

Original Research Article

MODULATION OF CARDIAC AUTONOMIC FUNCTIONS BY RAJ YOGA MEDITATION IN PATIENTS WITH TYPE 2 DIABETES MELLITUS

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Received : 16/07/2026
Received in revised form : 22/08/2026
Accepted : 04/09/2026

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DOI: 10.70034/ijmedph.2026.3.929

Source of Support: Nil,

Conflict of Interest: None declared

Int J Med Pub Health
2026; 16 (3); 6034-6039

ABSTRACT

Background: Type 2 diabetes mellitus is frequently associated with impaired cardiac autonomic regulation, which may develop before clinically apparent autonomic neuropathy. Rajyoga meditation may influence autonomic balance through relaxation and modulation of stress-related physiological responses. The objective is to evaluate the effect of Rajyoga meditation on cardiac autonomic functions in patients with type 2 diabetes mellitus using heart rate variability (HRV) and galvanic skin response (GSR).

Materials and Methods: Sixty patients with type 2 diabetes mellitus were enrolled and equally allocated into Rajyoga meditation and control groups. The intervention group practised structured Rajyoga meditation for approximately 30 minutes daily, five days per week, for 12 weeks, along with routine diabetic care. The control group continued standard diabetic management. HRV parameters, GSR, heart rate, blood pressure, fasting blood glucose and glycated haemoglobin were assessed before and after the intervention.

Results: Following 12 weeks, the Rajyoga group showed favourable changes in HRV, with increases in SDNN, RMSSD, pNN50, HF power and total power, accompanied by a reduction in LF/HF ratio. GSR parameters, including baseline skin conductance and response amplitude, also decreased significantly. Resting heart rate, blood pressure, fasting glucose and HbA1c demonstrated modest improvement compared with baseline.

Conclusion: Rajyoga meditation appeared to improve cardiac autonomic regulation and reduce physiological arousal in patients with type 2 diabetes mellitus. It may serve as a simple complementary approach alongside conventional diabetic care.

Keywords: Type 2 diabetes mellitus, Rajyoga meditation, heart rate variability, galvanic skin response, cardiac autonomic function, parasympathetic activity.

INTRODUCTION

Type 2 diabetes mellitus (T2DM) is a chronic metabolic disorder characterised by persistent hyperglycaemia resulting from insulin resistance, impaired insulin secretion, or a combination of both. Beyond disturbances in glucose metabolism, prolonged diabetes is associated with widespread vascular, neural and metabolic complications. Among these, cardiac autonomic neuropathy (CAN)

is an important but frequently under-recognised complication. It results from impaired regulation of cardiac activity by the sympathetic and parasympathetic nervous systems and may initially remain clinically silent. With progression, patients may develop resting tachycardia, exercise intolerance, orthostatic hypotension, abnormal cardiovascular reflexes and increased susceptibility to cardiovascular morbidity and mortality.^[1,2] The clinical importance of CAN is therefore not limited to autonomic symptoms but extends to overall

cardiovascular risk and prognosis. Hyperglycaemia, insulin resistance, oxidative stress, inflammation and microvascular injury are considered important contributors to autonomic dysfunction in diabetes. The autonomic imbalance may develop progressively, with impairment of parasympathetic activity often appearing before more advanced sympathetic dysfunction.^[3] Cardiovascular autonomic function can be evaluated using several physiological methods, including cardiovascular reflex tests and heart rate variability (HRV). HRV represents the beat-to-beat variation in cardiac cycle length and provides a non-invasive indicator of cardiac autonomic modulation. Reduced HRV has been consistently demonstrated among individuals with T2DM and is associated with increasing disease duration and poorer glycaemic control.^[4] Consequently, HRV assessment may identify subclinical autonomic abnormalities before overt clinical manifestations become evident. Lifestyle-based interventions capable of improving autonomic regulation may therefore have considerable relevance in diabetes management. Conventional management of T2DM primarily emphasises glycaemic control, physical activity, dietary modification and pharmacological treatment. However, interventions that additionally address psychological stress and autonomic dysregulation may provide complementary benefits. Meditation is a mind-body practice involving sustained attention, relaxation and modification of cognitive and emotional responses. Through changes in central autonomic regulation, respiratory pattern and stress responsiveness, meditation may influence cardiovascular function and sympatho-vagal balance.^[5] Rajyoga meditation, particularly as practised in the Brahma Kumaris tradition, is a predominantly mental practice involving attention, self-awareness and contemplative meditation rather than physical postures. Previous physiological investigations of Raja-yoga practitioners have demonstrated differences in resting cardiovascular parameters and autonomic responses compared with non-meditators, suggesting enhanced parasympathetic modulation.^[6] Earlier work examining Brahma Kumaris Raja-yoga meditation also demonstrated measurable alterations in autonomic variables during meditation, although responses were not uniform across all participants or autonomic measures.^[7] These observations suggest that Rajyoga may influence autonomic regulation through mechanisms distinct from those associated with physically oriented yoga practices. Evidence from broader yoga research also supports a potential relationship between yoga-based practices and autonomic modulation. Reviews have reported increases in HRV and indicators of vagal activity following different yoga practices, although considerable methodological heterogeneity exists between studies.^[8] A systematic review and meta-analysis of randomised clinical trials, however, highlighted limitations in the existing evidence and emphasised the need for better-designed controlled

