

EFFECT OF SAHAJA YOGA MEDITATION ON SLEEP QUALITY AND AUTONOMIC FUNCTION IN PATIENTS WITH DIABETES MELLITUS AND INSOMNIA: A CLINICAL INTERVENTIONAL STUDY

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ABSTRACT

Background: Sleep disturbances are common among patients with diabetes mellitus and may coexist with impaired autonomic regulation. Meditation-based interventions may improve sleep and autonomic balance. This study evaluated the effect of Sahaja Yoga meditation on sleep quality and autonomic parameters in diabetic patients with insomnia. **Materials and Methods:** A prospective interventional study was conducted among 54 diabetic patients with insomnia. Participants underwent an 8-week Sahaja Yoga meditation programme consisting of 30-minute sessions, five days per week. Sleep quality was assessed using the Pittsburgh Sleep Quality Index (PSQI). Resting heart rate, blood pressure and heart rate variability (HRV) parameters were assessed before and after the intervention. **Results:** Following the intervention, the mean PSQI score decreased from 11.24 ± 2.31 to 7.18 ± 2.14 ($p < 0.001$). Resting heart rate decreased from 84.6 ± 8.7 to 78.9 ± 7.6 beats/min ($p < 0.001$). SDNN increased from 28.6 ± 8.9 to 35.7 ± 9.8 ms, while RMSSD increased from 21.4 ± 7.1 to 29.8 ± 8.3 ms ($p < 0.001$). HF power increased and LF/HF ratio decreased significantly following intervention. **Conclusion:** Sahaja Yoga meditation was associated with improved sleep quality and favourable changes in autonomic regulation among diabetic patients with insomnia. It may serve as a simple, low-cost complementary approach alongside conventional diabetes and insomnia management.

INTRODUCTION

Diabetes mellitus is a chronic metabolic disorder associated with substantial physiological and psychosocial consequences. In addition to hyperglycaemia and its microvascular and macrovascular complications, disturbances of sleep are increasingly recognised as an important but often under-addressed component of diabetes care. Sleep problems and diabetes appear to have a bidirectional relationship, wherein metabolic disturbances may impair sleep, while inadequate or fragmented sleep can adversely influence glucose regulation, insulin sensitivity, appetite, daytime functioning and quality of life.^[1,2] A systematic review reported that sleep disorders are highly prevalent among individuals with diabetes, with insomnia, obstructive sleep apnoea and restless legs syndrome being commonly

encountered.^[3] Insomnia is characterised by persistent difficulty in initiating or maintaining sleep, early morning awakening or dissatisfaction with sleep despite adequate opportunity for sleep, with associated daytime impairment. In people with type 2 diabetes mellitus (T2DM), insomnia has particular clinical relevance because sleep disruption may be accompanied by psychological stress, altered neuroendocrine activity and increased sympathetic nervous system activation. Insomnia has also been associated with poorer glycaemic control, including higher glycated haemoglobin levels.^[3,4] Thus, identification and management of insomnia may represent an additional approach to improving the overall health of patients with diabetes. Autonomic dysfunction is another important consequence of diabetes, particularly with increasing disease duration and the development of diabetic autonomic

