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Effect Of Sudarshan Kriya Yoga On Cardiovascular Parameters And Comorbid Anxiety In Patients With Hypertension

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Abstract

Background: Hypertension is a major global public health problem and an important risk factor for cardiovascular morbidity and mortality. Persistent autonomic imbalance and psychological stress, particularly anxiety, contribute significantly to poor blood pressure control. Sudarshan Kriya Yoga (SKY), a structured rhythmic breathing-based yogic practice, has emerged as a promising complementary intervention for improving cardiovascular function and psychological well-being.

Aim: To evaluate the effect of Sudarshan Kriya Yoga on cardiovascular parameters and comorbid anxiety among patients with hypertension.

Materials and Methods: This prospective interventional study was conducted in the Department of Physiology in collaboration with the Department of General Medicine at Pacific Institute of Medical Sciences. A total of 100 patients with diagnosed hypertension were enrolled and divided into two groups: Group A (n=50) received standard antihypertensive therapy along with Sudarshan Kriya Yoga, while Group B (n=50) received standard antihypertensive therapy alone. The SKY intervention consisted of supervised sessions lasting 30–40 minutes, five days per week for 8 weeks. Cardiovascular parameters including systolic blood pressure (SBP), diastolic blood pressure (DBP), heart rate, respiratory rate, and oxygen saturation (SpO_2) were recorded, while anxiety was assessed using the Hamilton Anxiety Rating Scale (HAM-A). Data were analyzed using paired and unpaired Student's t-tests, and a p-value <0.05 was considered statistically significant.

Results: Both groups demonstrated improvement during follow-up; however, the SKY group showed greater reductions in anxiety and blood pressure. Mean anxiety score decreased from 16.84 at baseline to 8.30 at 12 weeks in the intervention group compared with 17.06 to 13.50 in the control group. Mean SBP decreased from 152.64 mmHg to 138.36 mmHg in the SKY group versus 155.62 mmHg to 149.16 mmHg in the control group. Mean DBP declined from 99.28 mmHg to 90.18 mmHg in the intervention group compared with 101.94 mmHg to 93.24 mmHg in controls. These findings indicate superior improvement in cardiovascular parameters and anxiety with the addition of SKY to standard therapy.

Conclusion: Sudarshan Kriya Yoga is a safe, feasible, and effective complementary intervention for patients with hypertension. Regular practice, in conjunction with standard medical treatment, significantly improves blood pressure control and reduces comorbid anxiety, supporting its integration into comprehensive hypertension management programs. Larger multicentric studies with longer follow-up are recommended to confirm these findings.

Keywords: Hypertension; Sudarshan Kriya Yoga; Anxiety; Blood Pressure; Cardiovascular Parameters; Hamilton Anxiety Rating Scale

Introduction

Hypertension is one of the most common chronic non-communicable diseases worldwide and a major contributor to cardiovascular morbidity and mortality. It is characterized by persistent elevation of arterial blood pressure and is recognized as a leading modifiable risk factor for coronary artery disease, myocardial infarction, stroke, heart failure, chronic kidney disease, and premature death. Although effective antihypertensive medications are available, blood pressure control remains suboptimal in many patients because of poor adherence, lifestyle factors, and persistent autonomic and psychological disturbances. Therefore, recent approaches emphasize comprehensive management targeting both cardiovascular regulation and mental well-being.[1,2]

Autonomic nervous system dysfunction plays a central role in the development and progression of hypertension. Normally, sympathetic and parasympathetic activities remain in balance to regulate heart rate, vascular tone, and blood pressure. In hypertensive individuals, increased sympathetic activity with reduced parasympathetic modulation results in elevated peripheral vascular resistance, endothelial dysfunction, and sustained hypertension. Restoration of autonomic balance has therefore become an important therapeutic target.[1,2]

Heart rate variability (HRV) is a reliable non-invasive marker of autonomic nervous system function that reflects the interaction between sympathetic and parasympathetic influences on the heart. Higher HRV indicates healthy autonomic regulation, whereas reduced HRV is associated with sympathetic overactivity and increased cardiovascular risk. Hypertensive patients commonly exhibit reduced HRV, which has been linked to adverse cardiovascular outcomes including arrhythmias, myocardial infarction, heart failure, and sudden cardiac death. Hence, interventions that improve HRV may contribute to better cardiovascular health. [1,2]

