

**FROM INSULIN SENSITIVITY TO INNER STILLNESS : UNDERSTANDING THE
MULTIFACETED BENEFITS OF YOGA IN GESTATIONAL DIABETES
MELLITUS**

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Abstract:

Gestational diabetes mellitus (GDM), a common pregnancy complication that poses risks to both mother and baby, may be improved through yoga as an integrative therapy, with evidence supporting better maternal glycemic control and psychological well-being. Accordingly, this study assessed and compared glycemic control, maternal outcomes in women with GDM who were given yogic practices combined with lifestyle changes and dietary management. A total of 100 pregnant women, comprising both working and non-working women, were included and categorized into two age groups, 20–30 years and 30 years and above. The distribution of participants according to working status and age was considered for analysis to examine whether these factors influenced the outcomes of yogic intervention imparted focussing gestational diabetes mellitus. Over the 6-week study, all participants followed the integrated yoga programme 5 days a week. Yoga alongwith dietary changes and lifestyle management did reduce fasting plasma glucose with a significance at (0.05), in the working and non-working pregnant women in the age group of 20-30 years but no statistically significant effect was observed in the level of fasting plasma glucose in age group of above 30 years due to insulin sensitivity and already elevated glucose level, hormonal status and lifestyle patterns. The fasting glucose appears to require the consistent combined effect of balanced meal and lifestyle changes alongside yoga and some moderate/dynamic exercises as per the need/capacity, that helps the muscle use glucose more effectively rather than practiced alone. What the intervention did significantly improve was postprandial (after-meal) glucose (0.01) in both working and non-working pregnant women under age group of 20-30 years and above 30 years, suggesting the yoga programme mainly enhanced the body's disposal of glucose after meals. The author explains this physiologically that fasting glucose is primarily regulated by the liver through hormonal mechanisms, whereas postprandial glucose is more responsive to changes in insulin action and glucose uptake so the intervention seems to have worked through improved insulin sensitivity and glucose uptake rather than on the liver-driven fasting pathway.

Keywords: *Gestational diabetes mellitus (GDM), integrated yoga programe; glycemic control; fasting plasma glucose; postprandial glucose; insulin sensitivity; maternal outcomes; pregnancy; lifestyle changes*

Introduction

The WHO wants every woman to have a safe, healthy pregnancy, but gestational diabetes (GDM) is one of the most common problems that can come up and it puts both mother and baby at risk. Research shows that yoga can also help control blood sugar and support a

mother's mental well-being. This article reviews what we know about gestational diabetes and its current treatments, and looks at how yoga fits into managing it. During pregnancy, placental hormones (human placental lactogen, progesterone, estrogen, cortisol, and prolactin) progressively reduce insulin effectiveness and increase insulin resistance (Catalano, 2010), ensuring more glucose remains available for the fetus. Increase in insulin resistance places greater demands on pancreatic β -cells, which normally compensate by increasing insulin secretion. When β -cells fail to adequately meet this increased demand, particularly in women with underlying metabolic risk factors, blood glucose levels may rise, resulting in hyperglycemia and gestational diabetes mellitus (GDM). Its diagnosis is commonly based on the 75 g Oral Glucose Tolerance Test (OGTT), following WHO or ADA criteria. Management goals include maintaining fasting plasma glucose < 95 mg/dL and postprandial < 120 mg/dL (WHO, 2013).

Literature Review:

Several randomized and controlled studies have explored yoga's influence on glycaemic regulation among pregnant women.

Rakhshani et al. (2012) conducted a randomized controlled trial in pregnant women with GDM, demonstrating significant improvements in glucose tolerance and reduced anxiety in the yoga group compared with standard care.

Youngwanichsetha S., et al. (2014) conducted a controlled trial combining mindful eating and yoga for women with GDM, observing significant reductions in mean fasting and postprandial blood glucose compared with routine care. Participants also reported enhanced self-awareness of dietary behavior, suggesting synergistic benefits of mindfulness and movement.

Abirami and Judie (2015) observed that an integrated yoga therapy program improved maternal glycaemic parameters and fetal growth indices among women diagnosed with GDM. The intervention group showed improved maternal blood glucose profiles, enhanced fetal biophysical parameters, and better maternal well-being scores than controls receiving standard antenatal care.

Sivakumar V, (2014) This study highlights the importance of early risk assessment even before pregnancy to enable timely detection and treatment. It also introduces a prediction tool designed to identify susceptible women based on biological risk factors.

Similarly, **Rakshani et al. (2015)** reported that integrated yoga therapy improved glycemic control and decreased the need for insulin therapy in high-risk pregnancies.

Sreedevi et al. (2017) found that a yoga-based lifestyle intervention paired with peer support improved glycaemic outcomes and self-management adherence, suggesting the feasibility of yoga as an adjunct therapy.

