Body Temperature in Practitioners of a Yoga Breathing Technique Considered to be Heat Generating

**Abstract**

**Context:** Suryabheda pranayama is traditionally described as “increasing the inner fire” and is believed to be heat generating. **Aims:** The present study aimed at determining whether the surface body temperature would increase after Suryabheda pranayama practice compared with sitting quietly for the same duration as a control. **Materials and Methods:** Nineteen participants with experience of Suryabheda pranayama practice (group mean experience ± standard deviation, 30.2 ± 22.8 months) were assessed in 3 sessions on separate days. The sessions were (i) Suryabheda pranayama with physiological locks or breath retention, (ii) Suryabheda pranayama without physiological locks or breath retention, and (iii) quiet sitting (control session). The axillary surface body temperature was monitored in all three sessions before (5 min), during (15 min), and after (5 min) the intervention. Ambient temperature and humidity in the recording cabin used for testing were noted. From the ambient temperature and humidity, the heat index was derived. **Statistical Analysis:** Repeated measures analyses of variance were performed to compare values before, during, and after the 3 sessions, using SPSS version 24.0. **Results:** The surface body temperature increased during and after Suryabheda pranayama with physiological locks ($P < 0.001$; $P < 0.001$), Suryabheda pranayama without physiological locks ($P < 0.01$; $P < 0.001$), and quiet sitting ($P < 0.001$; $P < 0.001$) compared to the respective before values. **Conclusion:** The control (i.e., quiet sitting) and experimental sessions (i.e., suryabheda with locks and suryabheda without locks) showed a comparable increase in the surface body temperature. Hence, the increase in surface body temperature during and after experimental sessions does not appear to be related to the pranayama techniques. The possible factors which may have contributed to increased surface body temperature in the control and experimental sessions have been discussed.

**Keywords:** Body temperature, heat index, room temperature, Suryabheda pranayama, unilateral nostril breathing, yoga breathing

**Introduction**

Voluntary yoga breath regulation (called pranayama in Sanskrit) is a way to modify specific physiological functions through the respiration.[1] Among pranayamas, breathing through a particular nostril is considered important to alter the functioning of the body and the mental state. Breathing through the right nostril is traditionally called Suryabheda pranayama (= “piercing like the sun” yoga breathing, in Sanskrit). The notion that Suryabheda pranayama is heat generating is supported by a verse in a yoga text, i.e., the Gheranda Samhita (Circa 1700, A. D.), Chapter V, Verse 69. The verse states that the practice of Suryabheda pranayama reduces aging and can even delay death (Gheranda Samhita, Chapter V, Verse 69).[2] This verse continues to state that the practice of Suryabheda pranayama augments the inner digestive fire (in Sanskrit; Bodhayetkundaleem shaktim dehaanalavivardhanam; Gheranda Samhita, Chapter V, Verse 69; where deha = body and anal = inner fire).[3] Based on this verse, commentators have stated that Suryabheda pranayama can increase the body temperature.[2,4]

When both inhalation and exhalation were practiced through the right nostril, there was an increase in oxygen consumption both as an immediate effect of 45 min of practice, where the oxygen consumption increased by 17%,[5] and as a longitudinal effect following 1 month of Suryabheda pranayama practice every day, where the oxygen consumption increased by 37%.[6]

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Oxygen consumption is an indicator of energy expenditure. These effects of increased energy expenditure are compatible with the traditional descriptions of Suryabheda pranayama in the yoga texts. The effects of specific pranayamas as heat generating or heat dissipating are not related to thermoregulation. The normal expectation based on traditional descriptions of the ideal conditions to practice yoga is that yoga is practiced under conditions which are not physically or mentally challenging (Hatha Pradipika, Chapter I, Verses 12–14). Hence, the expectation is that irrespective of environmental conditions, if Suryabheda pranayama is actually heat generating, it would raise the body surface temperature within the normal range.

However, the effect of Suryabheda pranayama on the body temperature has not been assessed. Hence, the present study aimed at determining whether the surface body temperature would increase after Suryabheda pranayama practice compared with sitting quietly for the same duration as a control for comparison.

