

Effects of Slow-Phase Pranayama and Meditation on Cardiovascular Parameters and Haemoglobin Levels in Women Receiving Cancer Care

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Abstract- Cancer and its associated treatments often result in physiological disturbances including cardiovascular stress, fatigue, and haematological alterations that negatively affect patients' well-being. Integrative approaches such as yoga-based breathing techniques and meditation have gained increasing attention as supportive interventions in oncology care. The present study aimed to examine the effects of slow-phase pranayama and meditation on cardiovascular parameters and haemoglobin levels among women receiving cancer care. An experimental pretest–post-test control group design was employed. Twenty women aged 40–55 years undergoing cancer care were randomly assigned to an experimental group (n = 10) and a control group (n = 10). The experimental group participated in slow-phase pranayama and meditation sessions for 45 minutes per day, five days per week, for eight weeks, while the control group continued routine medical care without the intervention. Cardiovascular parameters including pulse rate, systolic blood pressure, diastolic blood pressure, and haemoglobin levels were assessed before and after the intervention. Data were analyzed using paired t-tests and analysis of covariance (ANCOVA). Results showed a statistically significant reduction in systolic blood pressure in the experimental group (p = 0.0477). However, no significant changes were observed for diastolic blood pressure, pulse rate, or haemoglobin levels. The findings suggest that slow-phase pranayama and meditation may contribute to improvements in systolic blood pressure among women receiving cancer care, supporting the potential integration of yoga-based breathing practices in supportive oncology care.

Keywords: Pranayama, Meditation, Cardiovascular parameters, Haemoglobin, Cancer care, Integrative oncology

I. INTRODUCTION

1.1 Global Burden of Cancer and Treatment-Related Complications

Cancer remains one of the leading causes of morbidity and mortality worldwide and continues to present major challenges for healthcare systems and patients. According to global cancer statistics, the incidence of cancer is steadily increasing due to population aging, lifestyle factors, and environmental influences (Sung et al., 2021). Although advances in diagnostic technologies and therapeutic interventions have improved survival rates, individuals undergoing cancer treatment frequently experience a range of physiological and psychological complications. These complications may include cardiovascular stress, fatigue, anemia, sleep disturbances, and reduced quality of life, which can significantly affect patients during and after treatment (Bower et al., 2005; Danhauer et al., 2019). Many of these conditions arise not only from the cancer itself but also from the adverse effects of treatments such as chemotherapy, radiotherapy, and targeted therapies.

Women receiving cancer treatment, particularly for malignancies such as breast, colorectal, and ovarian cancers, often experience substantial physiological disturbances that affect cardiovascular stability and oxygen transport capacity. Treatment-related anemia and fatigue are commonly reported among cancer patients and may contribute to decreased physical performance and impaired daily functioning (Mustian et al., 2014). Consequently, supportive care strategies that complement conventional medical treatment are essential for improving patient well-being and functional outcomes.

1.2 Integrative Oncology and Mind–Body Interventions

In recent years, the concept of integrative oncology has emerged as an interdisciplinary approach that

combines conventional cancer treatments with evidence-based complementary therapies to improve patient outcomes. Integrative oncology focuses on addressing not only tumor control but also the physical, psychological, and social well-being of patients (Culos-Reed et al., 2012). Among the complementary interventions used in integrative oncology, yoga-based practices such as pranayama (regulated breathing techniques) and meditation have gained increasing scientific attention.

Yoga practices are widely recognized as mind–body interventions capable of influencing multiple physiological systems, including the autonomic nervous system, respiratory function, and cardiovascular activity (Ross & Thomas, 2010). Previous studies have reported that yoga interventions may reduce fatigue, improve sleep quality, and enhance quality of life among cancer survivors (Buffart et al., 2012). These findings suggest that yoga-based interventions may provide supportive benefits for individuals undergoing cancer treatment.

