awareness has been paid to exercise-related hippocampal neurogenesis. During this process, new neurons are born to be integrated into the hippocampus. One of the essential molecules mediating this process is known as the brain-derived neurotrophic factor (BDNF) [15]. This morphological and functional plasticity theory may provide a better insight into how physical activity can promote brain function. Erickson and colleagues, in their study, reported positive effects of aerobic exercise on increased hippocampal volume and cognitive function improvement, e.g., enhanced spatial memory after seven weeks of an aerobic exercise program [16]. Notably, exercise-related hippocampal neurogenesis might contribute to better understanding the antidepressant effects of exercise. In summary, physical activity exerts various neurochemical changes positively affecting well-being and the ability to cope with stressful encounters, e.g., due to the transient increase of cortisol and plasma β -endorphin levels [17, 18]. This review aims to discuss current literature regarding different types of physical activities/exercises in relation to sleep quality.

2. PHYSICAL ACTIVITIES

Physical activity-based treatment approaches and protocols

Physical activity can be defined as any bodily motion produced by the action of skeletal muscles that expends energy and can be performed in the way of transportation, as part of work, housework, leisure activities, or when participating in exercise or sports [11]. Exercise as a component of physical activity is usually planned, structured, and repetitive. It can further be characterized by its type, duration, frequency, and intensity. Regarding the intensity of physical activity, metabolic equivalents (METs) are commonly used in epidemiological research to assign an intensity category to a specific physical activity. One MET can be defined as an energy cost while sitting quietly (resting metabolic rate) and is equivalent to a caloric consumption of 1kcal/kg/hour. Guidelines from the American College of Sports Medicine and the American Heart Association recommend using the following reference thresholds: 1.5 to 3.0 METs for light, 3.0 to 6.0 METs for moderate, and >6.0 METs for vigorous intensities. Concerning an individual's cardiorespiratory fitness, a commonly used measure is a scale of 0–10, where 0 is sitting, and 10 represents the highest level of effort possible [19]. Being aware of simplification and potential overlap, we categorized different physical activities according to their types and intensities.

Exercise to prevent and treat insomnia

The role of physical activity in insomnia treatment

Light intensity physical activities do not substantially raise heart or breathing rates and energy expenditure. These may

include, e.g., walking, pilates, or stretching exercises. Hartescu et al. conducted a randomized controlled trial (RCT) in a sample of inactive people with insomnia, exploring the effect of brisk walking on self-reported outcomes. At six months post-baseline, the authors reported that the increased physical activity group significantly reduced insomnia symptoms compared to the control group, where participants maintained their lifestyle as usual [20]. Chen and colleagues, in their systematic review with meta-analysis from 2020, documented an improvement in sleep quality in individuals practicing pilates-based exercised. On the other hand, the effect on reducing the use of sleep-promoting medications was not supported by evidence according to their study [21]. Two RCTs documented the beneficial effects of pilates on sleep quality [22, 23]. Pa and coworkers conducted a study exploring the effects on reducing sleep difficulties in older adults with cognitive decline and sleep complaints. According to their results, a combination of light cognitive exercises together with light-intensity activities, such as stretching, was reported to be superior to moderate or high-intensity workouts [24].

Resistance training increases strength without significantly changing peak oxygen consumption [25]. Exemplary activities would be, e.g., weight-lifting, body-weight workouts, or resistance band exercises. In their systematic review from 2018, Kovacevic and coworkers made an effort to determine both the acute and chronic effects of resistance training on sleep characteristics. According to their findings, regular resistance training improved sleep quality, with further benefits of combining with aerobic exercise. As regards the acute effects of resistance exercise on sleep quality, the evidence was inconsistent [26]. In their RCT, D'Aurea et al. compared the effects of stretching (group 1) and resistance exercise (group 2) on chronic insomnia. Both exercise types were similarly effective in improving subjective and objective sleep parameters, while both approaches were found superior to the control group (group 3) [27]. A combination of resistance training, walking, and social activity for seven weeks improved sleep in older adults more than in a regular care control group. It also showed no significant same-day effects of resistance training on sleep architecture [28].

High-intensity interval training (HIIT) is a cardiovascular exercise defined by short bursts of repeated vigorous activity that consists of short periods of rest or low-intensity exercise for body recovery. Jurado-Fascoli et al., in their RCT, observed improved objective sleep quality parameters, like total sleep time, sleep efficiency, and sleep interruptions after 12 weeks of HIIT training [29]. In their community-based study, Bullock and coauthors found HIIT inferior for improving sleep in insomniacs compared with moderate-intensity or stretching exercises. HIIT after eight weeks of training showed a positive effect on the improvement in depressive symptoms, sleep quality, and cardiorespiratory adaptation [30]. A study with middle-aged men showed that practicing HIIT close to bedtime reduced sleep quality in the first three hours [31].