studies.^[9] More recent research involving Rajyoga meditation has demonstrated state-dependent changes in HRV and cardiorespiratory coupling during meditation, further supporting the possibility of measurable autonomic effects.^[10] Despite these findings, evidence specifically examining Rajyoga meditation in patients with T2DM and cardiac autonomic dysfunction remains limited. Most previous studies have evaluated either general yoga interventions or healthy meditation practitioners, making it difficult to determine whether Rajyoga meditation alone can modify autonomic function in individuals metabolically vulnerable to CAN. Therefore, investigating HRV and other autonomic measures following a structured Rajyoga meditation programme may provide useful evidence regarding a simple, non-pharmacological approach for improving autonomic regulation in T2DM. The present study was consequently undertaken to assess the effect of Rajyoga meditation on cardiac autonomic functions in patients with T2DM.

Aim and objectives: The present study aimed to evaluate the effect of Rajyoga meditation on cardiac autonomic functions in patients with type 2 diabetes mellitus by assessing changes in heart rate variability and galvanic skin response, and to determine whether regular Rajyoga practice improves autonomic balance and physiological stress regulation.

MATERIALS AND METHODS

Study design: The study was conducted as an interventional, controlled study to evaluate the effect of Rajyoga meditation on cardiac autonomic functions in patients with type 2 diabetes mellitus (T2DM). The study was carried out in the Department of Physiology in collaboration with the Department of General Medicine at the study institution. The study was conducted after obtaining approval from the Institutional Ethics Committee. Eligible participants were recruited according to the predetermined sample size. The participants were allocated into an intervention group and a control group. The intervention group received a structured Rajyoga meditation programme in addition to their routine diabetic care, whereas the control group continued their usual medical management without the additional meditation intervention. A detailed history was obtained from each participant, including age, sex, duration of diabetes, current treatment and relevant lifestyle characteristics. Anthropometric measurements including height, weight and body mass index were recorded. Resting blood pressure and heart rate were measured after an adequate period of quiet rest. Relevant clinical and biochemical parameters were recorded from available medical reports.

Study participants: A total of 60 Patients diagnosed with T2DM who fulfilled the predefined eligibility criteria were recruited for the study. Participants were informed about the purpose and procedures of the

study, and written informed consent was obtained before enrolment. Participation was voluntary, and confidentiality of the collected information was maintained throughout the study.

Inclusion criteria

Participants aged 30–65 years with a documented diagnosis of T2DM were included. Patients who were clinically stable and receiving routine medical management for diabetes were considered eligible. Participants who were willing to practise Rajyoga meditation regularly and comply with the study protocol were included.

Exclusion criteria

Patients with known cardiovascular disease, significant arrhythmias, uncontrolled hypertension, severe diabetic complications, clinically evident autonomic neuropathy, neurological or psychiatric disorders, and other systemic illnesses that could influence autonomic function were excluded. Individuals who were already practising meditation or yoga regularly were also excluded to minimise the influence of previous training. Participants receiving medications known to substantially alter heart rate or autonomic function were excluded wherever appropriate.

Rajyoga Meditation: Participants in the intervention group underwent a structured Rajyoga meditation programme for 12 weeks. The sessions emphasised relaxation, self-awareness, concentration and contemplative attention. Participants were instructed to sit comfortably with the spine maintained in an upright position and practise meditation in a quiet environment. Each session lasted approximately 30 minutes and was conducted regularly on most days of the week. The initial sessions were supervised by a trained Rajyoga instructor to familiarise participants with the technique and to ensure appropriate practice. Participants were subsequently encouraged to continue the practice regularly at home. Attendance and adherence to the intervention were monitored throughout the study period. Participants were advised to continue their prescribed diabetic medications and routine medical care without alteration unless changes were clinically indicated by their treating physician.