neuropathy. Alterations in sympathetic and parasympathetic regulation can affect cardiovascular homeostasis and may be detected through heart rate variability (HRV), resting heart rate and blood pressure responses. HRV provides a non-invasive measure of cardiac autonomic modulation and is particularly useful for evaluating changes in sympathovagal balance. Evidence indicates that yoga-based interventions may influence cardiac autonomic regulation, with several studies reporting increased HRV and enhanced vagal activity following regular practice.^[5] In patients with T2DM, an integrated yoga intervention has also demonstrated favourable changes in autonomic function, supporting the potential role of mind-body practices in addressing diabetes-related autonomic imbalance.^[6] Meditation-based interventions may be particularly relevant because they combine attentional regulation, relaxation and reduction of psychological arousal without requiring substantial physical exertion. Sahaja Yoga meditation is a form of meditation that emphasises mental silence, attention and achievement of a relaxed state through meditation practices. By reducing mental stress and excessive arousal, such practices may potentially influence autonomic regulation and facilitate healthier sleep patterns. Although evidence concerning meditation in diabetes is expanding, most studies have focused on glycaemic control, psychological well-being or general self-management rather than patients specifically presenting with insomnia. Meta-analyses have suggested beneficial effects of meditation-based interventions on psychological outcomes and, in some studies, glycaemic control among people with diabetes.^[7,8] Evidence from other mind-body interventions is also encouraging. A recent systematic review and meta-analysis found that physical and mind-body exercise interventions significantly improved sleep quality among individuals with diabetes mellitus.^[9] Similarly, yoga-based intervention has been reported to improve sleep quality and selected biochemical and inflammatory parameters in individuals with T2DM.^[10] However, the effects of a specific meditation practice such as Sahaja Yoga on both subjective sleep quality and objective physiological indicators of autonomic function in diabetic patients with insomnia remain inadequately explored. The Pittsburgh Sleep Quality Index (PSQI) is a widely used instrument for evaluating subjective sleep quality and related sleep disturbances over the preceding month. It assesses several dimensions, including sleep latency, duration, efficiency, disturbances and daytime dysfunction, thereby providing a comprehensive assessment of perceived sleep quality.^[11] Combining PSQI assessment with HRV and cardiovascular parameters may therefore provide a broader understanding of the relationship between sleep and autonomic regulation. Considering the high burden of sleep disturbances in diabetes and the potential influence of meditation on autonomic and psychological pathways, evaluating

Sahaja Yoga meditation in diabetic patients with insomnia is clinically relevant. The present study was therefore undertaken to assess the effect of Sahaja Yoga meditation on sleep quality and autonomic parameters in patients with diabetes mellitus and insomnia.

Aim and objectives: The present study aimed to evaluate the effect of Sahaja Yoga meditation on sleep quality and autonomic parameters in patients with diabetes mellitus and insomnia, by assessing changes in Pittsburgh Sleep Quality Index scores, heart rate variability, resting heart rate and blood pressure following a structured meditation intervention.

MATERIALS AND METHODS

Study design: A prospective interventional study was conducted among patients with diabetes mellitus who had symptoms of insomnia. The study protocol was explained to all participants, and written informed consent was obtained before enrolment.

Study participants: A total of 54 adult patients diagnosed with diabetes mellitus and fulfilling the predefined criteria for insomnia were recruited. Participants of either sex were included. Patients with major psychiatric illness, severe cardiovascular disease, neurological disorders affecting autonomic function, obstructive sleep apnoea, chronic kidney disease, or those regularly practising yoga or meditations were excluded. Participants receiving medications known to substantially alter sleep or autonomic function were also excluded.

Assessment of sleep quality: Subjective sleep quality was assessed using the Pittsburgh Sleep Quality Index (PSQI). The questionnaire assessed sleep quality over the preceding month through components including subjective sleep quality, sleep latency, sleep duration, habitual sleep efficiency, sleep disturbances, use of sleep medication and daytime dysfunction. The global PSQI score was calculated according to the standard scoring procedure, with higher scores indicating poorer sleep quality.

Assessment of autonomic parameters: Autonomic function was evaluated under standardised laboratory conditions. Participants were instructed to avoid vigorous physical activity, caffeine and other stimulants before assessment. After adequate rest in a quiet environment, resting heart rate and blood pressure were recorded. Heart rate variability (HRV) was assessed using a validated recording system under controlled conditions. Time-domain parameters such as SDNN and RMSSD, and frequency-domain parameters including low-frequency (LF), high-frequency (HF) power and LF/HF ratio, were obtained. The recordings were performed at baseline and after completion of the intervention.

Sahaja Yoga meditation intervention: Participants underwent a structured Sahaja Yoga meditation

programme for 8 weeks. Each session lasted approximately 30 minutes and was conducted five days per week. The sessions included guided meditation, attention to breathing, mental relaxation and techniques aimed at achieving a state of mental silence and sustained attention. Participants were initially trained under supervision and were subsequently encouraged to practise regularly according to the prescribed schedule. Attendance and adherence to the intervention were monitored throughout the study period.

Post-intervention assessment: At the end of 8 weeks, the PSQI questionnaire and autonomic assessments were repeated using the same procedures as the baseline evaluation. Changes in sleep quality and autonomic parameters between pre-intervention and post-intervention assessments were analysed.

Data analysis: The collected data were entered into a spreadsheet and analysed using appropriate statistical software. Continuous variables were expressed as mean $\pm$ standard deviation. Pre- and post-intervention values were compared using an appropriate paired statistical test based on data distribution. A p-value <0.05 was considered statistically significant.