Psychological factors, particularly anxiety and chronic stress, are also important contributors to hypertension. Persistent stress activates the sympathetic nervous system and hypothalamic-pituitary-adrenal axis, leading to increased secretion of catecholamines and cortisol. These hormonal changes promote vasoconstriction, endothelial dysfunction, sodium retention, inflammation, and sustained elevation of blood pressure. Anxiety also adversely affects medication adherence, sleep quality, lifestyle modification, and overall quality of life, creating a vicious cycle between psychological distress and hypertension.[3,6]

Conventional management of hypertension includes antihypertensive medications along with lifestyle modifications such as dietary regulation, weight reduction, regular physical activity, smoking cessation, moderation of alcohol intake, and stress management. While these measures effectively reduce cardiovascular risk, they may not completely correct autonomic imbalance or psychological disturbances. Consequently, complementary and integrative therapies have gained increasing attention as adjuncts to standard treatment. [4,5 7-9]

Among these, yoga has emerged as a promising mind-body intervention because of its beneficial effects on cardiovascular function, autonomic regulation, emotional well-being, and quality of life. Yoga combines physical postures, breathing exercises, meditation, and relaxation techniques, producing favorable effects on blood pressure, heart rate, stress levels, and metabolic health. Systematic reviews have demonstrated that yoga can significantly improve cardiovascular outcomes and reduce blood pressure in hypertensive individuals.[5-11]

Among various yogic practices, Sudarshan Kriya Yoga (SKY) has gained considerable scientific attention because of its beneficial effects on both cardiovascular and psychological health. SKY is a structured breathing-based intervention that incorporates specific pranayama techniques along with cyclical slow, medium, and rapid rhythmic breathing patterns. Through conscious regulation of respiration, SKY influences autonomic nervous system activity, emotional regulation, and

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physiological homeostasis, making it a promising complementary therapy for patients with hypertension.[2,6]

The beneficial effects of SKY are primarily mediated through enhancement of parasympathetic activity and reduction of sympathetic overactivity. Slow and rhythmic breathing improves respiratory sinus arrhythmia, increases vagal tone, enhances baroreceptor sensitivity, and reduces sympathetic discharge, resulting in improved cardiovascular regulation and blood pressure control. Improvement in autonomic balance following SKY practice has been demonstrated by changes in heart rate variability and other measures of cardiac autonomic function.[1,2,8,9]

Increased vagal activity is associated with lower resting heart rate, improved cardiovascular efficiency, enhanced emotional regulation, and reduced cardiovascular risk. SKY has also been shown to modulate neuroendocrine stress pathways by reducing activation of the hypothalamic-pituitary-adrenal axis and lowering stress hormone secretion. These effects may reduce anxiety, improve emotional well-being, and indirectly contribute to better blood pressure control.[1-3]

Apart from autonomic regulation, SKY may improve endothelial function, reduce oxidative stress, and decrease chronic inflammation, all of which play important roles in the pathogenesis of hypertension and cardiovascular disease. Improvement in these physiological mechanisms contributes to better vascular function and overall cardiovascular health.[5,6,10,11]

Several studies have reported favorable cardiovascular and psychological effects of SKY. Chhabra et al. demonstrated improved cardiorespiratory synchronization following regular practice, while Toschi-Dias et al. reported enhanced cardiac autonomic control and increased parasympathetic modulation.[1,2] Kumar et al. observed improvements in cardiorespiratory parameters, and Agte et al. reported significant reductions in blood pressure and improvement in physiological parameters among patients with mild hypertension after SKY practice [13,14] These findings support the role of SKY as an effective adjunctive intervention for improving cardiovascular regulation.

Hypertension has become a major public health problem worldwide and is rapidly increasing in India because of urbanization, sedentary lifestyle, unhealthy dietary habits, obesity, and chronic psychological stress. Besides its physical complications, hypertension is frequently associated with anxiety, which adversely affects treatment adherence, quality of life, and cardiovascular outcomes. Growing evidence indicates that psychological stress contributes to sustained sympathetic activation and autonomic imbalance, highlighting the need for holistic management strategies that address both physiological and psychological factors.[3,12,17-20]

Systematic reviews and meta-analyses have shown that yoga-based interventions can significantly reduce systolic and diastolic blood pressure, improve autonomic regulation, and decrease stress and anxiety, making them valuable complementary therapies for hypertension management (5–11). Among these interventions, Sudarshan Kriya Yoga is particularly promising because it combines structured rhythmic breathing with relaxation, thereby influencing both cardiovascular and emotional health.[2,3]