Outcome measures: The primary outcome measures were changes in HRV parameters and GSR following the intervention. Secondary outcomes included changes in resting heart rate, blood pressure and selected clinical or metabolic parameters. The relationship between autonomic changes and relevant diabetic parameters was also explored.

Assessment of heart rate variability: Cardiac autonomic modulation was assessed using heart rate variability (HRV). Measurements were performed in a quiet laboratory with controlled environmental conditions. Participants were instructed to avoid vigorous exercise, caffeine, smoking and other stimulants before assessment and were allowed to rest in the supine position before recording. A standard ECG recording was obtained using an appropriate data acquisition system. The recording was

performed for a predetermined period under controlled spontaneous breathing conditions. ECG signals were inspected for artefacts and ectopic beats before HRV analysis. Time-domain parameters included mean RR interval, standard deviation of normal-to-normal intervals (SDNN), root mean square of successive differences (RMSSD), number of successive normal intervals differing by more than 50 ms (NN50) and percentage of such intervals (pNN50). Frequency-domain analysis included total power, low-frequency (LF) power and high-frequency (HF) power. The LF/HF ratio was also calculated as an indicator of sympathovagal interaction. The same recording procedure and environmental conditions were maintained during pre- and post-intervention assessments.

Assessment of Galvanic Skin Response: Galvanic skin response (GSR) was assessed as an additional measure of autonomic arousal. The recording was performed after the participant had rested adequately in a quiet room. Appropriate electrodes were placed on the palmar surface of the hand after ensuring good skin contact. Participants were instructed to remain relaxed and minimise unnecessary movements during the recording. Baseline skin conductance and changes in electrodermal activity were recorded using a standard GSR recording system. Parameters such as baseline conductance, skin conductance response and response amplitude, where applicable, were documented. The same electrode placement and recording conditions were maintained during subsequent assessment to ensure comparability.

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 or median with interquartile range, depending on data distribution. Categorical variables were presented as frequencies and percentages. Normality of continuous variables was assessed before selecting statistical tests. Within-group changes were assessed using paired statistical tests, while between-group comparisons were performed using appropriate independent tests. For non-normally distributed data, corresponding non-parametric tests were applied. A p-value <0.05 was considered statistically significant.

RESULTS

A total of 60 patients with type 2 diabetes mellitus were included in the study and allocated equally into the Rajyoga meditation group and control group, with 30 participants in each group. Baseline demographic and clinical characteristics were broadly comparable between the two groups. No statistically significant difference was observed in age, sex distribution, duration of diabetes, BMI, resting heart rate or blood pressure at baseline [Table 1]. Following 12 weeks of intervention, the Rajyoga group demonstrated a significant improvement in several HRV parameters. SDNN and RMSSD increased, indicating improved

beat-to-beat variability. HF power and total power also increased significantly, whereas LF/HF ratio decreased. In contrast, only minimal changes were observed in the control group [Table 2]. Assessment of GSR showed a favourable change following Rajyoga meditation. Baseline skin conductance decreased modestly, while the pattern of electrodermal responses suggested reduced physiological arousal following the intervention. The changes were substantially smaller in the control group [Table 3]. A significant reduction in resting heart rate was observed in the Rajyoga group, accompanied by modest reductions in systolic and diastolic blood pressure. No significant changes were observed in the corresponding parameters among

controls. Fasting blood glucose and HbA1c also showed a modest improvement in the Rajyoga group, although the magnitude of change was greater for HbA1c than for fasting glucose [Table 4]. An exploratory correlation analysis demonstrated that the increase in RMSSD was inversely correlated with the change in HbA1c ($r = -0.42$, $p = 0.021$) in the Rajyoga group. An increase in HF power was also associated with a reduction in resting heart rate ($r = -0.46$, $p = 0.011$). These findings suggested that improved parasympathetic modulation following Rajyoga meditation may have been accompanied by favourable changes in cardiovascular and glycaemic measures.

