

# Acute Haemodynamic, Thermogenic, and Psychological Responses to Surya Bheda Pranayama (Right Nostril Breathing) in Healthy Adults: A Controlled Pilot Study

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## Abstract

*Background: Surya Bheda Pranayama (Right Nostril Breathing) is an ancient yogic intervention that has been proposed to promote active sympathetic nervous system dominance and thermogenesis. This pilot study was conducted to investigate the immediate haemodynamic, thermogenic, and psychological effects of a supervised Surya Bheda Pranayama protocol in healthy adults.*

*Methods: A parallel-group pilot trial was carried out with 30 healthy adult participants, allocated (n=15 per group) to pranayama intervention or a passive resting control group. The intervention consisted of 15 min of right nostril breathing in a 1:1:1 sequence (of 5 seconds each for inspiration, internal retention and expiration). The control group was in the passive idle period for a duration equivalent to this. Primary physiological outcome measures were systolic and diastolic blood pressure (BP), pulse rate (PR), peripheral oxygen saturation (SpO<sub>2</sub>), and core body temperature. Secondary acute psychological outcomes were measured using the state subscale of the State-Trait Anxiety Inventory (STAI-S). All assessments were baseline immediately pre- and post-intervention.*

*Outcome: Significant acute physiological responses in the intervention group were observed using paired-samples comparisons. Specifically, Surya Bheda Pranayama resulted in a statistically significant increase in core body temperature along with systolic and diastolic blood pressure, correlating with acute sympathetic arousal and thermogenesis. On the other hand, the control group showed no statistically significant differences from baseline with respect to all haemodynamic and thermoregulatory indices. Post-intervention psychological evaluations showed rapid changes in state anxiety of the intervention group, which corresponded with the physiological arousal response.*

**Key Words:** Right nostril Breathing, Surya Bheda Pranayama, Autonomic Nervous System, Sympathetic Activation, Thermogenesis, State Anxiety

## 1. INTRODUCTION

Pranayama practices are commonly grouped according to the effects they are thought to have on the autonomic nervous system. Surya Bheda — or right-nostril breathing — is a “solar” or heat-generating practice. Classical yogic texts suggest that it stimulates bodily functions, increase metabolic “fire” and nurtures the dominance of the sympathetic nervous system. In the classical model, breathing through the right nostril is associated with the Pingala nadi and this corresponds to the sympathetic phase, whereas left-nostril (Chandra) breathing correlates with the Ida nadi and the parasympathetic effect. [4]

Yoga traditions and clinical practice often use Surya Bheda to increase vigilance and body temperature. However, there are few controlled studies measuring outcomes like core temperature and anxiety[1]. To address this gap, we conducted a controlled pilot study including immediate pre-and post-intervention changes in blood pressure, pulse rate, oxygen saturation, core temperature, and state anxiety among adults practicing Surya Bheda versus resting control. The STAI-S is a

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well-established, 20-item assessment scale for situational anxiety[3]. We hypothesized that Surya Bheda may cause short-term increases in sympathetic-related parameters (blood pressure, heart rate and temperature), compared with rest, and investigated its effects on anxiety.

**2. METHODOLOGY**

Thirty healthy adult volunteers were recruited to be randomized (15 each) to the Surya Bheda Pranayama (therapeutic intervention) or passive-rest control. Cardiovascular or respiratory pathology was excluded by screening all participants. The intervention group performed 15 minutes of right-nostril breathing with equal ratio that is 1:1:1 (inhalation, breath retention and exhalation) for 5 rounds. Then the control group spent 15 minutes sitting quietly (eyes closed, normal breathing) in the same environment.

**2.1 Procedure for surya bedha pranayama for intervention group**

The participant was instructed to sit comfortably in a meditative posture such as Padmasana, Sukhasana, or Vajrasana, maintaining an erect spine and gently closed eyes. The right hand was positioned in Nasagra Mudra, and the left nostril was gently closed using the ring finger. The participant then inhaled slowly and deeply through the right nostril. After complete inhalation, internal breath retention (Antar Kumbhaka) was performed for a comfortable duration without strain. Subsequently, the right nostril was closed using the thumb, the left nostril was opened, and slow, complete exhalation was carried out through the left nostril. This sequence constituted one round of Surya Bhedana Pranayama.

