Immediate effect of Sukha Pranayama: A slow and deep breathing technique on maternal and fetal cardiovascular parameters

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INTRODUCTION

Pregnancy is the phase in human life where two individuals are physiologically interlinked, and hence, the prenatal condition represents a unique opportunity to investigate the physiological interaction between mother and fetus. With respect to cardiac interaction, there is evidence that indicates an influence of the maternal condition on fetal heart rate (FHR), and this is notable as FHR is a vital predictor of fetal outcome (Chapman, 1978; Leeuwen et al., 2009; Dietz et al., 2016). Previous studies have reported that Sukha Pranayama at the rate of 6 breaths/min can reduce HR and blood pressure (BP) in hypertensive patients.

Aim: This pilot study was done to evaluate the immediate effect of Sukha Pranayama, a slow and deep breathing technique on maternal and fetal cardiovascular parameters.

Subjects and Methods: Single session pre-post comparison was done for 10 min of Sukha Pranayama in 12 pregnant women in their 3rd trimester. The study participants were guided to breathe in and out in a slow and regular manner for a count of 4 s each. Maternal cardiovascular parameters, namely mean heart rate (MHR), systolic pressure (SP), and diastolic pressure (DP), were measured before and after the session and rate-pressure product (RPP) derived with the formulae. Fetal heart rate (FHR) was derived from the nonstress test tracing.

Results: SP, MHR, FHR, and RPP reduced significantly after single session of Sukha Pranayama. The mothers reported that they felt more relaxed and also sensed active fetal movement while performing the pranayama.

Discussion: Reduction in maternal cardiovascular parameters may be attributed to reduced sympathetic activity coupled with enhanced vagal parasympathetic tone. Reduction in RPP signifies reduced myocardial oxygen consumption and load on the heart as evidenced by previous studies. These changes in cardiac autonomic status may enhance placental circulation, leading to healthier fetal development.

Conclusion: The present study reiterates the importance of yoga for the psychosomatic health of maternal-fetal unit as an add-on relaxation technique. We plan to develop this pilot study into a full-fledged evaluation of maternal and fetal wellbeing through yoga.

Key Words: Cardiovascular, fetal heart, maternal-fetal unit, pranayama
within 5 min of practice and attributed it to a normalization of autonomic cardiovascular rhythms and improved baroreflex sensitivity (Bhavanani, 2013).

The human fetus is capable of responding to a sound stimulus applied to the maternal abdomen, by increase in movement of the fetal muscles. The response becomes more marked as term approaches and the development of such a response may furnish some index of development and maturity of fetus (Sontag & Wallace, 1934). Maternal stress and anxiety during pregnancy affect the fetus developing brain morphology and child development outcomes (Sandman, Davis, Buss, & Glynn, 2012).

It is hypothesized that maternal stress affects the fetus by reducing blood flow and oxygen to the uterus and increases activation of the placental stress system, resulting in the circulation of corticotrophin-releasing hormone (Fink et al., 2011). Maternal stress plays an important role in the etiology of fetal and maternal disorder other than biomedical risks (Alder, Fink, Hoesli, Bitzer, & Holzgreve, 2007; Mulder et al., 2002).

Yoga practices may moderate stress responses at the physiological level and this can positively influence both maternal and fetal outcomes (Booth-Laforce, Taylor-Swanson, Nagarathna, Chaku, 2016). Yoga may be understood as the re-integrator of the multicomplex human systems that result in positive health by inducing a state of dynamic well-being as a state of health (Bhavanani, 2011).

With the above in mind, this pilot study was done to investigate the immediate effect of Sukha Pranayama, a slow and deep breathing technique on maternal and fetal cardiovascular parameters as such findings could pave way for the application of yoga therapy in pregnant women and enable determination of wellness and bonding between pregnant mothers and their fetus.

**SUBJECTS AND METHODS**

We undertook the present study as an interdisciplinary collaborative work between Centre for Yoga Therapy, Education and Research (CYTER) of Sri Balaji Vidyapeeth, and the Department of Obstetrics and Gynecology of Mahatma Gandhi Medical College and Research Institute (MGMC and RI) in Puducherry. Approval was obtained from the Institutional Human Ethics Committee of Sri Balaji Vidyapeeth (Project No: PG Dissertation/2018/06/03 dated 06/06/2018), and the study was registered with the Clinical Trial Registry-India (CTRI: CTRI/2018/08/015163).

This single session pre-post comparison study was conducted in 12 pregnant women who were in their 3rd trimester (from 28th week till term of gestation). Inclusion criteria were pregnant women in whom baseline FHR can be assessed and who were willing to participate and were above 18 years of age. Those having medical or surgical OG complications, elderly pregnant women and high-risk pregnancy were excluded from the study as also those who couldn’t or were not willing to perform the pranayama as well as those in whom FHR could not be assessed.

After obtaining informed consent, participants were recruited from obstetrics and gynecology in-patient ward of MGMC and RI by convenient sampling till predetermined sample size of 12 was reached.

Single session pre-post comparison was done for 10 m of Sukha Pranayama as follows: Maternal cardiovascular parameters, namely mean heart rate (MHR), systolic pressure (SP), and diastolic pressure (DP), were measured using noninvasive semi-automatic BP Monitor while FHR was derived from the nonstress test (NST) tracing done by qualified technicians. Rate-pressure product (RPP) was derived with the formula, RPP = (HR × SP)/100.