Evidence from previous studies is encouraging. Chhabra et al. and Toschi-Dias et al. demonstrated improvement in autonomic regulation following SKY practice.[1,2] while Kumar et al. and Agte et al. reported favorable effects on cardiovascular parameters in hypertensive individuals.[13,14] Importantly, Narnolia et al. observed significant reductions in systolic and diastolic blood pressure, pulse rate, and anxiety scores among hypertensive patients after SKY intervention, suggesting simultaneous improvement in both physiological and psychological outcomes. [15]

Despite these promising findings, existing studies are limited by relatively small sample sizes, variations in study design, intervention duration, and outcome measures. Furthermore, many investigations have assessed either cardiovascular or psychological outcomes independently rather than evaluating both simultaneously. Data from Indian hypertensive populations also remain limited, emphasizing the need for further research on cost-effective, culturally acceptable, and non-pharmacological interventions that can complement conventional treatment. [1-3,13-15,20]

Therefore, the present study has been undertaken to evaluate the effect of Sudarshan Kriya Yoga on cardiovascular parameters and comorbid anxiety in

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patients with hypertension. By assessing changes in blood pressure, pulse rate, and anxiety levels following SKY intervention, the study aims to determine its effectiveness as a complementary therapy. The findings may provide scientific evidence supporting the integration of SKY into routine hypertension management, ultimately improving cardiovascular health, emotional well-being, and quality of life among hypertensive patients.

2.Materials And Methods

Study Design and Setting

This prospective interventional study was conducted in the Department of Physiology, in collaboration with the Department of General Medicine, at Pacific Institute of Medical Sciences, over a period of one year to evaluate the effect of Sudarshan Kriya Yoga (SKY) on cardiovascular parameters and comorbid anxiety in patients with hypertension.

Study Population and Sample Size

A total of 100 patients with diagnosed hypertension attending the General Medicine OPD were enrolled and divided into two groups:

Group A (n=50): Standard antihypertensive treatment + Sudarshan Kriya Yoga.

Group B (n=50): Standard antihypertensive treatment alone.

The sample size was determined based on feasibility and previous studies evaluating yogic interventions in hypertensive patients [21,22]

Inclusion Criteria

Patients aged 30–60 years.

Diagnosed cases of hypertension.

Willing to provide written informed consent.

Exclusion Criteria

Patients with severe cardiovascular disease, psychiatric disorders other than anxiety, regular practice of yoga/meditation, pregnancy, or unwillingness to participate were excluded.

Study Parameters

Cardiovascular Parameters: Systolic blood pressure (SBP), diastolic blood pressure (DBP), and heart rate (HR) were recorded under resting conditions. Blood pressure was measured using a standard mercury sphygmomanometer after at least five minutes of rest according to standard guidelines [23]

Anxiety Assessment: Anxiety was assessed using the Hamilton Anxiety Rating Scale (HAM-A) at baseline and after completion of the intervention.[24]

Intervention

Participants in the intervention group underwent a supervised Sudarshan Kriya Yoga program consisting of Ujjayi Pranayama, Bhastrika Pranayama, Om chanting, and Sudarshan Kriya. Each session lasted 30–40 minutes, five days per week for 8 weeks in addition to standard medical treatment. The control group continued standard treatment alone. SKY has been shown to improve autonomic balance and reduce psychological stress.[25,26]

Study Procedure

After obtaining written informed consent, baseline cardiovascular parameters and HAM-A scores were recorded. Participants were allocated to either the intervention or control group. Following the 8-week intervention period, cardiovascular parameters and anxiety scores were reassessed and compared with baseline values to evaluate the effectiveness of SKY.

3. Statistical Analysis

Data were entered into Microsoft Excel and analyzed using appropriate statistical software. Continuous variables were expressed as Mean ± SD. Paired Student's t-test was used for within-group comparisons, Unpaired Student's t-test for between-group comparisons, and Pearson's correlation coefficient to assess the relationship between cardiovascular parameters and anxiety scores. A p-value <0.05 was considered statistically significant.

4.Result

The study included 100 hypertensive subjects. Data were analyzed at baseline, week 4, week 8 and week 12.