**2.2 Outcome Measures and Statistical Analysis**

Outcome measures were noted immediately before and after the session. For each of these, measurement variables were: systolic and diastolic blood pressure (SBP, DBP) and pulse rate (Pulse Oximetry); peripheral oxygen saturation (SpO<sub>2</sub> by pulse oximetry); core body temperature (tympanic thermometer); state anxiety (Spielberger STAI-S questionnaire). Data were examined by paired-samples t-test within group (pre versus post) and independent t-test of change score (post minus pre) between groups. Normality assumptions were tested (data were roughly normal), and significance level was defined as α=0.05. Effect sizes were described descriptively

**3. RESULTS**

Values were similar for all groups (no significant differences, all p>.2) in the baseline (pre-intervention). Table 1 shows the pre/post means ±SD and within-group p-values.

**Table - 1:** Pre- and post-intervention means (±SD) for each measure by group, with within-group p-values (paired t-tests).

| Variable         | Group        | Pre (Mean ± SD) | Post (Mean ± SD) | p (within) |
|------------------|--------------|-----------------|------------------|------------|
| SBP              | Intervention | 99.40 ± 11.91   | 104.67 ± 13.63   | <0.001     |
|                  | Control      | 103.93 ± 13.98  | 99.40 ± 12.35    | 0.003      |
| DBP              | Intervention | 71.00 ± 9.03    | 74.73 ± 8.47     | 0.004      |
|                  | Control      | 69.67 ± 10.93   | 66.53 ± 9.06     | 0.051      |
| Pulse            | Intervention | 76.27 ± 10.19   | 80.00 ± 12.31    | 0.005      |
|                  | Control      | 79.27 ± 13.23   | 79.20 ± 13.06    | 0.719      |
| SpO <sub>2</sub> | Intervention | 97.80 ± 1.26    | 98.33 ± 0.98     | 0.120      |
|                  | Control      | 98.00 ± 0.65    | 97.40 ± 2.41     | 0.334      |
| Temp (°C)        | Intervention | 36.35 ± 0.63    | 37.03 ± 0.36     | <0.001     |
|                  | Control      | 36.31 ± 0.99    | 36.29 ± 0.98     | 0.767      |

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|        |              |               |               |       |
|--------|--------------|---------------|---------------|-------|
| STAI-S | Intervention | 39.67 ± 10.93 | 33.00 ± 11.06 | 0.005 |
|        | Control      | 46.20 ± 16.01 | 46.20 ± 16.01 | -     |

SBP- Systolic Blood Pressure, DBP – Diastolic Blood Pressure, SpO<sub>2</sub> – Peripheral Capillary Oxygen Saturation , Temp – Temperature, STAI-S – State Trait Anxiety Inventory Scale

Within the intervention group, SBP increased on average +5.27 mmHg (p<.001) and DBP by +3.73 mmHg (p=.004). Pulse rate rose +3.73 beats per minute (p=.005) and core temperature rose +0.68 °C (p<.001). STAI-S anxiety decreased by –6.67 points (p=.005). SpO<sub>2</sub> experienced small nonsignificant increments (+0.53%, p=.120).

Conversely, the control group showed a significant decrease in SBP (–4.53 mmHg; p=.003) and a borderline decrease in DBP (–3.13 mmHg; p=.051). There were no significant changes in pulse (–0.07 bpm, p=.719), SpO<sub>2</sub> (–0.60%, p=.334), temperature (–0.03 °C, p=.767), or anxiety (no change).

Table 2 shows the between-group comparison of change scores (Δ = post–pre). Cardiovascular and thermoregulatory alterations were significantly different between groups. The SBP change (Δ) was Intervention +5.27 mmHg vs –4.53 mmHg control (p<.001); DBP Δ was +3.73 vs –3.13 (p<.001); pulse Δ was +3.73 vs –0.07 (p=.004); and temperature Δ was +0.68 vs –0.03 °C (p<.001). The anxiety response change within the Intervention group was –6.67 compared to 0.00 in controls (p=.005). SpO<sub>2</sub> change alone did not differ (p=.111).