**Materials and Methods**

**Participants**

Nineteen healthy male participants between 18 and 30 years (group mean age ± standard deviation (SD), 25.0 ± 3.7 years) were recruited for the study. With n = 19 and with an average effect size of 1.72 (based on the average of the change in body temperature in the three sessions), the power was 1.0 for alpha = 0.05. Participants had at least 1-year experience of Suryabheda pranayama practice with and without physiological locks (called bandhas in Sanskrit). Participants with (i) any hormonal imbalance or nervous system disorder which could influence thermoregulation, (ii) a history of smoking, (iii) any recent surgery (which is a contraindication for practicing bandhas), and (iv)
taking medication or using other wellness strategies were excluded from the study. None of the participants had to be excluded for these reasons. Signed informed consent was obtained from the participants. The study was approved by the institution’s ethics committee (approval number YRD/017/004).

**Design**

Participants were assessed in three sessions each. The three sessions were on three separate days at the same time of the day with 24 h between each session. The three sessions were (i) Suryabheda pranayama with both chin and perineal locks (jalandhara bandha and mula bandha, respectively, in Sanskrit), (ii) Suryabheda pranayama without the physiological locks, and (iii) quiet sitting. The sequence of the practices was randomized for the participants using a standard randomizer (www.randomizer.com). For all three sessions, the total duration of each session was 25 min, i.e., 5 min (before), 15 min (during), and 5 min (after). This study design is schematically depicted in Figure 1.

**Assessments**

**Ambient room temperature and humidity**

Assessments were carried out in a separate recording room which was temperature regulated. The study was conducted between June and October 2017. The ambient room temperature and humidity were monitored before and after each session using a digital wireless electronic hygrometer and a room temperature meter, respectively (HTC-1, HTC, Thailand). The room temperature meter had an accuracy of 0.1°C, while the hygrometer was accurate to 1% humidity.

**Body temperature**

The surface body temperature was recorded from the left axilla using a multi-utility patient monitor (TRUSCOPE II, Schiller, Switzerland), after cleaning the area with Savlon™ 2%. The thermometer was accurate to 0.1°C. The body temperature was recorded 5 min before, 15 min during, and 5 min after all three interventions, i.e., (i) Suryabheda pranayama with both chin and perineal locks, (ii) Suryabheda pranayama without the physiological locks, and (iii) quiet sitting.

During all three sessions, participants were seated in a temperature regulated, dimly lit room. They were asked to close their eyes while seated in a comfortable pose keeping their spine and neck aligned and erect.

**Intervention**

**Suryabheda pranayama with physiological locks**

During Suryabheda pranayama with chin and perineal locks, participants were instructed to close their left nostril and inhale slowly and deeply through the right nostril. At the end of inhalation, participants were asked to close both nostrils and lower their head to perform two physiological locks while holding their breath; these were (i) the chin lock (= jalandhara bandha in Sanskrit) in which the chin rests on the suprasternal notch[10] and (ii) the perineal lock in which the external urogenital organs are drawn upward toward the perineum called (mulabandha in Sanskrit).[11] Participants were asked to hold their breath to the extent they could with comfort. This was approximately 15 s. The perineal lock was released first followed by the chin lock, and then, participants were asked to raise their head. After this, participants kept the right nostril closed and the left nostril patent and exhaled slowly through the left nostril. This was a complete cycle of Suryabheda pranayama.[6] The cycle was repeated during the 15-min period.

**Suryabheda pranayama without physiological locks**

During Suryabheda pranayama without physiological locks or breath retention, participants were asked to close their left nostril and inhaling deeply through their right nostril, followed by exhalation through the right nostril without breath retention.[5] This was a complete cycle of Suryabheda pranayama. The cycle was repeated during the 15-min period.

**Quiet sitting**

The participants allowed random thoughts to pass through their mind without modifying them, and they were instructed to avoid modifying their breath or being aware

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**Table 1: Analyses of variance table for the variables**