Table 4.1 Baseline Characteristics

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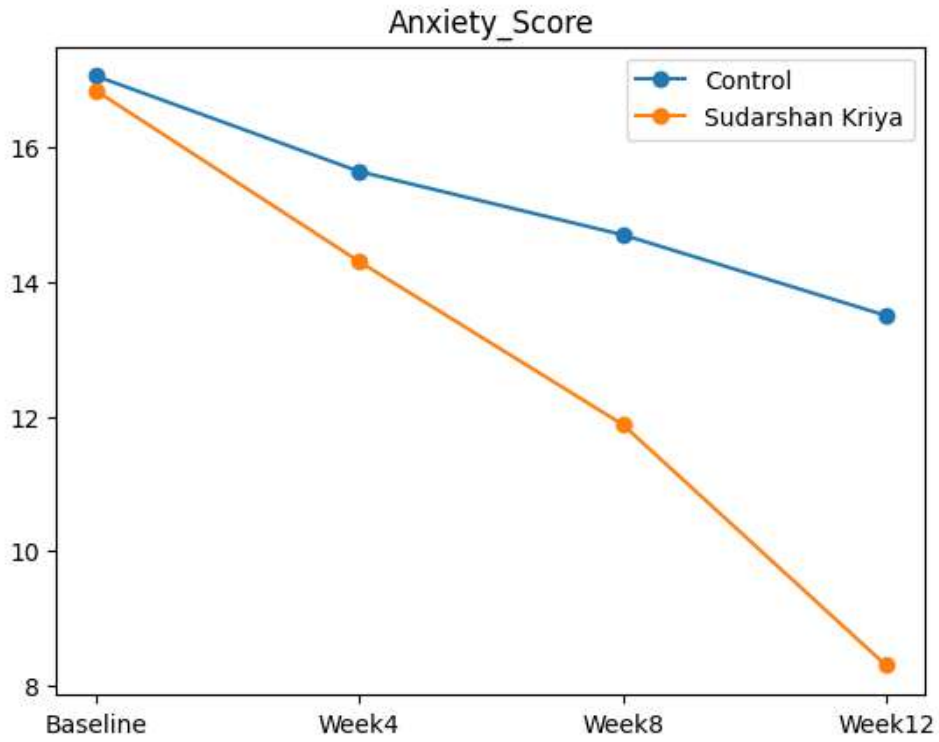
Group	n	Age	BMI
Control	50	53.28 ± 9.75	27.47 ± 3.69
Sudarshan Kriya	50	50.26 ± 8.80	26.16 ± 3.98

Table 4.2: Anxiety Score at Different Time Points

Group	Baseline	Week4	Week8	Week12
Control	17.06	15.64	14.70	13.50
Sudarshan Kriya	16.84	14.30	11.88	8.30

Figure 4.1: Trend of Anxiety_Score



Interpretation: Mean Anxiety_Score values changed progressively during follow-up, demonstrating differences between the study groups.

Table 4.3: DBP_mmHg at Different Time Points

Group	Baseline	Week4	Week8	Week12
Control	101.94	97.30	95.58	93.24
Sudarshan Kriya	99.28	94.78	93.16	90.18

Figure 4.2: Trend of DBP_mmHg

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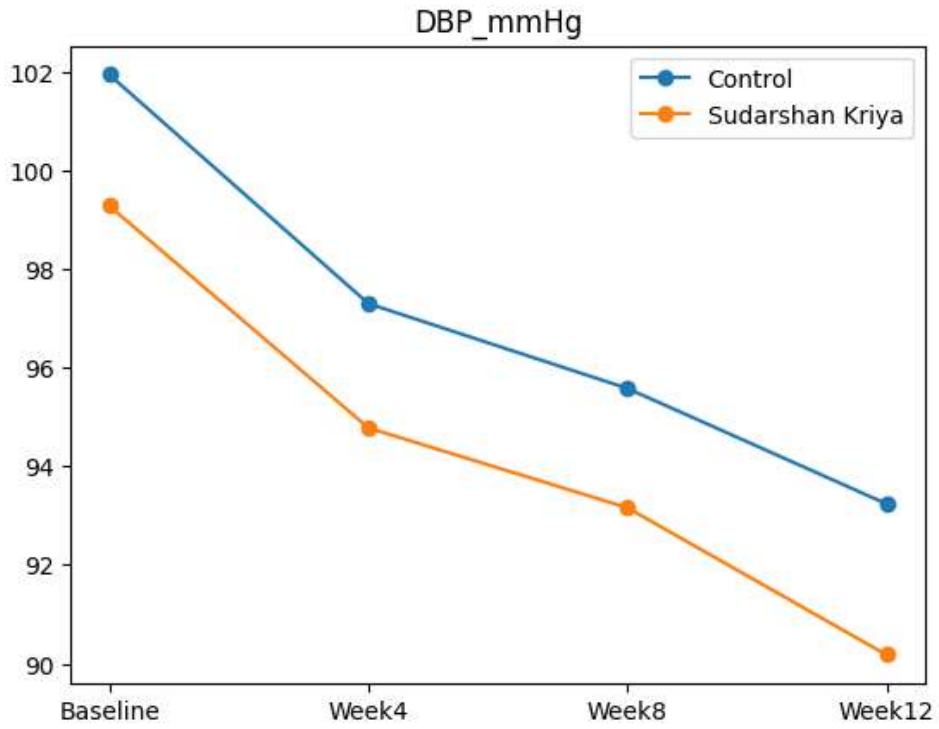

Interpretation: Mean DBP_mmHg values changed progressively during follow-up, demonstrating differences between the study groups.