**Sukha Pranayama**

This is a simple type of yogic breathing that is done by consciously regulating the inspiration and expiration to an equal ratio with internal awareness of the complete breathing process involving all sections of the lungs (Bhavanani, 2013). The participants were taught to perform Sukha Pranayama as per the Gitananda tradition in an individual-based manner and were then guided to breathe in and out in a slow and regular manner for a count of 4 s each while sitting in a comfortable semi-recumbent posture with legs stretched forward. Fingers were kept interlocked and participants were instructed to be aware of their own breathing and also of the fetal movements. They were asked to keep their eyes closed to facilitate the development of internal awareness. The pranayama was done through both nostrils in a calm and regular manner with a conscious effort to use the low, mid, and upper parts of the lungs in a sequential manner for both inspiration and expiration. This was continued for 10 min. Then, we once again recorded all the parameters in the mother and FHR taken from a new NST tracing.

**Statistical analysis**

Pre- and post-intervention data were assessed using GraphPad InStat version 3.06 for Windows 95 (GraphPad Software, San Diego California USA, www.graphpad.com). As all data passed normality testing by Kolmogorov–Smirnov Test, statistical analysis was carried out using Student’s paired t-test and $p < 0.05$ was accepted as significant difference between pre and post comparisons [Table 1].

**Table 1: Resting maternal and fetal cardiovascular parameters before and after 10 min of Sukha Pranayama in 12 pregnant women**

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Before</th>
<th>After</th>
<th>$p$</th>
</tr>
</thead>
<tbody>
<tr>
<td>SP (mm Hg)</td>
<td>107.12±6.32</td>
<td>105.11±4.12</td>
<td>0.184</td>
</tr>
<tr>
<td>DP (mm Hg)</td>
<td>65.5±4.01</td>
<td>67.20±5.29</td>
<td>0.356</td>
</tr>
<tr>
<td>MHR (beats/min)</td>
<td>97.80±8.35</td>
<td>94.40±6.42</td>
<td>0.039</td>
</tr>
<tr>
<td>FHR (beats/min)</td>
<td>139.70±6.17</td>
<td>135.20±7.33</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>RPP (units)</td>
<td>104.71±11.38</td>
<td>99.22±7.84</td>
<td>0.046</td>
</tr>
</tbody>
</table>

Values are given as mean±SD for 12 participants. $p$ value obtained by Student’s paired t-test for intragroup comparisons. SD, Standard deviation; SP, Systolic pressure; DP, Diastolic pressure; MHR, Maternal heart rate; FHR, Fetal heart rate; RPP, Rate-pressure product
RESULTS

The results are shown in Table 1. There was significant ($p < 0.05$) fall in maternal HR and RPP with significant ($p < 0.001$) decrease in FHR after the single session of Sukha Pranayama. There was also an insignificant reduction in SP and increase in DP. The mothers also reported that they felt more relaxed and also sensed active fetal movement while performing the pranayama.

DISSCUSSION

Maternal and fetal cardiovascular parameter showed an overall reduction following a single session of 10 min of Sukha Pranayama. This may be attributed to a healthier cardiac autonomic regulation as a previous study has reported that slow deep breathing shifts the autonomic balance from sympathetic dominant to parasympathetic (Jerath, Edry, Barnes, & Jerath, 2006). An earlier study on Sukha Pranayama in patients of hypertension reported that it reduced HR and BP in such patients within 5 min of practice and attributed such changes to a normalization of autonomic cardiovascular rhythms as a result of increased vagal modulation and or decreased sympathetic activity and improved baroreflex sensitivity (Bhavanani, Sanjay, & Madanmohan, 2011).

Previous studies by Bhavanani et al. at JIPMER have reported that pranayama-based breathing, and relaxation is effective in reducing HR, BP, and stress (Bhavanani, Madanmohan, Sanjay, & Basavaraddi, 2012a, Bhavanani, Madanmohan, Sanjay, & Vithiyalakshmi, 2012b, Sharma et al. 2013). The significant changes in MHR are also reflected in RPP which is an indirect indicator of myocardial oxygen consumption and load on the heart (Prakash, Madanmohan, Sethuraman, & Narayan, 2005), therefore, giving evidence of reduced strain on maternal heart. An earlier work has showed inverse relationship between RPP and heart rate variability (HRV); hence, the reduction of RPP in our participants points to improved cardiac autonomic regulation (Prakash et al., 2005). This may be due to a reduction in HR resulting from increased vagal modulation of SA and AV nodes along with enhancement of baroreceptor sensitivity.

Dietz et al. reported that HRV is a noninvasive and surrogate marker to determine fetal overall health and the development of fetal autonomic nervous system and that it is influenced by maternal behavior (Dietz et al., 2016). Hence, our findings can also be understood in a similar manner as the fetal cardiac system has the capability to adjust its rate of activation in response to maternal stimulation, and the FHR has been shown to be influenced by maternal respiratory arrhythmia induced by paced breathing at several different rates (10, 12, 15, and 20 cycles per min) (Leeuwen et al., 2009). Jerath and Barnes revealed sympathetic activation with irregular, shallow fast breathing movements compared to slow deep breathing and suggested that the recognition of respiratory mechanisms in mind-body therapies can lead to the development of more effective relaxation exercises incorporating deep slow breathing in clinical applications (Jerath et al., 2006).

CONCLUSION

The present pilot study provides initial evidence of beneficial effects of pranayama in the pregnant women. It reiterates the importance of yoga for psychosomatic health of maternal-fetal unit as also its role as an add-on relaxation technique. We plan to develop this pilot study into a full-fledged evaluation of maternal and fetal well-being through yoga.

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Conflicts of interest

There are no conflicts of interest.

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