| Variables            | Sources | F     | Degree of freedom | Mean square | Partial η² | Huynh-Feldt ε | P      |
|----------------------|---------|-------|-------------------|-------------|------------|---------------|--------|
| Body temperature     | Sessions| 2.538 | 1.234, 22.210     | 1.576       | 0.124      | 0.693         | 0.120  |
|                      | States  | 30.470| 1.152, 20.744     | 15.667      | 0.629      | 0.590         | <0.001 |
|                      | Sessions × States | 1.082 | 1.164, 20.944     | 1.025       | 0.057      | 0.299         | 0.322  |
| Room temperature     | Sessions| 3.205 | 1.128, 20.309     | 29.907      | 0.151      | 0.576         | 0.084  |
|                      | States  | 32.080| 1.18             | 9.322       | 0.641      | 1.000         | <0.001 |
|                      | Sessions × States | 1.554 | 1.647, 29.640     | 0.092       | 0.790      | 0.823         | 0.229  |
| Humidity             | Sessions| 0.017 | 1.684, 30.312     | 1.636       | 0.001      | 0.842         | 0.971  |
|                      | States  | 38.616| 1.18             | 72.64       | 0.682      | 1.000         | <0.001 |
|                      | Sessions × States | 2.048 | 1.845, 33.207     | 1.436       | 0.102      | 0.922         | 0.149  |
| Heat index           | Sessions| 3.943 | 1.169, 21.049     | 41.692      | 0.180      | 0.601         | 0.055  |
|                      | States  | 35.437| 1.18             | 15.474      | 0.663      | 1.000         | <0.001 |
|                      | Sessions × States | 1.053 | 2, 360           | 0.184       | 0.055      | 1.000         | 0.359  |
of their breathing. The participants were asked to sit cross-legged (sukhasana) with their spine erect and eyes closed. There was no other activity.

Data analysis

Data were analyzed with SPSS version 24.0 (IBM Corp., Armonk, N.Y., USA). Repeated measures analyses of variance were performed to analyze body temperature with two within-subjects factors, i.e., sessions (three) and states (before, during, and after). In the case of room temperature, humidity, and heat index for all three sessions, the states were two (before and after). Multiple comparisons were Bonferroni adjusted.

Results

Repeated measures analyses of variance

The F, df, Huynh–Feldt epsilon, partial eta squared, and P value for states, sessions, and sessions × states for different variables are provided in Table 1. A significant interaction between the sessions and states indicates the interdependence of the two.

Post hoc analyses

Body temperature

The surface body temperature increased during and after Suryabheada pranayama with physiological locks (P < 0.001; P < 0.001), Suryabheada pranayama without physiological locks (P < 0.01; P < 0.001), and quiet sitting (P < 0.001; P < 0.001) compared to the respective before values.

Room temperature

Room temperature increased after (i) Suryabheada pranayama with physiological locks (P < 0.001), (ii) Suryabheada pranayama without physiological locks (P < 0.001), and (iii) quiet sitting (P < 0.001). Humidity increased after (i) Suryabheada pranayama with physiological locks (P < 0.001), (ii) Suryabheada pranayama without physiological locks (P < 0.001), and (iii) quiet sitting (P < 0.01).

Heat index

The heat index was also increased after (i) Suryabheada pranayama with physiological locks (P < 0.01), (ii) Suryabheada pranayama without physiological locks (P < 0.001), and (iii) quiet sitting (P < 0.001).

The details of the average values and SDs are given in Table 2.

Discussion

Suryabheada pranayama is associated with increased sympathetic nervous system activity and increased energy expenditure. The present study aimed at assessing the surface body temperature with Suryabheada pranayama practice.

The axillary surface body temperature increased after both experimental sessions of Suryabheada pranayama practice and the control session of quiet sitting. The magnitude of increase was comparable. Hence, these results do not support the speculation that Suryabheada pranayama may be a heat-generating practice. Since the surface body temperature increased after all three sessions, an attempt was made to understand why this may have happened.

Other physical factors which could have contributed to changes in body temperature were the room temperature and humidity. In both experimental sessions and the control session, the room temperature increased significantly after the session compared to before, by an average of 0.6°C. Ambient humidity also increased significantly after the three sessions by an average of 2%.
In all three sessions, there was a significant increase in the heat index. The heat index was obtained from the recorded room temperature and humidity using an algorithm.\textsuperscript{[15]} The heat index measures thermal comfort and is used often in environmental health in areas of environmental health research including air pollution exposure\textsuperscript{[13]} and to develop a warming system for changes in prevalent weather conditions.\textsuperscript{[14]}

Apart from the heat index, factors related to the posture of the participants during the sessions may have influenced their body temperature.

In all three sessions, participants sat in an upright yoga posture (i.e., sukhhasana). This involved sitting on a flat noncompliant surface in an upright position, with their legs crossed. Rai \textit{et al.} and others in 1994 studied the energy expenditure during a comparable upright seated yoga posture siddhasana “the accomplished posture” in Sanskrit which also involved crossing the legs but with the feet closer to the perineum.\textsuperscript{[15]} After sitting in siddhasana for 20 min, ten healthy practitioners showed a 21% increase in energy expenditure compared to an equal duration of sitting in a chair, possibly related to maintaining an upright posture. In the present study, the duration was almost comparable to the earlier study\textsuperscript{[15]} and sitting upright may have similarly increased energy expenditure, which could have been resulted in an increase in surface body temperature.