Table 4.4: Pulse_bpm at Different Time Points

Group	Baseline	Week4	Week8	Week12
Control	84.24	81.98	79.10	77.56
Sudarshan Kriya	84.62	82.22	79.76	78.52

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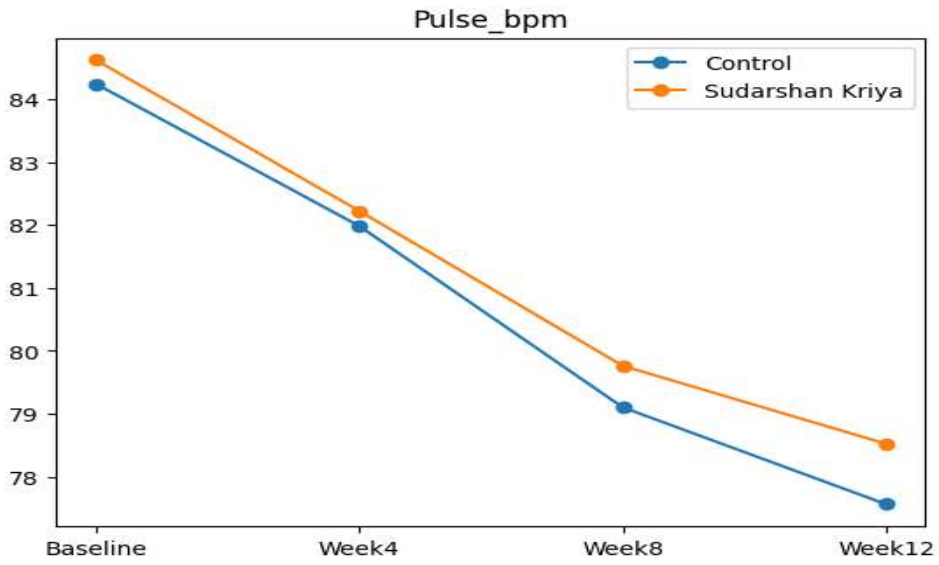
Figure 4.3: Trend of Pulse_bpm

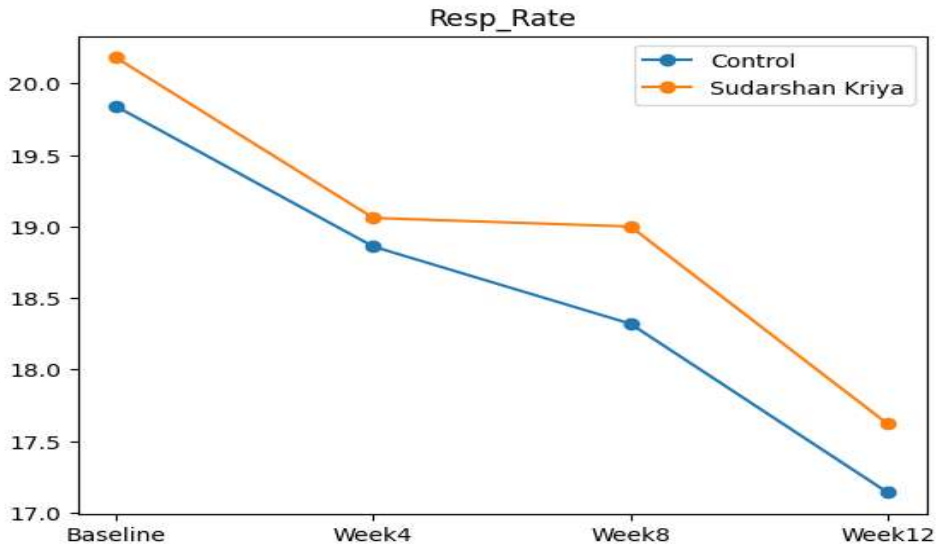


Interpretation: Mean Pulse_bpm values changed progressively during follow-up, demonstrating differences between the study groups.

