

## RESEARCH ARTICLE

### Physiological effects of yoga asanas and pranayama on metabolic parameters, maternal, and fetal outcome in gestational diabetes

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#### ABSTRACT

**Background:** Gestational diabetes affects the health of the women, the fetus, and even after birth, the baby or child. Studies related to the assessment of the effects of yoga and pranayama on metabolic parameters, maternal and fetal outcome among gestational diabetic patients are inadequate. **Aim and Objectives:** The aim of the present study was to assess the effects of yoga and pranayama on metabolic parameters, maternal and fetal outcome in gestational diabetes. **Materials and Methods:** A total of 162 gestational diabetic patients were recruited in the study; after removing the drop outs, 75 of them did specific yoga and pranayama (test group) for 3 months and the remaining, blood sugar-matched, 76 patients were recruited as (control group) who were not on any yoga practice. The data obtained were analyzed using appropriate statistical methods such as mean, standard deviation, and *t*-test for paired data and categorical data were analyzed using Chi-square test ( $r \times c$  table). *P* value was considered significant below 0.05. **Results:** Analysis of data showed statistically significant difference between metabolic parameters, maternal and fetal outcome of mothers with gestational diabetes mellitus (GDM) between yoga group and control group  $P < 0.01$ . **Conclusion:** Yoga and pranayama significantly decrease blood glucose level which in turn can prevent adverse maternal and fetal outcomes of GDM. Safety during pregnancy is paramount and exercises such as low exerting forces such as yoga can be safe for both mother and fetus.

**KEY WORDS:** Gestational Diabetes; Yoga Asanas; Pranayama; Maternal and Fetal Outcome

#### INTRODUCTION

Gestational diabetes mellitus (GDM) can be defined as the abnormal carbohydrate tolerance with the onset or first detection during the present pregnancy at 24-28 weeks of gestation. The prevalence of GDM in India varies from 3.8% to 21% in different parts of the country, depending on the geographical locations and diagnostic methods used.<sup>[1,2]</sup> GDM

has been found to be more prevalent in urban areas than in rural areas. Nearly 50% of women with GDM will develop type 2 diabetes mellitus over a period of 5-20 years. Chances of having diabetes in children are about 6% when the father is diabetic, it raises to 20% if both the parents are diabetic.<sup>[2,3]</sup> GDM affects the health of the women, the fetus, and even after birth, the baby or child. Hyperglycemic placental environments increase the risk of traumatic pregnancies influenced by macrosomia (larger than usual birth weight). This in turn increases the risk of the baby having shoulder damage during birth. Macrosomia can be further exacerbated by excess levels of insulin circulating in the placenta. This is due to the increased growth effects of insulin on the fetus.<sup>[4-7]</sup>

All the above facts strongly indicate for timely action for screening all pregnant women for glucose intolerance,

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achieving euglycemia in them, and ensuring adequate nutrition may prevent in all probability, the vicious cycle of transmitting glucose intolerance from one generation to another. The management of GDM should aim to reduce the effects of hyperglycemia by controlling blood glucose levels. Along with pharmacology and dietary interventions, exercise has a powerful potential to assist with blood glucose control. Due to the uncertainty of risks and benefits of exercise during pregnancy, women tend to avoid exercise.<sup>[8]</sup> The ancient Indian science of yoga is a way of life which includes changes in mental attitude, diet, and practice of specific techniques such as yoga postures (asanas), breathing practices (pranayamas), and meditation.<sup>[9]</sup> To treat GDM naturally, the antenatal mother should practice yoga, pranayama, relaxation, and meditation. It is the best recommendation to women with GDM.<sup>[10]</sup> There are significant benefits of yoga and pranayama practices on metabolic parameters and anthropometric measurements in uncomplicated type 2 diabetic patients. Yogic exercises cause the muscles to absorb the excess glucose in the blood, thereby reducing the blood sugar level. They help the pancreas and liver to function effectively, which regulates the blood sugar levels. Asanas help in rejuvenating the pancreatic cells, thereby assisting insulin secretion. The muscular movements also help in bringing down the blood sugar levels.<sup>[11]</sup>

Few studies have looked at the effects of yoga on maternal and fetal/neonatal outcome variables. However, studies related to assessment of the effects of yoga and pranayama on metabolic parameters, maternal and fetal outcome among gestational diabetic patients are still inadequate. Hence, the present study was carried out to assess the effects of yoga and pranayama on metabolic parameters, maternal and fetal outcomes in gestational diabetes.

## MATERIALS AND METHODS

The present prospective study was conducted from January to December 2016 in Department of Physiology, Dr. B. R. Ambedkar Medical College, Kadugondanahalli, Bangalore and Sakaria Hospital and Yoga Centre, Bangalore, India. Ethical Clearance was obtained from the Institutional Ethics Committee, Dr. B. R. Ambedkar Medical College, Kadugondana Halli, Bangalore, India and consent was obtained from the participants and was informed of their right to withdraw anytime during the course of the study.