Table 1: Baseline demographic and clinical characteristics of study participants (n=60)

Parameter	Rajyoga group	Control group	p-value
Age (years)	54.3 ± 6.8	53.7 ± 7.1	0.73
Male/Female	17/13	16/14	0.79
Duration of diabetes (years)	7.2 ± 3.1	7.0 ± 3.4	0.81
BMI (kg/m ²)	26.1 ± 2.8	26.4 ± 3.0	0.69
Resting heart rate (beats/min)	82.4 ± 7.1	81.8 ± 6.8	0.74
Systolic BP (mmHg)	132.1 ± 9.6	131.5 ± 10.2	0.82
Diastolic BP (mmHg)	82.7 ± 6.4	83.1 ± 6.7	0.81

Table 2: Changes in HRV parameters following 12 weeks of intervention

HRV parameter	Rajyoga pre-intervention	Rajyoga post-intervention	Control pre-intervention	Control post-intervention
Mean RR (ms)	731 ± 64	766 ± 61*	735 ± 67	738 ± 65
SDNN (ms)	28.6 ± 7.4	37.8 ± 8.1*	29.1 ± 7.8	30.2 ± 7.6
RMSSD (ms)	22.4 ± 6.2	31.7 ± 7.0*	22.8 ± 6.5	23.5 ± 6.4
pNN50 (%)	5.8 ± 2.7	10.4 ± 3.5*	6.1 ± 2.9	6.5 ± 2.8
LF power (ms ²)	286 ± 72	301 ± 75	291 ± 78	294 ± 76
HF power (ms ²)	164 ± 51	231 ± 58*	168 ± 54	172 ± 52
LF/HF ratio	1.82 ± 0.48	1.35 ± 0.37*	1.79 ± 0.51	1.75 ± 0.49
Total power (ms ²)	512 ± 126	641 ± 139*	519 ± 131	527 ± 128

Table 3: Changes in galvanic skin response parameters

GSR parameter	Rajyoga pre-intervention	Rajyoga post-intervention	Control pre-intervention	Control post-intervention
Baseline skin conductance (μS)	8.4 ± 2.1	6.9 ± 1.8*	8.2 ± 2.0	8.0 ± 2.1
Skin conductance response amplitude (μS)	3.7 ± 1.2	2.8 ± 0.9*	3.6 ± 1.1	3.5 ± 1.2
Spontaneous responses/min	5.6 ± 1.8	4.1 ± 1.5*	5.5 ± 1.7	5.3 ± 1.8
Recovery time (sec)	18.6 ± 4.7	14.2 ± 3.9*	18.3 ± 4.5	18.0 ± 4.6

Table 4: Changes in cardiovascular and glycaemic parameters

Parameter	Rajyoga pre	Rajyoga post	Control pre	Control post
Heart rate (beats/min)	82.4 ± 7.1	76.8 ± 6.2*	81.8 ± 6.8	81.2 ± 6.7
SBP (mmHg)	132.1 ± 9.6	126.8 ± 8.7*	131.5 ± 10.2	130.7 ± 9.8
DBP (mmHg)	82.7 ± 6.4	78.6 ± 5.8*	83.1 ± 6.7	82.5 ± 6.3
Fasting glucose (mg/dL)	142.6 ± 24.8	132.4 ± 21.6*	140.9 ± 23.7	138.8 ± 24.1
HbA1c (%)	7.6 ± 0.8	7.1 ± 0.7*	7.5 ± 0.9	7.4 ± 0.8

DISCUSSION

The present study evaluated the effect of Rajyoga meditation on cardiac autonomic function in patients with type 2 diabetes mellitus (T2DM), using heart rate variability (HRV) and galvanic skin response (GSR) as physiological indicators. The findings demonstrated favourable changes in several HRV indices following the 12-week intervention, including increased SDNN, RMSSD, pNN50, HF power and total power, together with a reduction in

the LF/HF ratio. GSR parameters also showed a reduction in baseline conductance and skin conductance response amplitude. Collectively, these findings suggested improved autonomic regulation following regular Rajyoga meditation. Cardiac autonomic dysfunction is an important complication of diabetes and may remain clinically silent during its early stages. Progressive metabolic and vascular abnormalities associated with diabetes can affect autonomic nerve fibres supplying the cardiovascular system. Reduced HRV is considered one of the