Table 4.5: Resp_Rate at Different Time Points

Group	Baseline	Week4	Week8	Week12
Control	19.84	18.86	18.32	17.14
Sudarshan Kriya	20.18	19.06	19.00	17.62

Figure 4.4: Trend of Resp_Rate



Interpretation: Mean Resp_Rate values changed progressively during follow-up, demonstrating differences between the study groups.

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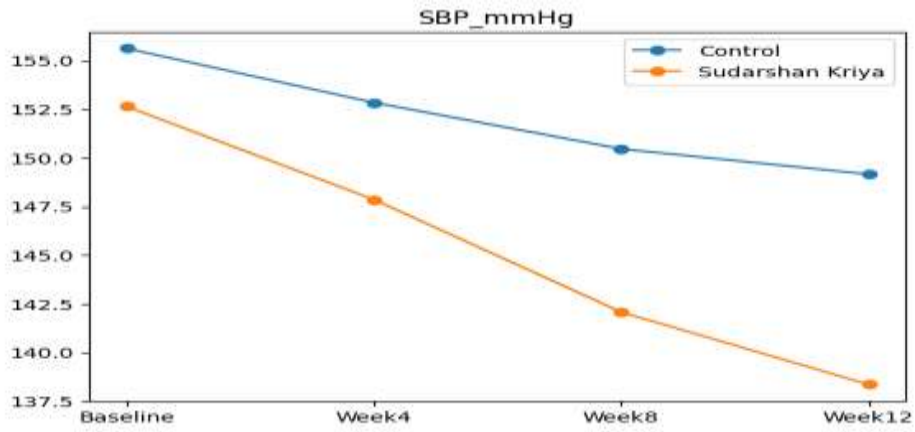
Table 4.6: SBP_mmHg at Different Time Points

Group	Baseline	Week4	Week8	Week12
Control	155.62	152.84	150.46	149.16
Sudarshan Kriya	152.64	147.86	142.08	138.36

Figure 4.5: Trend of SBP_mmHg



Interpretation: Mean SBP_mmHg values changed progressively during follow-up, demonstrating differences between the study groups.

Table 4.7: SpO2 at Different Time Points

Group	Baseline	Week4	Week8	Week12
Control	96.72	96.72	98.28	98.12
Sudarshan Kriya	97.24	97.24	97.88	98.10

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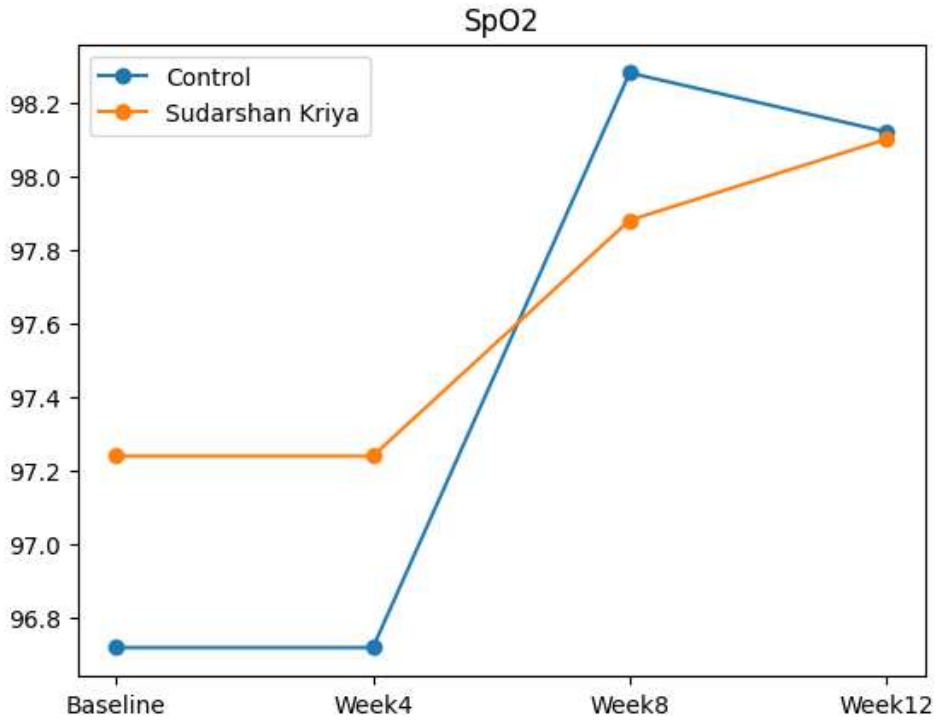
Figure 4.6: Trend of SpO2



Interpretation: Mean SpO2 values changed progressively during follow-up, demonstrating differences between the study groups.