Aerobic exercise is a moderate-intensity physical activity associated with cardiovascular conditioning. It can include activities like jogging, hiking, or dancing. Reid KJ et al. randomized individuals older than 55 years to either group

with aerobic physical exercise or control group with no physical activity. After 16 weeks of the training program, the authors assessed the study participants for sleep problems. This study concluded that subjects in the active group improved their sleep quality, efficiency, latency, duration, and daytime dysfunction. This group also showed less symptoms of depression, sleeping during the day, and increased vitality [32]. Ezati and colleagues did not find a positive effect of 4 weeks of aerobic exercise on sleep duration among university students. However, eight weeks of training positively affected all components of sleep [33]. Another relevant RCT showed that moderate-intensity aerobic exercise in patients with chronic primary insomnia decreased presleep anxiety and increases sleep [34]. A RTC by Hartescu with colleagues showed that more than 150 min of moderate – to vigorous-intensity physical activity per week for six months decreased severe insomnia symptoms [35]. Two studies documented that moderate-intensity exercise 90 minutes before bed by young and healthy men did not negatively impact sleep quality [36, 37].

Mind-body exercises have also been studied for the treatment of sleep disturbances. Notably, the mechanisms for improving sleep quality are different.

Yoga, in its traditional ancient Indian conception, is more way of living, also consisting of nutrition, lifestyle advices, and meditation. The Western version, sometimes called 'postural yoga' is a form of mind-body exercise. There are various yoga styles, e.g., Hatha, Vinyasa, Bikram, Ashtanga, Acroyoga, and many others, [38] with various intensities [39]. Postural yoga consists of changing static and dynamic positions with a specific breathing pattern. Concerning yoga practice in women with sleep problems, Wang and coauthors documented an improvement in sleep quality [40]. In their systematic review, Cramer and colleagues reported moderate evidence for yoga practice-related short-term effects on relieving symptoms of depression [41]. Yoga has also been documented to be beneficial in improving sleep quality in the elderly (aged ≥ 60 years) [42], patients with malignancy [43], and in postmenopausal women [44]. As reported by Innes and Selfe, yoga may improve in older women with restless legs syndrome [45]. On the other hand, European guidelines for the diagnosis and treatment of insomnia do not recommend yoga to treat insomnia because of poor evidence [46]. Regarding possible adverse effects of yoga, musculoskeletal injuries were reported, mainly when practicing without supervision [47]. In their systematic review with meta-analysis from 2019, Tang and coworkers concluded walking to be superior to yoga in reducing sleep disturbance in cancer patients [48]. In 2019, Kreutz and colleagues compared RCTs reporting sleep outcomes of patients after breast cancer treatment, following different mind-body and physical exercises. They included 22 studies with 2107 participants and reported improved subjective sleep outcomes after both physical and mind-body exercises. On the other hand, a positive impact on objective sleep measures was not documented [49].

Tai Chi, a mind-body exercise rooted in traditional Chinese martial art, is nowadays popular in Western society. Tai Chi exercise can vary from low to moderate intensities and can

also be suitable for middle-aged or older individuals [50]. Tai chi is widely used as a complementary treatment for different conditions. A favorable impact of Tai chi has also been documented on psychological well-being, including reduced stress and depression [51]. As reported in two recent systematic reviews with meta-analyses, Tai Chi exercise may positively affect sleep quality [52, 53]. Concerning possible adverse effects of meditative movement therapies, short term symptoms of anxiety may be reported initially [54].

Future Perspectives

A matter of debate is the potential harming effect of exercising before bedtime. According to sleep hygiene, [55] exercise close to bedtime is not recommended. Regarding vigorous exercise, a systematic review and meta-analysis conducted by Stutz et al. support this recommendation [56]. However, their review does not support the hypothesis that evening exercise, in general, has a negative impact on sleep quality. To this end, it seems that one should evaluate the appropriateness of evening exercise case by case.

Conclusions

The exercise intervention represents a safe and widely accessible health-promoting activity. In addition to various physical and mental benefits, regular exercise seems to be a good alternative treatment option to improve sleep quality. There is no optimal general recommendation as regards a specific physical activity type. Every individual should perform activities/exercises that fit in their lifestyle and preferences.