1.3 Physiological Effects of Pranayama on Cardiovascular Regulation

Pranayama refers to a set of controlled breathing techniques designed to regulate respiratory patterns and improve physiological balance. One specific form of pranayama, known as slow-phase pranayama, involves prolonged inhalation and exhalation cycles performed in a slow and rhythmic manner. This breathing pattern has been shown to influence autonomic nervous system regulation and cardiovascular functioning.

Slow breathing practices may enhance parasympathetic nervous system activity while simultaneously reducing sympathetic nervous system dominance, thereby improving autonomic balance (Zaccaro et al., 2018). Increased parasympathetic activity contributes to improved baroreflex sensitivity and stabilization of cardiovascular oscillations, which may lead to reductions in heart rate and blood pressure (Bhagat et al., 2017). Such physiological responses are particularly relevant for cancer patients, as treatment-related stress and inflammation may contribute to cardiovascular dysregulation.

1.4 Role of Meditation in Stress Reduction and Cardiovascular Health

Meditation practices often complement pranayama within yoga-based therapeutic programs. Meditation

promotes mental relaxation and emotional regulation by influencing neural pathways associated with stress perception and autonomic control. Through these mechanisms, meditation may reduce activation of the hypothalamic–pituitary–adrenal (HPA) axis and decrease circulating stress hormones such as cortisol (Streeter et al., 2012).

Reduced stress hormone levels can contribute to decreased sympathetic nervous system activity, improved cardiovascular stability, and enhanced emotional well-being. Previous studies have shown that meditation practices may reduce psychological distress and improve quality of life among cancer patients (Lin et al., 2019). When combined with controlled breathing techniques, meditation may produce synergistic physiological effects that support cardiovascular health.

1.5 Haemoglobin and Oxygen Transport in Cancer Care

Another important physiological concern in cancer patients is anemia, which is characterized by reduced haemoglobin levels and impaired oxygen transport. Anemia commonly occurs as a result of chemotherapy, radiation therapy, nutritional deficiencies, or chronic inflammation associated with cancer progression (Mustian et al., 2014). Reduced haemoglobin levels may lead to fatigue, weakness, and decreased physical endurance, thereby affecting patients' daily functioning and overall quality of life.

Because haemoglobin plays a critical role in oxygen transport and tissue metabolism, maintaining adequate haemoglobin levels is an important aspect of supportive oncology care. Mind–body interventions such as yoga and breathing practices may influence respiratory efficiency, oxygen exchange, and systemic circulation, which could potentially support oxygen transport mechanisms and hematological health.

1.6 Rationale and Objective of the Study

Although previous studies have demonstrated the potential benefits of yoga-based practices for cancer patients, relatively limited research has specifically examined the combined effects of slow-phase pranayama and meditation on cardiovascular parameters and haemoglobin levels among women receiving cancer care. Understanding these physiological effects may help identify safe and effective supportive interventions that complement conventional cancer treatments.

Therefore, the present study aimed to investigate the effects of slow-phase pranayama and meditation on cardiovascular parameters and haemoglobin levels in women receiving cancer care, with the goal of providing scientific evidence for the potential role of mind–body practices in supportive oncology.

II. METHODS

Study Design

The study employed an experimental pretest–posttest control group design to examine the effects of slow-phase pranayama and meditation on cardiovascular parameters and haemoglobin levels. The intervention period lasted eight weeks.

Participants

Twenty women aged 40–55 years undergoing cancer care were recruited from a cancer treatment center. Participants were randomly assigned into two groups:

- Experimental group (n = 10)
- Control group (n = 10)

Inclusion Criteria

Participants were included if they:

- Were female patients aged 40–55 years
- Were receiving cancer treatment or follow-up care
- Were medically stable and able to perform breathing exercises

Exclusion Criteria

Participants were excluded if they:

- Had severe cardiovascular or respiratory disorders
- Practiced yoga or meditation regularly before the study
- Had medical conditions limiting participation in breathing practices

Intervention Protocol

The experimental group participated in a structured pranayama and meditation program for eight weeks. Sessions were conducted five days per week for 45 minutes per session.