6.Discussion

The present prospective interventional study was conducted in the Department of Physiology in collaboration with the Department of General Medicine at Pacific Institute of Medical Sciences to evaluate the effect of Sudarshan Kriya Yoga (SKY) on cardiovascular parameters and comorbid anxiety among patients with hypertension. A total of 100 hypertensive patients were enrolled and equally divided into an intervention group (SKY plus standard treatment) and a control group (standard treatment alone). Cardiovascular parameters and anxiety scores were assessed at baseline and at regular follow-up intervals over a period of 12 weeks.

Hypertension is one of the most prevalent chronic non-communicable diseases worldwide and represents a major risk factor for cardiovascular morbidity and mortality. In addition to elevated blood pressure, psychological factors such as stress and anxiety significantly influence the onset and progression of hypertension. Consequently, non-pharmacological interventions including yoga, meditation, and breathing-based therapies have gained increasing attention as adjunctive approaches for cardiovascular risk reduction and psychological well-being. Similar observations have been reported by Brown and Gerbarg, Joseph et al., and Brook et al., who highlighted the beneficial role of breathing-based interventions in cardiovascular regulation and stress reduction.[27-29]

In the present study, baseline demographic characteristics such as age and body mass index were comparable between the intervention and control groups. The absence of statistically significant differences between the groups at baseline indicates that both groups were homogeneous and suitable for comparative analysis. Similar baseline comparability has been reported in several yoga-based intervention studies evaluating cardiovascular outcomes in hypertensive patients.[30,31]

A significant reduction in systolic blood pressure was observed among participants practicing Sudarshan Kriya Yoga compared with those receiving standard treatment alone. The intervention group demonstrated a greater decline in systolic blood pressure from baseline to the end of the study period. These findings

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are consistent with previous studies showing that yogic breathing practices reduce sympathetic nervous system activity, improve vagal tone, and enhance autonomic balance, thereby contributing to blood pressure reduction. Murugesan et al., Selvamurthy et al., and Wolff et al. also reported significant decreases in systolic blood pressure following yoga-based interventions in hypertensive individuals.[32-34]

Diastolic blood pressure also improved significantly among participants in the intervention group. Although both groups showed reductions in diastolic blood pressure during follow-up, the improvement was more pronounced in the Sudarshan Kriya Yoga group. Controlled breathing techniques are known to improve baroreceptor sensitivity, reduce peripheral vascular resistance, and promote endothelial function. Similar findings have been reported by Joseph et al., Pal et al., and Cramer et al., who demonstrated favorable effects of yoga and slow breathing exercises on diastolic blood pressure regulation.[28,36,36]

The present study further demonstrated a marked reduction in anxiety scores among participants practicing Sudarshan Kriya Yoga. Anxiety levels decreased significantly from baseline to the final follow-up assessment, whereas only modest improvement was observed in the control group. These findings support previous reports suggesting that Sudarshan Kriya Yoga is effective in reducing stress, anxiety, and psychological distress. Brown and Gerbarg, Gupta et al., and Streeter et al. reported significant improvements in psychological health and emotional well-being following yogic breathing interventions.[27,37,38]

The improvement observed in both cardiovascular parameters and anxiety scores suggests a close interaction between psychological and physiological mechanisms. Chronic stress and anxiety activate the hypothalamic-pituitary-adrenal axis and the sympathetic nervous system, leading to increased cardiovascular workload and elevated blood pressure. By reducing anxiety and enhancing parasympathetic activity, Sudarshan Kriya Yoga may indirectly contribute to improved cardiovascular outcomes. Similar mechanisms have been proposed by Jerath et al. and Brown and Gerbarg in explaining the beneficial effects of controlled breathing techniques.[39,40]

Another important observation in the present study was the progressive improvement observed throughout the follow-up period. The beneficial effects became more evident with continued practice of Sudarshan Kriya Yoga, suggesting that regular adherence to the intervention is necessary to achieve maximum therapeutic benefit. Comparable findings have been reported by Hagins et al., Cramer et al., and Wolff et al., who demonstrated cumulative benefits of yoga interventions over prolonged periods.[31,34,36]

The physiological mechanisms underlying the beneficial effects of Sudarshan Kriya Yoga are likely multifactorial. Controlled breathing practices improve autonomic regulation, enhance oxygen utilization, reduce circulating stress hormones, and improve cardiovascular efficiency. Furthermore, yoga promotes mindfulness, emotional stability, and resilience to stress, thereby improving overall quality of life. Previous studies by Streeter et al., Jerath et al., and Brown and Gerbarg support these mechanisms and provide evidence for the neurophysiological basis of yoga-induced health benefits.[38-40]

The findings of the present study support the growing body of literature suggesting that Sudarshan Kriya Yoga can serve as an effective complementary therapy for patients with hypertension. Incorporating SKY into routine hypertension management may provide additional benefits beyond conventional pharmacological treatment by addressing both physiological and psychological determinants of cardiovascular health.