Compliance with Ethical Standards

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REFERENCES

- [1] American Academy of Sleep Medicine. International classification of sleep disorders, revised: Diagnostic and coding manual. Published online 2014. <https://aasm.org/clinical-resources/international-classification-sleep-disorders/> Accessed on February 21, 2024
- [2] Ohayon MM. Epidemiology of insomnia: what we know and what we still need to learn. *Sleep Med Rev* 2002;6:97-111. doi:10.1053/smr.2002.0186
- [3] Grandner MA. Sleep, health, and society. *Sleep Med Clin* 2017;12:1-22. doi:10.1016/j.jsmc.2016.10.012
- [4] Zailinawati AH, Mazza D, Teng CL. Prevalence of insomnia and its impact on daily function amongst Malaysian primary

- care patients. Accessed on February 20, 2024. <https://pubmed.ncbi.nlm.nih.gov/23186221/>
- [5] Jarrin DC, Alvaro PK, Bouchard MA, Jarrin SD, Drake CL, Morin CM. Insomnia and hypertension: A systematic review. *Sleep Med Rev* 2018;41:3-38. doi:10.1016/j.smr.2018.02.003
- [6] Ibarra-Coronado EG, Pantaleón-Martínez AM, Velazquez-Moctezuma J, et al. The bidirectional relationship between sleep and immunity against infections. *J Immunol Res* 2015;2015:678164. doi:10.1155/2015/678164
- [7] Hamdy RC, Kinser A, Dickerson K, et al. Insomnia and mild cognitive impairment. *Gerontol Geriatr Med* 2018;4:233.372.1418778421. doi:10.1177/233.372.1418778421
- [8] Cunnington D, Junge M. Chronic insomnia: diagnosis and non-pharmacological management. *BMJ* 2016;355:i5819. doi:10.1136/bmj.i5819
- [9] Hrehova L, Mezian K. Nonpharmacologic treatment of insomnia in primary care settings. Authorea Published online 2020. doi:10.22541/au.160708.066.60329056/v1 Accessed February 20, 2024.
- [10] Lowe H, Haddock G, Mulligan LD, et al. Does exercise improve sleep for adults with insomnia? A systematic review with quality appraisal. *Clin Psychol Rev* 2019;68:1-12. doi:10.1016/j.cpr.2018.11.002
- [11] World Health Organization. WHO Guidelines on physical activity and sedentary behaviour. Published online 2020. <https://www.who.int/publications/i/item/978.924.0015128> Accessed February 20, 2024.
- [12] Das P, Horton R. Rethinking our approach to physical activity. *Lancet* 2012;380(9838):189-90. doi:10.1016/S0140-6736(12)61024-1
- [13] Li S, Li Z, Wu Q, et al. Effect of exercise intervention on primary insomnia: a meta-analysis. *J Sports Med Phys Fitness* 2021;61:857-66. doi:10.23736/S0022-4707.21.11443-4
- [14] Chennaoui M, Arnal PJ, Sauvet F, Léger D. Sleep and exercise: a reciprocal issue? *Sleep Med Rev* 2015;20:59-72. doi:10.1016/j.smr.2014.06.008
- [15] Liu PZ, Nusslock R. Exercise-mediated neurogenesis in the hippocampus via BDNF. *Front Neurosci* 2018;12:52. doi:10.3389/fnins.2018.00052
- [16] Erickson KI, Voss MW, Prakash RS, et al. Exercise training increases size of hippocampus and improves memory. *Proc Natl Acad Sci U S A* 2011;108:3017-3022. doi:10.1073/pnas.101.595.0108
- [17] Basso JC, Suzuki WA. The effects of acute exercise on mood, cognition, neurophysiology, and neurochemical pathways: A review. *Brain Plast* 2017;2:127-52. doi:10.3233/BPL-160040
- [18] Duclos M, Corcuff JB, Arsac L, et al. Corticotroph axis sensitivity after exercise in endurance-trained athletes. *Clin Endocrinol (Oxf)* 1998;48:493-501. doi:10.1046/j.1365-2265.1998.00334.x