RESULTS

Results were presented in table 1 to table 3. A total of 54 diabetic patients with insomnia completed the intervention and were included in the analysis. Following 8 weeks of Sahaja Yoga meditation, an improvement in subjective sleep quality was observed. The mean global PSQI score decreased substantially, indicating better overall sleep quality. Improvements were also observed in sleep latency, sleep duration and daytime functioning. The autonomic assessment demonstrated a favourable shift following the meditation programme. Resting heart rate and systolic and diastolic blood pressure showed modest reductions. Time-domain HRV indices, particularly RMSSD and SDNN, increased after the intervention, suggesting improved cardiac autonomic modulation. Frequency-domain HRV analysis also showed an increase in HF power with a corresponding reduction in LF/HF ratio after the intervention. These findings indicated a relative enhancement of parasympathetic activity and improvement in sympathovagal balance. The findings suggested that an 8-week Sahaja Yoga meditation programme was associated with improved sleep quality and favourable changes in cardiovascular autonomic regulation among diabetic patients with insomnia.

Table 1: Baseline and post-intervention sleep quality parameters (n = 54)

Sleep parameters	Baseline (Mean $\pm$ SD)	Post-intervention (Mean $\pm$ SD)	p-value
Global PSQI score	11.24 $\pm$ 2.31	7.18 $\pm$ 2.14	<0.001
Subjective sleep quality	2.02 $\pm$ 0.61	1.34 $\pm$ 0.55	<0.001
Sleep latency	2.08 $\pm$ 0.67	1.39 $\pm$ 0.58	<0.001
Sleep duration	1.71 $\pm$ 0.73	1.28 $\pm$ 0.62	<0.001
Habitual sleep efficiency	1.63 $\pm$ 0.71	1.21 $\pm$ 0.57	<0.001
Sleep disturbances	1.67 $\pm$ 0.49	1.31 $\pm$ 0.46	<0.001
Daytime dysfunction	1.54 $\pm$ 0.63	0.65 $\pm$ 0.54	<0.001

Table 2: Comparison of cardiovascular and time-domain HRV parameters (n = 54)

Parameter	Baseline (Mean $\pm$ SD)	Post-intervention (Mean $\pm$ SD)	p-value
Heart rate (beats/min)	84.6 $\pm$ 8.7	78.9 $\pm$ 7.6	<0.001
Systolic BP (mmHg)	137.2 $\pm$ 12.4	131.5 $\pm$ 10.8	0.003
Diastolic BP (mmHg)	84.8 $\pm$ 8.1	80.9 $\pm$ 7.2	0.006
SDNN (ms)	28.6 $\pm$ 8.9	35.7 $\pm$ 9.8	<0.001
RMSSD (ms)	21.4 $\pm$ 7.1	29.8 $\pm$ 8.3	<0.001

Table 3: Comparison of frequency-domain HRV parameters (n = 54)

HRV	Baseline	Post-intervention	p-value
LF power (ms ²)	386.4 $\pm$ 104.6	349.7 $\pm$ 96.8	0.041
HF power (ms ²)	218.7 $\pm$ 76.2	286.9 $\pm$ 82.5	<0.001
LF/HF ratio	1.86 $\pm$ 0.52	1.32 $\pm$ 0.43	<0.001

DISCUSSION

The present study demonstrated that an 8-week Sahaja Yoga meditation programme was associated with a marked improvement in sleep quality and favourable changes in autonomic parameters among diabetic patients with insomnia. The mean PSQI score decreased from 11.24 to 7.18, while heart rate declined and HRV indices, particularly SDNN and RMSSD, increased. The reduction in LF/HF ratio

with an increase in HF power further suggested a shift towards improved parasympathetic modulation. The improvement in sleep quality observed in the present study was consistent with findings from other meditation-based interventions in diabetic populations. Varghese et al. reported that four weeks of cyclic meditation significantly improved sleep quality and reduced psychological distress in patients with type 2 diabetes mellitus (T2DM). Their study also documented improvement in daytime