However, certain limitations should be acknowledged. The study was conducted at a single tertiary care center and involved a relatively limited sample size. Long-term follow-up beyond the study period was not performed, and adherence to home-based practice could not be monitored continuously. Future multicentric studies with larger sample sizes and longer follow-up durations are recommended to validate the present findings and assess the long-term sustainability of the observed benefits.

Overall, the present study demonstrated that Sudarshan Kriya Yoga significantly improved systolic blood pressure, diastolic blood pressure, and anxiety scores among patients with hypertension. These findings suggest that SKY is a safe, cost-effective, and beneficial adjunctive intervention in the comprehensive management of hypertension and associated anxiety.

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Summary

Hypertension is one of the most prevalent non-communicable diseases worldwide and is a major contributor to cardiovascular morbidity and mortality. Psychological factors, particularly anxiety and chronic stress, play an important role in the development and progression of hypertension. In recent years, complementary therapies such as yoga and meditation have gained increasing attention for their potential role in improving cardiovascular health and psychological well-being.

The present prospective interventional study was conducted in the Department of Physiology in collaboration with the Department of General Medicine at Pacific Institute of Medical Sciences to evaluate the effect of Sudarshan Kriya Yoga (SKY) on cardiovascular parameters and comorbid anxiety among patients with hypertension. A total of 100 hypertensive patients were enrolled and divided equally into two groups: an intervention group receiving Sudarshan Kriya Yoga along with standard treatment and a control group receiving standard treatment alone.

Cardiovascular parameters, including systolic blood pressure, diastolic blood pressure, and heart rate, along with anxiety scores, were assessed at baseline and during follow-up visits over a 12-week period. Statistical analysis was performed using appropriate parametric tests, and a p-value of less than 0.05 was considered statistically significant.

The findings of the study demonstrated a significant reduction in systolic blood pressure among participants practicing Sudarshan Kriya Yoga compared with the control group. Diastolic blood pressure also showed notable improvement following the intervention. Furthermore, anxiety scores decreased significantly in the intervention group, indicating the beneficial effect of Sudarshan Kriya Yoga on psychological health. The progressive improvement observed during follow-up suggested that regular and sustained practice of the breathing-based intervention contributed to better cardiovascular regulation and emotional stability.

The observed benefits may be attributed to improved autonomic balance, reduced sympathetic overactivity, enhanced parasympathetic activity, improved baroreceptor sensitivity, and reduction in stress-related neuroendocrine responses. By simultaneously influencing physiological and psychological pathways, Sudarshan Kriya Yoga appears to provide a holistic approach to the management of hypertension.

The results of the present study support the integration of Sudarshan Kriya Yoga as a complementary non-pharmacological intervention alongside conventional antihypertensive therapy. The practice is simple, safe, cost-effective, and easily adaptable, making it a valuable adjunct in the comprehensive management of hypertensive patients.

Conclusion

The present study demonstrated that regular practice of Sudarshan Kriya Yoga produced significant beneficial effects on cardiovascular parameters and anxiety levels among patients with hypertension. Participants who underwent the intervention showed greater reductions in systolic and diastolic blood pressure as well as marked improvement in anxiety scores when compared with those receiving standard treatment alone.

The findings suggest that Sudarshan Kriya Yoga helps improve autonomic regulation, reduces psychological stress, and promotes cardiovascular stability. The simultaneous improvement in both blood pressure and anxiety highlights the close relationship between emotional well-being and cardiovascular health.

Sudarshan Kriya Yoga can be considered a safe, feasible, and effective complementary therapy for hypertensive patients. Incorporation of this breathing-based yogic practice into routine lifestyle modification programs may enhance the overall effectiveness of hypertension management and improve quality of life. Further large-scale multicentric studies with longer follow-up periods are recommended to confirm these findings and establish long-term benefits of the intervention.

Ithical Issues:

Research project approved by the ethics committee of Pacific Institute of Medical Sciences Udaipur-313005, Rajasthan, INDIA

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