The session structure included:

Activity	Duration
Preparatory relaxation	5 minutes
Slow-phase pranayama practice	25 minutes
Guided meditation	10 minutes
Final relaxation	5 minutes

Participants in the control group continued their routine medical care without the yoga intervention.

Outcome Measures

The following physiological parameters were measured:

Cardiovascular Parameters

- Pulse rate (beats per minute)
- Systolic blood pressure (mmHg)
- Diastolic blood pressure (mmHg)

Hematological Parameter

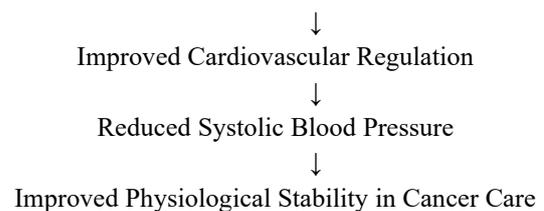
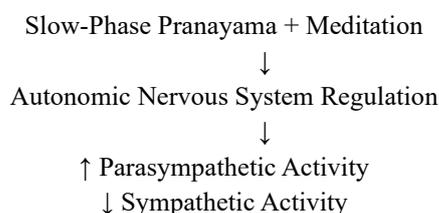
- Haemoglobin level (g/dL)

Measurements were recorded under resting conditions before and after the intervention period.

Conceptual Mechanism of the Intervention

Intervention	Physiological Mechanism	Biological Effect	Clinical Outcome
Slow-Phase Pranayama	Slow breathing (4–6 breaths/min)	Parasympathetic activation	Improved autonomic balance
Pranayama	Enhanced pulmonary ventilation	Improved oxygen exchange	Increased oxygen transport
Meditation	Stress reduction	Reduced cortisol & sympathetic activity	Cardiovascular stabilization
Pranayama + Meditation	Improved baroreflex sensitivity	Cardiovascular regulation	Reduced systolic blood pressure
Long-term practice	Reduced inflammation & oxidative stress	Support for erythropoiesis	Possible haemoglobin stabilization

Suggested graphical abstract flow



Statistical Analysis

Descriptive statistics were calculated to determine mean values of the variables. Paired t-tests were used to evaluate within-group differences between pre-test and post-test measurements. Analysis of

covariance (ANCOVA) was used to examine between-group differences while adjusting for baseline values. Statistical significance was set at $p < 0.05$.

III. RESULTS

Table 1 Pre- and post-test comparison of cardiovascular parameters and haemoglobin levels.

Variable	Group	Pre-test Mean	Post-test Mean	p value
Systolic Blood Pressure (mmHg)	Experimental	128.00	124.00	0.0477*
	Control	120.00	116.40	>0.05
Diastolic Blood Pressure (mmHg)	Experimental	88.00	88.00	>0.05
	Control	76.00	82.00	>0.05
Pulse Rate (bpm)	Experimental	80.52	85.60	>0.05
	Control	85.60	82.80	>0.05
Haemoglobin (g/dL)	Experimental	11.36	11.16	>0.05
	Control	11.24	11.58	>0.05

Significant at $p < 0.05$

Table 2 ANCOVA comparison of adjusted post-test scores

Variable	F (df)	p value
Systolic Blood Pressure	0.33 (1,7)	>0.05
Diastolic Blood Pressure	0.07 (1,7)	>0.05
Pulse Rate	1.63 (1,7)	>0.05
Haemoglobin	1.74 (1,7)	>0.05

IV.DISCUSSION

The present study investigated the effects of an eight-week intervention consisting of slow-phase pranayama and meditation on cardiovascular parameters and haemoglobin levels among women receiving cancer care. The findings demonstrated a significant reduction in systolic blood pressure within the experimental group, while no statistically significant changes were observed in diastolic blood pressure, pulse rate, or haemoglobin levels. These results provide insight into the physiological influence of breathing-based mind-body interventions on cardiovascular regulation during cancer treatment.