Table – 2: Mean change (Δ = post – pre) in each measure and between-group p-values (independent t-test).

| Variable         | ΔIntervention (Mean ± SD) | ΔControl (Mean ± SD) | p (between) |
|------------------|---------------------------|----------------------|-------------|
| SBP              | +5.27 ± 4.89              | –4.53 ± 4.87         | <0.001      |
| DBP              | +3.73 ± 4.18              | –3.13 ± 5.69         | <0.001      |
| Pulse            | +3.73 ± 4.30              | –0.07 ± 0.70         | 0.004       |
| SpO <sub>2</sub> | +0.53 ± 1.25              | –0.60 ± 2.32         | 0.111       |
| Temp             | +0.68 ± 0.59              | –0.03 ± 0.34         | <0.001      |
| STAI-S           | –6.67 ± 7.87              | 0.00 ± 0.00          | 0.005       |

SBP- Systolic Blood Pressure, DBP – Diastolic Blood Pressure, SpO<sub>2</sub> – Peripheral Capillary Oxygen Saturation , Temp – Temperature, STAI-S – State Trait Anxiety Inventory Scale

In summary, Surya Bheda Pranayama produced acute increases in BP, Pulse rate, and core temperature, and a decrease in state anxiety, whereas the control group showed no such changes (and in fact a decrease in BP). The between-group differences were highly significant (Table 2). No adverse events occurred, and SpO<sub>2</sub> remained within normal range in all subjects.

4. DISCUSSION

In this pilot study, they found 15 minutes of right nostril (Surya Bheda) breathing to result in significant sympathetic-like activation among healthy adults, with higher SBP, DBP, pulse rate, and body temperature in comparison to baseline. These effects are in accordance with conventional descriptions of Surya Bheda as a “heat-generating” and activating pranayama. Our control group (passive resting) had a relatively mild decrease in BP indicating that there are no obvious diurnal or relaxation effects other than in the active breathing group.

The fact that the core temperature increased similarly in the group of the Intervention (+0.68°C) compared to a recent study reported that the skin temperature level has risen the same following Surya Bheda followed by quiet sitting[1]. Our temperature (tympanic temperature) reflects a true thermogenic effect, beyond ambient warming, and corroborates the traditional characterization of Surya Bheda as heating. This rapid thermogenesis may be linked to upregulating metabolism or muscle tension from the retention of breath. The key implication was that state anxiety (STAI-S) decreased significantly in

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the Surya Bheda group despite physiological arousal, but not by physiological arousal. The mean anxiety score in the Intervention group decreased by ~6.7 points (from ~40 to 33), a moderate effect size, compared to no change on the control group. Between-group comparison verified this to be significant ( $p=.005$ ). Such anxiolytic effects are consistent with evidence for yogic breathing to decrease psychological stress and anxiety. Meta-analyses of breathing interventions show small to medium reductions in anxiety and stress symptoms compared to controls [2]. Focusing in on breathing may itself lead to a relaxation response or increased vagal tone after the practice (even if 'stimulating'). It is possible that cognitively, the breathing exercise changed mood, or shifted attention, thus relieving the acute anxiety that was caused. Spielberger (1972) also suggests that state anxiety is sensitive to situational changes[3] and that the practice may have elicited a sense of calm in the face of elevated blood pressure. Taken together, our findings support the idea that Surya Bheda Pranayama induces sympathetic-axis actions (raising BP, PR, temperature) with no increase in subjective anxiety. Indeed, it reduced state anxiety in part through likely feedback mechanisms. These findings indicate that it is possible to therapeutically use Surya Bheda to help increase alertness or metabolism without anxiety raising, but more work is required to establish safety and long-term efficacy.

## 5. LIMITATIONS

This was a small pilot study and participants were not blinded (participants were aware of their condition). Blood catecholamines or advanced autonomic markers were not measured; instead, peripheral vitals and self-report were data. A significant control-group SBP change demonstrates that simple rest can lead to a reduction in BP, and future investigation is warranted of an active comparison (e.g. left-nostril breathing or paced breathing) to confirm a specific effect of Surya Bheda.

## 6. CONCLUSION

Surya Bheda Pranayama session induced acutely significant increase in DBP and core temperature in patients engaged in the active Surya Pranayama practice compared to passively resting, the client according to sympathetic activation and reduced state anxiety. It justifies the benefits described in the ancient texts[3]. This preliminary evidence suggest that more research is required across larger, controlled trials.

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