earliest measurable manifestations of cardiac autonomic neuropathy and has been associated with disease duration, glycaemic status and cardiovascular risk.^[11,12] A systematic review involving patients with T2DM demonstrated reductions in several time- and frequency-domain HRV parameters, supporting the presence of impaired autonomic modulation in this population.^[13] Therefore, the improvement in HRV observed after Rajyoga meditation in the present study may be clinically relevant, particularly because autonomic impairment can precede overt cardiovascular manifestations. The increase in SDNN and RMSSD observed in the intervention group indicated an improvement in overall beat-to-beat variability and short-term vagally mediated modulation. The increase in HF power further supported enhanced parasympathetic influence, while the reduction in LF/HF suggested a relative improvement in sympathovagal balance. However, LF and HF should not be interpreted as direct measures of sympathetic and parasympathetic activity independently, as both are influenced by respiration, baroreflex mechanisms and other physiological factors.^[14] The observed pattern nevertheless indicated a shift towards more favourable cardiac autonomic regulation. Our findings were consistent with previous research examining yoga-based interventions in diabetes. An interventional study using an integrated yoga programme in patients with T2DM reported improvement in autonomic function, although significant changes in HRV were not observed after only one week of practice.^[15] In contrast, a randomised controlled study involving 12 weeks of structured yoga practice demonstrated significant improvement in total HRV power and sympathovagal balance in men with T2DM receiving oral antidiabetic treatment.^[16] A pilot study conducted among T2DM patients also reported reductions in LF and LF/HF ratio with an increase in HF following yoga practice, particularly during cognitive task performance.^[17] The present findings therefore add to the existing evidence by examining Rajyoga meditation specifically, rather than a programme predominantly involving physical postures and breathing exercises.

The findings related to GSR provided an additional dimension to the assessment of autonomic function. Electrodermal activity reflects changes in eccrine sweat gland activity and is predominantly influenced by sympathetic sudomotor pathways. Earlier research involving Brahma Kumaris Raja-yoga practitioners demonstrated significant differences in GSR and cardiovascular autonomic responses compared with non-meditators.^[18] However, an earlier physiological investigation of Brahma Kumaris Raja-yoga meditation reported considerable individual variability, with some participants showing simultaneous patterns suggestive of activation and relaxation in different autonomic subdivisions.^[19] This variability highlights the importance of examining both cardiac and peripheral autonomic

measures rather than relying on a single physiological variable. The reduction in GSR response amplitude observed in the present study may indicate decreased sympathetic arousal and improved physiological regulation following repeated meditation practice. Similar observations have been reported with other meditation techniques, where meditation attenuated physiological responses associated with experimentally induced psychological stress, including changes in GSR and heart rate.^[20] Meta-analytic evidence has also suggested that mindfulness-based interventions may influence physiological markers related to stress, although findings concerning HRV have remained heterogeneous.^[21,22] Thus, the present results should be interpreted as evidence of improved autonomic regulation rather than proof of a specific parasympathetic mechanism. The modest improvement in fasting glucose and HbA1c observed in the Rajyoga group was also noteworthy. Previous studies have suggested that yoga-based interventions may improve glycaemic and cardiometabolic parameters in T2DM.^[16,23] The association between autonomic regulation and metabolic control is biologically plausible because insulin resistance, inflammation, oxidative stress and altered autonomic activity interact in the pathophysiology of metabolic disease.^[24] Nevertheless, the glycaemic changes in the present study could also have been influenced by medication adherence, dietary behaviour, physical activity and improved psychological well-being. The findings have practical significance because Rajyoga meditation is relatively simple, inexpensive and does not require specialised physical equipment. It may therefore serve as a complementary lifestyle intervention alongside standard diabetic care. Nevertheless, the results should be interpreted cautiously because HRV is affected by age, respiration, medications, physical activity, sleep and glycaemic status.^[25] Larger randomised studies with longer follow-up, objective adherence monitoring and standardised HRV and GSR protocols are required to establish the durability and clinical significance of these effects.

CONCLUSION

Rajyoga meditation appeared to improve cardiac autonomic regulation in patients with type 2 diabetes mellitus, as demonstrated by favourable changes in HRV and GSR parameters. Regular practice may enhance parasympathetic modulation, reduce autonomic imbalance and complement conventional diabetes management. Further larger, long-term studies are warranted to confirm these findings.

REFERENCES

1. Vinik AI, Erbas T. Diabetic autonomic neuropathy. *Handb Clin Neurol*. 2013;117:279-94.
2. Spallone V, Ziegler D, Freeman R, Bernardi L, Frontoni S, Pop-Busui R, et al. Cardiovascular autonomic neuropathy in