### Study Protocol

Patients were involved based on the inclusion and exclusion criteria, non-probability purposive sampling technique. A total of 162 gestational diabetic patients were selected in the age group of 25-35 years based on the WHO criteria

of diagnosis of gestational diabetes. Patients were matched with regard to blood sugar levels at Sakaria Hospital, Bangalore, India. Data on obstetrical information were recorded. All the patients were instructed to continue routine treatment which included counseling on diet and regular monitoring of blood glucose level, insulin therapy based on the blood glucose level, and regular dose of iron, folic acid, and calcium tablets from 24<sup>th</sup> week to till delivery. They were instructed to follow-up the visits regularly in the antenatal outpatient department. They were divided into test group (who underwent yoga practice) and control group (who did not undergo any yoga practice). The test group consisting of 82 patients was on insulin therapy. The test group was taught yoga and pranayama for 3 continuous months (from 24 weeks of gestation onwards), 1 h every day by yoga expert in the morning between 7.00-8.00 am and 8.00-9.00 am in two batches as per the time/batch chosen by the patients. The control group involved 80 patients and was also on insulin treatment and did not undergo any yoga practice.

Protocol of yogic practices and pranayama used in the present study:

1. Loosening exercises for 10 min, which included loosening neck, loosening fingers, loosening wrist, shoulder rotation, twisting, hand stretch breathing, hands in and out breathing, ankle stretching.
2. Asanas for 20 min, which included a) standing - *tadasana* and *ardhakatichakrasana*, b) sitting - *vajrasana*, *titili asana* (*purna* and *ardha*), *siddha yoni asana*, c) supine - *savasana* (left lateral position).
3. Deep relaxation technique for 5-7 min.
4. Pranayama for 15 min which included *nadi shuddi*, *sitali*, *sitakari*, *sadanta*, *bhramari pranayamas*.

### Drop Outs

During the study, out of 82 patients from yoga group, 7 of them dropped out and out of 80 patients from control group, 4 of them withdrew from the study due to personal reasons.

Blood samples for fasting blood sugar (FBS), postprandial blood sugar (PPBS), glycosylated hemoglobin (HbA1c), and insulin requirement per day were estimated before the starting and at the end of 3-month period. HbA1c was estimated by Bio-Rad D-10<sup>TM</sup>.

Inclusion criteria included those with a history of GDM between 24 and 28 weeks of gestation. Exclusion criteria involved those with polyhydramnios, multiple pregnancy, pregnancy induced hypertension (PIH), complicated pregnancy, cardiac problems, obesity. Sample size was determined by considering the results of previously published studies and taking standard normal variate of 0.84 for power of 80% and standard normal variate of 1.96 at 5% type 1 error.

## Statistics

The data obtained were analyzed using MedCalc Statistical Software version 12.7.8 (MedCalc Software bvba, Ostend, Belgium; <http://www.medcalc.org>; 2014) and appropriate statistical methods such as mean, SD and *t*-test for paired data and categorical data were analyzed using Chi-square test ( $r \times c$  table). *P* value was considered statistically significant below 0.05.

## RESULTS

Tables 1-3 depicted very clearly that there is a significant decrease in blood glucose level in yoga group compared to control group and also the maternal and fetal outcome parameters have significantly improved among yoga group compared to control group.

## DISCUSSION

In the present prospective study, 75 patients in yoga group and 76 in control group showed statistically significant difference between metabolic parameters and maternal and fetal outcome of mothers with GDM between yoga group and control group at  $P < 0.01$ . Among yoga group, the FBS improved from 132.44 to 100.06 with  $P < 0.001$  compared to control group which showed the improvement from 133.45 to 111.23 with  $P < 0.01$ . Similarly, the PPBS among yoga group showed improvement from 150.33 to 121.56 with  $P < 0.001$ . Concordantly in a study conducted in Tamil Nadu, India, among yoga group, 24<sup>th</sup> week fasting blood glucose mean score was 122.99 mg/dl; after intensive practice of yoga, the mean score at 28<sup>th</sup> week was 106.31 mg/dl, 32<sup>nd</sup> week was 102.37 mg/dl, and 36<sup>th</sup> week was 90.27 mg/dl and the post prandial blood glucose mean score at 24<sup>th</sup> week was 160.45 mg/dl and after yoga, the mean score at 28<sup>th</sup> week was 140.14 mg/dl, 32<sup>nd</sup> week was 127.01 mg/dl, and 36<sup>th</sup> week was 117.13 mg/dl and concluded that there was a significant reduction in the fasting and postprandial blood glucose level in yoga group than control group at  $P < 0.001$  level of significance.<sup>[12]</sup> A randomized controlled study conducted by Sununta found that the intervention group showed significantly reduced fasting plasma glucose, 2-h postprandial blood glucose, and HbA1c in the intervention group with ( $P < 0.05$ ).<sup>[13]</sup> In another study which evaluated ten randomized controlled trials indicated that yoga intervention presented with lower incidences of prenatal disorders ( $P < 0.05$ ), and small gestational age ( $P < 0.05$ ), lower levels of pain and stress ( $P < 0.05$ ), and higher score of relationship ( $P < 0.05$ ) and suggested that yoga is a safe and more effective intervention during pregnancy.<sup>[14]</sup> Narendran et al. illustrated the effects of yoga in pregnant women, who were matched to controls. Pregnant women practiced yoga daily for 1 h, for 20-22 weeks, while the control