Effects on Systolic Blood Pressure

One of the key findings of the present study was the significant reduction in systolic blood pressure observed in the experimental group following the intervention. This outcome suggests that the combined practice of slow-phase pranayama and meditation may positively influence cardiovascular regulation. Slow breathing techniques are known to stimulate the parasympathetic branch of the autonomic nervous system, thereby reducing sympathetic activity and lowering vascular

resistance. Enhanced parasympathetic dominance leads to improved baroreflex sensitivity and stabilization of blood pressure fluctuations.

Previous physiological studies have demonstrated that controlled yogic breathing performed at a slow respiratory rate can improve cardiovascular oscillations and autonomic balance, resulting in reductions in systolic blood pressure. The mechanisms underlying these effects are believed to involve respiratory sinus arrhythmia, improved vagal tone, and decreased stress-related activation of the hypothalamic-pituitary-adrenal (HPA) axis. For women undergoing cancer treatment, these mechanisms are particularly relevant because treatment-related stress and systemic inflammation often contribute to cardiovascular dysregulation.

However, although a significant within-group improvement was observed in the experimental group, the between-group comparison using ANCOVA did not reveal statistically significant differences after adjusting for baseline values. This finding suggests that while the intervention may have contributed to improvements within participants practicing pranayama and meditation, the magnitude of change may not have been sufficiently large to produce clear differences when compared with the control group within the study duration.

Effects on Diastolic Blood Pressure

The results of the study indicated no significant change in diastolic blood pressure in the experimental group, while a non-significant increase was observed in the control group. Diastolic

pressure is largely influenced by peripheral vascular resistance and arterial elasticity, which may require longer intervention periods to demonstrate measurable changes.

Previous studies on yoga-based breathing interventions have reported variable results regarding diastolic blood pressure. Some investigations have shown modest reductions after extended practice periods, whereas others have reported minimal short-term effects. The absence of significant changes in the present study may therefore be attributed to the relatively short intervention duration and the small sample size, which may limit the ability to detect subtle physiological adaptations.

Effects on Pulse Rate

The findings also showed no statistically significant change in pulse rate in either the experimental or control groups. Although slow breathing and meditation are theoretically associated with reduced heart rate due to increased vagal activity, the results of the present study suggest that the intervention did not produce measurable changes in resting pulse rate during the study period.

One possible explanation is that pulse rate is influenced by multiple factors including physical fitness, medication use, emotional state, and treatment-related physiological stress. In cancer patients, these factors may vary considerably, which could obscure the effects of breathing-based interventions. Additionally, improvements in autonomic regulation may sometimes be reflected more clearly in heart rate variability rather than simple pulse rate measurements.

Effects on Haemoglobin Levels

The present study did not observe statistically significant changes in haemoglobin levels in either the experimental or control groups. Haemoglobin levels are influenced by complex physiological processes including erythropoiesis, nutritional status, inflammation, and treatment-related factors such as chemotherapy-induced bone marrow suppression. Because these processes operate over longer biological time scales, an eight-week breathing and meditation intervention may not be sufficient to produce measurable hematological changes.

Nevertheless, theoretical mechanisms suggest that pranayama could influence oxygen transport and

respiratory efficiency. Slow breathing practices enhance alveolar ventilation and oxygen diffusion, potentially improving systemic oxygen utilization. Over longer periods, improved oxygenation and stress reduction could indirectly support hematological health. However, the present findings indicate that such changes were not detectable within the duration of the current study.

Implications for Integrative Oncology

Despite the limited statistical changes observed in some physiological parameters, the significant reduction in systolic blood pressure suggests that slow-phase pranayama and meditation may offer supportive benefits in cardiovascular regulation for women undergoing cancer care. Integrative interventions that reduce stress and promote autonomic balance may contribute to improved physiological stability during cancer treatment.