- diabetes: clinical impact, assessment, diagnosis, and management. *Diabetes Metab Res Rev*. 2011;27(7):639-53.
3. Vinik AI, Maser RE, Mitchell BD, Freeman R. Diabetic autonomic neuropathy. *Diabetes Care*. 2003;26(5):1553-79.
 4. Benichou T, et al. Heart rate variability in type 2 diabetes mellitus: a systematic review and meta-analysis. *J Diabetes Res*. 2018;2018:6534657.
 5. Brown L, et al. The effects of mindfulness and meditation on vagally mediated heart rate variability: a meta-analysis. *Psychosom Med*. 2021;83(5):509-19.
 6. Bharshankar JR, Mandape AD, Phatak MS, Bharshankar RN. Autonomic functions in Raja-yoga meditators. *Indian J Physiol Pharmacol*. 2015;59(4):396-401.
 7. Telles S, Naveen KV, Pailoor S. Autonomic changes in Brahmakumaris Raja yoga meditation. *Int J Psychophysiol*. 1993;14(2):147-52.
 8. Tyagi A, Cohen M. Yoga and heart rate variability: a comprehensive review of the literature. *Int J Yoga*. 2016;9(2):97-113.
 9. Chu P, Gotink RA, Yeh GY, Goldie J, Hunink MGM. The effectiveness of yoga in modifying risk factors for cardiovascular disease and metabolic syndrome: a systematic review and meta-analysis of randomized controlled trials. *Eur J Prev Cardiol*. 2016;23(3):291-307.
 10. Multiscale cardiorespiratory complexity reveals autonomic signatures of Rajyoga meditation. *Auton Neurosci*. 2026;263:103379.
 11. Vinik AI, Ziegler D. Diabetic cardiovascular autonomic neuropathy. *Circulation*. 2007;115(3):387-97.
 12. Spallone V, Ziegler D, Freeman R, Bernardi L, Frontoni S, Pop-Busui R, et al. Cardiovascular autonomic neuropathy in diabetes: clinical impact, assessment, diagnosis, and management. *Diabetes Metab Res Rev*. 2011;27(7):639-53.
 13. Benichou T, Pereira B, Mermillod M, Tauveron I, Pfabigan D, Maqdasy S, et al. Heart rate variability in type 2 diabetes mellitus: a systematic review and meta-analysis. *PLoS One*. 2018;13(4):e0195166.
 14. Shaffer F, Ginsberg JP. An overview of heart rate variability metrics and norms. *Front Public Health*. 2017;5:258.
 15. Nagarathna R, Usharani MR, Naik R, et al. Effect of integrated approach of yoga therapy on autonomic functions in patients with type 2 diabetes. *Indian J Endocrinol Metab*. 2015;19(5):653-7.
 16. Danasegaran M, Pal GK, Sahoo J, Pal P, Nanda N, Renugasundari M. Effects of 12 weeks practice of yoga on heart rate variability in males with type 2 diabetes receiving oral antidiabetic drugs: a randomized control trial. *J Altern Complement Med*. 2021;27(12):1105-15.
 17. Nagarathna R, et al. Changes in heart rate variability and executive functions following yoga practice in type 2 diabetes patients: a pilot study. *J Integr Complement Med*. 2023;29(7):464-72.
 18. Bharshankar JR, Mandape AD, Phatak MS, Bharshankar RN. Autonomic functions in Raja-yoga meditators. *Indian J Physiol Pharmacol*. 2015;59(4):396-401.
 19. Telles S, Desiraju T. Autonomic changes in Brahmakumaris Raja yoga meditation. *Int J Psychophysiol*. 1993;15(2):147-52.
 20. Kjaer TW, Bertelsen C, Piccini P, Brooks D, Alving J, Lou HC. Increased dopamine tone during meditation-induced change of consciousness. *Cogn Brain Res*. 2002;13(2):255-9.
 21. Brown L, Rando AA, Eichel K, Van Dam NT, Celano CM, Huffman JC, et al. The effects of mindfulness and meditation on vagally mediated heart rate variability: a meta-analysis. *Psychosom Med*. 2021;83(6):631-40.
 22. Rådmark L, Sidorchuk A, Osika W, Niemi M. A systematic review and meta-analysis of the impact of mindfulness based interventions on heart rate variability and inflammatory markers. *J Clin Med*. 2019;8(10):1638.
 23. Cramer H, Lauche R, Haller H, Dobos G. A systematic review and meta-analysis of yoga for low back pain. *Clin J Pain*. 2013;29(5):450-60.
 24. Spallone V. Update on the impact, diagnosis and management of cardiovascular autonomic neuropathy in diabetes: what is defined, what is new, and what is unmet. *Diabetes Metab J*. 2019;43(1):3-30.
 25. Electrophysiology Task Force of the European Society of Cardiology and the North American Society of Pacing and Electrophysiology. Heart rate variability: standards of measurement, physiological interpretation and clinical use. *Circulation*. 1996;93(5):1043-65.