- [19] US Department of Health and Human Services, Committee. Physical Activity Guidelines for Americans. 2nd ed. Published online 2018. https://d197for5662m48.cloudfront.net/documents/publicationstatus/54162/preprint_pdf/c023c6dad75e677343912db9f2f8bb29.pdf Accessed on 20 February, 2024
- [20] Hartescu I, Morgan K, Stevinson CD. Increased physical activity improves sleep and mood outcomes in inactive people with insomnia: a randomized controlled trial. *J Sleep Res* 2015;24:526-34. doi:10.1111/jsr.12297
- [21] Chen Z, Ye X, Shen Z, et al. Effect of pilates on sleep quality: A systematic review and meta-analysis of randomized controlled trials. *Front Neurol* 2020;11:158. doi:10.3389/fneur.2020.00158
- [22] Ahmadinezhad M, Kargar M, Vizehfar F, Hadianfard MJ. Comparison of the effect of acupressure and pilates-based exercises on sleep quality of postmenopausal women: A randomized controlled trial. *iran J Nurs Midwifery Res* 2017;22:140-6. doi:10.4103/1735-9066.205954
- [23] Aibar-Almazán A, Hita-Contreras F, Cruz-Díaz D, de la Torre-Cruz M, Jiménez-García JD, Martínez-Amat A. Effects of pilates training on sleep quality, anxiety, depression and fatigue in postmenopausal women: A randomized controlled trial. *Maturitas* 2019;124:62-7. doi:10.1016/j.maturitas.2019.03.019
- [24] Pa J, Goodson W, Bloch A, King AC, Yaffe K, Barnes DE. Effect of exercise and cognitive activity on self-reported sleep quality in community-dwelling older adults with cognitive complaints: a randomized controlled trial. *J Am Geriatr Soc* 2014;62:2319-26. doi:10.1111/jgs.13158
- [25] Lambert CP, Evans WJ. Adaptations to aerobic and resistance exercise in the elderly. *Rev Endocr Metab Disord* 2005;6:137-43. doi:10.1007/s11154.005.6726-5
- [26] Kovacevic A, Mavros Y, Heisz JJ, Fiatarone Singh MA. The effect of resistance exercise on sleep: A systematic review of randomized controlled trials. *Sleep Med Rev* 2018;39:52-68. doi:10.1016/j.smr.2017.07.002
- [27] D'Aurea CVR, Poyares D, Passos GS, et al. Effects of resistance exercise training and stretching on chronic insomnia. *Braz J Psychiatry* 2019;41:51-7. doi:10.1590/1516-4446-2018-0030
- [28] Herrick JE, Puri S, Richards KC. Resistance training does not alter same-day sleep architecture in institutionalized older adults. *J Sleep Res* 2018;27:e12590. doi:10.1111/jsr.12590
- [29] Jurado-Fasoli L, De-la-O A, Molina-Hidalgo C, Migueles JH, Castillo MJ, Amaro-Gahete FJ. Exercise training improves sleep quality: A randomized controlled trial. *Eur J Clin Invest* 2020;50:e13202. doi:10.1111/eci.13202
- [30] Bullock A, Kovacevic A, Kuhn T, Heisz JJ. Optimizing sleep in older adults: Where does high-intensity interval training fit? *Front Psychol* 2020;11:576316. doi:10.3389/fpsyg.2020.576316
- [31] Larsen P, Melehan K, Marino F, Duffield R, Guelfi K, Skein M. The effects of exercise time-of-day on sleep quality and quantity among inactive middle-aged men. Poster session presented at Australasian Sleep Association's (ASA) Sleep DownUnder 2017, Auckland, New Zealand.
- [32] Reid KJ, Baron KG, Lu B, Naylor E, Wolfe L, Zee PC. Aerobic exercise improves self-reported sleep and quality of life in older adults with insomnia. *Sleep Med* 2010;11:934-40. doi:10.1016/j.sleep.2010.04.014