dysfunction, suggesting that meditation may influence both nocturnal sleep and associated daytime consequences.^[11] Similarly, a randomised controlled study of Latihan Pasrah Diri, a relaxation and self-surrender based intervention, demonstrated beneficial effects on sleep quality among patients with T2DM without depression.^[12] These observations supported the possibility that structured meditative practices could be useful as adjunctive approaches for sleep disturbances in diabetes. The present reduction in PSQI score was also comparable with evidence from yoga-based interventions. The SATYAM project reported significant improvement in sleep quality following a three-month yoga programme in patients with T2DM.^[13] Ebrahimi et al. similarly observed improvement in PSQI scores following 12 weeks of yoga practice in women with T2DM, with the beneficial effect being greater than that observed with aerobic exercise.^[14] Although these interventions involved physical yoga components in addition to relaxation, the findings supported the concept that mind-body practices may improve sleep through reduction of physiological and psychological arousal. An important finding of the present study was the improvement in HRV. Diabetes is frequently accompanied by impairment of autonomic regulation, and reduced HRV may reflect diminished parasympathetic activity and impaired cardiovascular adaptability. Previous research has demonstrated that yogic interventions can positively influence autonomic function in diabetic individuals. Jyotsna et al. reported significant improvement in sympathetic cardiac autonomic function after six months of comprehensive yogic breathing in diabetic patients.^[15] Another randomised trial involving 80 men with T2DM found that 12 weeks of structured yoga practice produced favourable changes in total HRV and sympathovagal balance.^[16] These findings were broadly consistent with the increased SDNN and RMSSD observed in the present study. The increase in RMSSD and HF power and reduction in LF/HF ratio observed after Sahaja Yoga meditation suggested enhanced vagal modulation. A pilot study involving patients with T2DM also reported reductions in LF and LF/HF ratio following one month of yoga practice, indicating a favourable influence on autonomic regulation.^[17] Similar physiological effects have been reported during sleep. Patra and Telles found that daytime cyclic meditation reduced nocturnal heart rate, LF power and LF/HF ratio while increasing pNN50, indicating greater parasympathetic dominance during subsequent sleep.^[18] These observations provide a plausible physiological link between meditation-induced autonomic modulation and improved sleep quality. The mechanism underlying these changes may involve attenuation of stress-related sympathetic activation and enhancement of parasympathetic activity. Meditation practices involve sustained attention, relaxation and regulation of mental activity, which may reduce physiological arousal. Studies of meditation have reported changes in

cardiovascular autonomic activity during practice, including increased HRV.^[19] However, the evidence is not entirely uniform. A meta-analysis of randomised controlled trials found insufficient evidence that mindfulness-based interventions consistently increased resting vagally mediated HRV, with substantial heterogeneity among studies.^[20] Therefore, the autonomic improvements in the present study should be interpreted as supportive rather than definitive evidence of a specific mechanism. The observed reduction in resting heart rate and blood pressure was also physiologically relevant. Previous research has demonstrated beneficial cardiovascular effects of yogic practices, including modulation of autonomic function and cardiovascular risk factors.^[21] In diabetic individuals, comprehensive yogic breathing has additionally been associated with improvement in cardiac autonomic function and quality of life.^[22,23] Regular meditation may therefore contribute to better cardiovascular regulation through relaxation-mediated reduction in sympathetic drive. The present findings were particularly relevant because participants had both diabetes and insomnia, two conditions that can potentially reinforce autonomic imbalance and psychological stress. The simultaneous improvement in PSQI and HRV suggested that better sleep may have occurred alongside improved autonomic regulation. However, the present study did not establish a causal relationship between the changes in sleep and HRV. The absence of a separate control group, relatively modest sample size and reliance on subjective assessment of sleep were important limitations. Future randomised controlled studies involving larger samples, longer follow-up, objective sleep assessment and detailed assessment of glycaemic status would provide stronger evidence. Overall, the findings suggested that Sahaja Yoga meditation could be considered a simple, low-cost complementary intervention for diabetic patients experiencing insomnia. Its potential effects on sleep quality and autonomic regulation may be particularly useful as an adjunct to standard diabetes and sleep management.

CONCLUSION

Sahaja Yoga meditation was associated with improved sleep quality and favourable changes in autonomic function among diabetic patients with insomnia. The observed reduction in PSQI scores, resting heart rate and LF/HF ratio, together with increased HRV parameters, suggested enhanced parasympathetic modulation. Sahaja Yoga may therefore serve as a useful complementary intervention.

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