**Table 1:** Metabolic parameters in patients of test group and control group

Parameters	Test group (n=75)		Control group (n=76)	
	At 24 weeks	After 36 weeks	At 24 weeks	After 36 weeks
FBS (mg/dl)	132.44	100.06**	133.45	111.23*
PPBS (mg/dl)	150.33	121.56**	152.11	128.99*
HbA1C	6.1±0.2	6.32±0.3	6.0±0.2	6.61±0.2
Requirement of insulin/day	26.22±7.5	18.34±4.3**	28.44±4.8	20.14±6.4*

\* $P < 0.01$ , \*\* $P < 0.001$ . FBS: Fasting blood sugar, PPBS: Postprandial blood sugar

**Table 2:** Comparison of maternal outcome of patients with GDM between test and control group

Parameters	Maternal outcome	Test group n=75 (%)	Control group n=76 (%)
Weeks of gestation (at delivery)	<37	13 (17.33)	42 (55.26)
	37-39	35 (46.66)	14 (18.42)
	39-42	25 (33.33)	19 (25)
	above 42	2 (2.66)	1 (1.31)
Mode of delivery	Normal	23 (30.66)	2 (2.63)
	Normal with episiotomy	28 (37.33)	3 (3.9)
	Forceps	12 (16)	15 (19.73)
Complications during labor	LSCS	12 (16)	56 (73.6)
	Perianal injuries	4 (5.33)	23 (30.26)
	Primary postpartum hemorrhage	2 (2.66)	4 (5.26)
	Prolonged labor	9 (12)	26 (34.21)
	No complications	60 (60)	23 (30.26)

Chi-square: (1) 25.38, df=3,  $P < 0.00$ . (2) 66.6, df=3,  $P < 0.00$ . (3) 38.79, df=3,  $P < 0.00$ . GDM: Gestational diabetes mellitus, LSCS: Lower segment caesarean section

group walked twice daily for 30 min. The study showed that in the group that practiced yoga, the incidence of preterm labor was statistically lower ( $P < 0.0006$ ) and birth weight was higher ( $P < 0.01$ ).<sup>[15]</sup> Rakhshani et al. showed that pregnant women who completed an 1 h yoga classes, 3 times a week, from 12 to 28 weeks of gestation, showed reduced rates of PIH, preeclampsia, gestational diabetes, and intrauterine growth restriction ( $P = 0.018$ , 0.042, 0.049, 0.05 respectively).<sup>[16]</sup> Field examined the benefits of yoga and pregnant women who were clinically depressed reporting that the yoga intervention group had longer gestational age and increased birth weight as compared to the control group receiving no yoga therapy.<sup>[17]</sup>

**Table 3:** Comparison of fetal outcome and birth weight of baby of patients with GDM between test and control group

Parameters	Fetal outcome	Test group (n=75)	Control group (n=76)
Fetal outcome	Congenital malformation	2 (2.66)	4 (5.26)
	Fetal macrosomia	22 (29.33)	40 (52.6)
	Intra uterine growth restriction	2 (2.66)	13 (17.10)
	Intrauterine fetal death	1 (1.33)	2 (2.63)
	No complications	48 (64)	17 (22.36)
Birth weight of baby (kg)	<2.5	5 (6.6)	16 (21.05)
	2.5-3.5	48 (64)	25 (32.89)
	>3.5	22 (29.33)	35 (46.05)

Chi-square: (1) 29.07, df=4,  $P<0.00$ . (2) 15.96, df=2,  $P<0.01$ .  
GDM: Gestational diabetes mellitus

Another study by Martins and Pinto e Silva showed that women with pregnancy-related lumbar and pelvic pain had reduced pain after a 10 weeks yoga intervention ( $P < 0.0058$ ). The pain level was measured by a visual analog scale and by pain provocation tests.<sup>[18]</sup>

In the present study, among yoga group, the insulin requirement per day reduced from  $26.22 \pm 7.5$  to  $18.34 \pm 4.3$  with  $P < 0.001$  compared to that among control group, the reduction was from  $28.44 \pm 4.8$  to  $20.14 \pm 6.4$  with  $P < 0.01$ . We could not find studies to compare which addressed this aspect of insulin requirement per day.

### Limitations of the Present Study

(i) Larger sample study involving patients of different geographical areas, ethnic background, religion, and customs will be more informative, (ii) fetal outcomes such as APGAR scoring, fetal anthropometry measurements were not considered, (iii) trend of maternal anthropometry during the study could not be analyzed, and (iv) studies including gestational diabetic patients on metformin and patients on insulin, both undergoing yoga and pranayama will be more informative for planning proper management of gestational diabetes.

### CONCLUSION

Yoga and pranayama significantly decreases blood glucose level which in turn can prevent adverse maternal and fetal outcomes of GDM. Safety during pregnancy is paramount

and exercises such as low exerting forces such as yoga can be safe for both mother and fetus.<sup>[19]</sup>

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