Mind-body practices are increasingly recognized within integrative oncology as non-pharmacological strategies that may enhance patient well-being, reduce psychological distress, and support physiological resilience. The results of the present study contribute to this growing body of evidence by highlighting the potential role of controlled breathing and meditation in managing cardiovascular stress among cancer patients.

V. CONCLUSION

The findings of this study indicate that slow-phase pranayama and meditation may contribute to improvements in systolic blood pressure among women receiving cancer care. Although no significant changes were observed in diastolic blood pressure, pulse rate, or haemoglobin levels, the intervention demonstrated potential benefits for cardiovascular regulation. These results support the integration of breathing-based mind-body practices as complementary strategies in supportive cancer care. Future research involving larger samples and longer intervention durations is recommended to further evaluate the physiological effects of yoga-based interventions in oncology populations.

REFERENCE

- [1] Buffart, L. M., van Uffelen, J. G., Riphagen, I. I., et al. (2012). Physical and psychosocial benefits of yoga in cancer patients and survivors: A systematic review and meta-analysis. *BMC Cancer*, 12, 559.

- [2] Danhauer, S. C., Addington, E. L., Cohen, L., & Sohl, S. J. (2019). Yoga for symptom management in oncology: A review of the evidence base. *Cancer*, 125(12), 1979–1989.
- [3] Bower, J. E., Woolery, A., Sternlieb, B., & Garet, D. (2005). Yoga for cancer patients and survivors. *Cancer Control*, 12(3), 165–171.
- [4] Zaccaro, A., Piarulli, A., Laurino, M., et al. (2018). How breath-control can change your life: A systematic review. *Frontiers in Human Neuroscience*, 12, 353.
- [5] Nivethitha, L., & Mooventhan, A. (2016). Effects of pranayama on cardiovascular and autonomic variables. *Ancient Science of Life*, 36(2), 72–77.
- [6] Bhagat, O. L., Kharya, C., Jaryal, A., & Deepak, K. K. (2017). Acute effects of controlled slow yogic breathing. *Indian Journal of Medical Research*, 145(4), 503–512.
- [7] Ross, A., & Thomas, S. (2010). The health benefits of yoga and exercise. *Journal of Alternative and Complementary Medicine*, 16(1), 3–12.
- [8] Streeter, C. C., Gerbarg, P. L., Saper, R. B., et al. (2012). Effects of yoga on the autonomic nervous system. *Medical Hypotheses*, 78(5), 571–579.
- [9] Lin, P. J., Kleckner, I. R., Loh, K. P., et al. (2019). Yoga for cancer-related fatigue. *Integrative Cancer Therapies*, 18, 1–11.
- [10] Culos-Reed, S. N., Mackenzie, M. J., Sohl, S. J., et al. (2012). Yoga interventions for cancer survivors. *Evidence-Based Complementary and Alternative Medicine*, 2012, 642576.
- [11] Mustian, K. M., Janelins, M., Peppone, L. J., et al. (2014). Yoga for insomnia among cancer patients. *Oncology & Hematology Review*, 10(2), 1–7.
- [12] Blockhuys, S., & Wittung-Stafshede, P. (2024). Yoga as a complementary therapy for cancer patients. *Complementary Medicine Research*, 31(5), 403–412.
- [13] Momeni, M., Khatooni, M., Alizadeh, A., et al. (2025). Effects of pranayama on women with breast cancer undergoing chemotherapy. *BMC Complementary Medicine and Therapies*, 25, 81.
- [14] Goyal, A. K., Bakshi, J., Rani, S., et al. (2019). Rajyoga meditation and biochemical profiles in breast cancer treatment. *Journal of Complementary and Integrative Medicine*, 16(3).
- [15] Nagar, L., Betal, C., Kushwaha, J., & Bhatt, A. (2025). Impact of pranayama on haemoglobin levels and cortisol. *Journal of Integrative Medicine*, 23(2), 102–109.