- [33] Ezati M, Keshavarz M, Barandouzi ZA, Montazeri A. The effect of regular aerobic exercise on sleep quality and fatigue among female student dormitory residents. *BMC Sports Sci Med Rehabil* 2020;12:44. doi:10.1186/s13102.020.00190-z
- [34] Passos GS, Poyares D, Santana MG, Garbuio SA, Tufik S, Mello MT. Effect of acute physical exercise on patients with chronic primary insomnia. *J Clin Sleep Med* 2010;6:270-5.
- [35] Hartescu I, Morgan K, Stevinson CD. Increased physical activity improves sleep and mood outcomes in inactive people with insomnia: a randomized controlled trial. *J Sleep Res* 2015;24:526-34. doi:10.1111/jsr.12297
- [36] Miller DJ, Sargent C, Roach GD, Scanlan AT, Vincent GE, Lastella M. Moderate-intensity exercise performed in the evening does not impair sleep in healthy males. *Eur J Sport Sci* 2020;20:80-9. doi:10.1080/17461.391.2019.1611934
- [37] Vincent GE, Sargent C, Roach GD, et al. Exercise before bed does not impact sleep inertia in young healthy males. *J Sleep Res* 2020;29:e12903. doi:10.1111/jsr.12903
- [38] Cramer H, Lauche R, Langhorst J, Dobos G. Is one yoga style better than another? A systematic review of associations of yoga style and conclusions in randomized yoga trials. *Complement Ther Med* 2016;25:178-87. doi:10.1016/j.ctim.2016.02.015
- [39] Forseth B, Hunter SD. Range of yoga intensities from savasana to sweating: A systematic review. *J Phys Act Health* 2020;17:242-9. doi:10.1123/jpah.2019-0372
- [40] Wang WL, Chen KH, Pan YC, Yang SN, Chan YY. The effect of yoga on sleep quality and insomnia in women with sleep problems: a systematic review and meta-analysis. *BMC Psychiatry* 2020;20:195. doi:10.1186/s12888.020.02566-4
- [41] Cramer H, Lauche R, Langhorst J, Dobos G. Yoga for depression: a systematic review and meta-analysis. *Depress Anxiety* 2013;30:1068-83. doi:10.1002/da.22166
- [42] Halpern J, Cohen M, Kennedy G, Reece J, Cahan C, Baharav A. Yoga for improving sleep quality and quality of life for older adults. *Altern Ther Health Med* 2014;20:37-46.
- [43] Mustian KM, Janelins M, Peppone LJ, Kamen C. Yoga for the treatment of insomnia among cancer patients: evidence, mechanisms of action, and clinical recommendations. *Oncol Hematol Rev* 2014;10:164-8. doi:10.17925/ohr.2014.10.2.164
- [44] Afonso RE, Hachul H, Kozasa EH, et al. Yoga decreases insomnia in postmenopausal women: a randomized clinical trial. *Menopause* 2012;19:186-93. doi:10.1097/gme.0b013e318228225f
- [45] Innes KE, Selfe TK. The effects of a gentle yoga program on sleep, mood, and blood pressure in older women with restless legs syndrome (rls): a preliminary randomized controlled trial. *evid based complement Alternat Med* 2012;2012:294058. doi:10.1155/2012/294058
- [46] Riemann D, Baglioni C, Bassetti C, et al. European guideline for the diagnosis and treatment of insomnia. *J Sleep Res* 2017;26:675-700. doi:10.1111/jsr.12594
- [47] Cramer H, Quinker D, Schumann D, Wardle J, Dobos G, Lauche R. Adverse effects of yoga: a national cross-sectional survey. *BMC Complement Altern Med* 2019;19:190. doi:10.1186/s12906.019.2612-7
- [48] Tang MF, Chiu HY, Xu X, et al. Walking is more effective than yoga at reducing sleep disturbance in cancer patients: A systematic review and meta-analysis of randomized controlled trials. *Sleep Med Rev* 2019;47:1-8. doi:10.1016/j.smrv.2019.05.003
- [49] Kreutz C, Schmidt ME, Steindorf K. Effects of physical and mind-body exercise on sleep problems during and after breast cancer treatment: a systematic review and meta-analysis. *Breast Cancer Res Treat* 2019;176:1-15. doi:10.1007/s10549.019.05217-9
- [50] Chen YW, Hunt MA, Campbell KL, Peill K, Reid WD. The effect of Tai Chi on four chronic conditions-cancer, osteoarthritis, heart failure and chronic obstructive pulmonary disease: a systematic review and meta-analyses. *Br J Sports Med* 2016;50:397-407. doi:10.1136/bjsports-2014-094388
- [51] Wang C, Bannuru R, Ramel J, Kupelnick B, Scott T, Schmid CH. Tai Chi on psychological well-being: systematic review and meta-analysis. *BMC Complement Altern Med* 2010;10:23. doi:10.1186/1472-6882-10-23
- [52] Si Y, Wang C, Yin H, et al. Tai Chi Chuan for subjective sleep quality: A systematic review and meta-analysis of randomized controlled trials. *Evid Based Complement Alternat Med* 2020;2020:4710527. doi:10.1155/2020/4710527
- [53] Li H, Chen J, Xu G, et al. The effect of Tai Chi for Improving sleep quality: A systematic review and meta-analysis. *J Affect Disord* 2020;274:1102-1112. doi:10.1016/j.jad.2020.05.076
- [54] Astin JA, Shapiro SL, Eisenberg DM, Forsys KL. Mind-body medicine: state of the science, implications for practice. *J Am Board Fam Pract* 2003;16:131-147. doi:10.3122/jabfm.16.2.131
- [55] American Academy of Sleep Medicine. International Classification of Sleep Disorders, Revised: Diagnostic and Coding Manual. American Academy of Sleep Medicine; 2001.
- [56] Astin JA, Shapiro SL, Eisenberg DM, Forsys KL. Mind-body medicine: state of the science, implications for practice. *J Am Board Fam Pract* 2003;16:131-47. doi:10.3122/jabfm.16.2.131