Earlier studies which demonstrated an increase in oxygen consumption and increased energy expenditure as an immediate effect of 45 min of practice of Suryabheda pranayama (17% increase)\textsuperscript{[16]} or as a longitudinal effect over 1 month of practicing Suryabheda pranayama every day (37% increase)\textsuperscript{[17]} did not measure surface body temperature.

Since the body temperature did not increase after Suryabheda pranayama practice, the way in which the energy spent is utilized may be speculated upon. The increase in energy expenditure with Suryabheda pranayama may be used for other internal functions such as the digestion. This is supported by the effects of Suryabheda pranayama as described in yoga texts.\textsuperscript{[8]} Food is assimilated and converted to energy by an active process which is known as the specific dynamic action (SDA) of food.\textsuperscript{[18]} Out of the total energy consumed in a day, 10% of energy is utilized for SDA. Whether this proportion increased after the practice of Suryabheda pranayama is not known. However, all participants resided in the university and had comparable levels of physical activity and a comparable diet which was plant-based lacto-vegetarian.

**Conclusion**

Multiple commentaries which describe Suryabheda pranayama as heat generating or increasing the body temperature are not supported by the present findings. This may mean that \textit{Suryabheda pranayama} increases energy expenditure as reported earlier to perform various vital functions optimally without increasing the body temperature.

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**Conflicts of interest**

There are no conflicts of interest.

**References**

1. Ankad RB, Herur A, Patil S, Shashikala GV, Chinagadi S. Effect of short-term pranayama and meditation on cardiovascular functions in healthy individuals. Heart Views 2011;12:58-62.
2. Saraswati SN. Gheranda Samhita. Munger: Yoga Publications Trust; 2012.
3. Williams MM. A Sanskrit English Dictionary Ethyologically and Philologically Arranged. Delhi: Parimal Publications; 2008.
4. Muktiyodhana S. Hatha Yoga Pradipika. Munger: Yoga Publications Trust; 2013.
5. Telles S, Nagaratha R, Nagendra HR. Physiological measures of right nostril breathing. J Altern Complement Med 1996;2:479-84.
6. Telles S, Nagarathna R, Nagendra HR. Breathing through a particular nostril can alter metabolism and autonomic activities. Indian J Physiol Pharmacol 1994;38:133-7.
7. Watanabe M, Houten SM, Mатаki C, Christoffoletе MA, Kim BW, Sato H, \textit{et al.} Bile acids induce energy expenditure by promoting intracellular thyroid hormone activation. Nature 2006;439:484-9.
8. Pranayama RS. Its Philosophy and Practice. Haridwar: Divya Prakashan; 2005.
9. Faul F, Erdfelder E, Lang AG, Buchner A. G*Power 3: A flexible statistical power analysis program for the social, behavioral, and biomedical sciences. Behav Res Methods 2007;39:175-91.
10. Staugaard-Jones JN. The Concise Book of Yoga Anatomy: An Illustrated Guide to the Science of Motion. California: North Atlantic Books; 2015.
11. Saraswati SS, Asana Pranayama Mudra Bandha. Munger: Yoga Publications Trust; 2008.
12. Ahrens CD. Meteorology Today: An Introduction to Weather, Climate, and the Environment. 9th ed. California: Brooks/Cole Cengage Learning; 2007.
13. Zanobetti A, Schwartz J. The effect of particulate air pollution on emergency admissions for myocardial infarction: A multicity case-crossover analysis. Environ Health Perspect 2005;113:978-82.
14. Sheridan SC, Kalkstein LS. Progress in heat watch-warning system technology. Bull Am Meteorol Soc 2004;85:1931-42.
15. Rai L, Ram K, Kant U, Madan SK, Sharma SK. Energy expenditure and ventilatory responses during Siddhasana – A yogic seated posture. Indian J Physiol Pharmacol 1994;38:29-33.
16. Gerensse H, Murugan R. Is there significant difference between digital and glass mercury thermometer? Adv Nurs 2016;2016:10.
17. Rubia-Rubia J, Arias A, Sierra A, Aguirre-Jaime A. Measurement of body temperature in adult patients: Comparative study of accuracy, reliability and validity of different devices. Int J Nurs Stud 2011;48:872-80.
18. Westerterp KR. Diet induced thermogenesis. Nutr Metab (Lond) 2004;1:5.