Martínez-Vizcaíno et al. (2023), concluded that mind-body practices including yoga effectively prevent or mitigate GDM and hypertensive disorders.

A network meta-analysis by **Ren et al. (2025)** ranked yoga among the most beneficial low-impact exercise modalities for reducing GDM risk and enhancing glucose homeostasis, emphasizing its safety and acceptability in late gestation.

Telles & Sharma (2019) concluded that the yogic practices enhances parasympathetic dominance and reduces sympathetic activity, thereby decreasing stress hormone levels

Put it all together and the picture is fairly consistent that yoga seems to help women with or at risk of GDM, keep their blood sugar in check, calm their stress hormones, and head toward healthier outcomes for both mother and baby. It's fair to admit the evidence isn't perfect as most studies so far are small and done differently from one another yet the same benefits keep turning up. So while we can't yet call yoga a fully evidence-based part of GDM care, the signs are promising, what's needed now are bigger, well-designed randomized trials with standardized protocols to seal the deal.

Research Methodology

Research Design : Convenience sample method for single group of working and non-working pregnant females in two age groups i.e. aged 20-30 years and aged above 30 years, pre-post design in the present research was used combining qualitative and quantitative analysis:

1. Quantitative: Assess changes in measurable Test like Glucose Challenge Test and Glucose Tolerance(as per DIPSI guidelines), Using Fasting Plasma Glucose (<92 mg/dl) and 2 hour Plasma glucose after 75g glucose(non-fasting)(< or = 140 mg/dl).
2. Maternal heart rate and weight.
3. Qualitative: Collect feedback through interviews or questionnaires about emotional and psychological well-being.

Sample

1. A total of 100 pregnant women, comprising both working and non-working women, were included and categorized into two age groups: 20–30 years and 30 years and above, who were in their second or third trimester and who previously did not have diabetes.
2. Inclusion criteria: Healthy pregnancies without complications.
3. Exclusion criteria: High-risk pregnancies or pre-existing psychological conditions.

Following protocol was adopted for 35–40 minutes per day, over a period of 4–6 weeks while keeping in view that the movement primarily occurs through the musculoskeletal structures of the spine, ribs, pelvis, and surrounding soft tissues. So, gentle lateral movement or modified spinal rotation during pregnancy mobilises the spine, ribs and surrounding muscles while respecting the changing anatomy of the pregnant body. Moreover, the uterus, amniotic sac and amniotic fluid provide a protected environment for the fetus. Hence gentle modified spinal rotation/lateral flexion practices were adopted.

Sl. No.	Asanas(Postures) and exercises	Effect
1.	Gentle movement of all body parts to improve the blood flow in every organ using Yogic Sukshm Vyayam.	Repeated muscular contraction shall increase glucose uptake and improve insulin sensitivity.

1.	Tadasana (Mountain Pose)	enhances blood circulation
2.	Marjariasana (Cat-Cow)	improves spinal flexibility and relaxation
3.	Tiryak Tadasana, Ardh Katichakrasana, Ardh Parsvkonasana, Vakrasan Anantasana (VishnuPose) & Trikonasana with modifications.	to stimulate the pancreatic gland, improve liver functions and increase the metabolic rate.
4.	Vrikshasana (Tree Pose)	to stimulate the nervous system and bring hormonal balance
5.	Baddha Konasana (Bound Angle Pose)	promotes pelvic flexibility
6.	Supta Baddha Konasana	relaxation and improved uterine blood flow
7.	Ardha Titli Asana (Half Butterfly)	gentle hip movement
2.	Pranayama (Breathing Practices)	
1.	Anulom Vilom (Alternate Nostril Breathing)	balances autonomic activity
2.	Bhramari Pranayama (Humming Bee Breath)	reduces stress and anxiety
	Chandra Bhedana (Left-nostril breathing)	induces cooling and relaxation
3.	Meditation and Relaxation	
1.	Yoga Nidra (guided relaxation), Sohum Jaap and Om chanting	enhance parasympathetic activation and reduce psychological stress.

During the practices deep closed twists, forceful rotation, breath-holding, or movements that cause pain, discomfort, dizziness, or abdominal pressure were avoided also keeping in view the degree and direction of the movement, gestational age, individual pregnancy status, and appropriate modification of the posture

Data Collection Methods : For Pregnant women: blood glucose level report (Fasting and Post Prandial) **For Fetuses:** Heart rate variability using Doppler ultrasound & Fetal growth.

Ethical Statement

All 100 participants were informed about the purpose, procedures, potential benefits, and possible risks associated with the yoga intervention and were informed of their right to withdraw from the study at any stage without any adverse consequences.

Results & Interpretation

Quantitative data were analysed using descriptive statistics and a paired t-test to compare the pre-intervention and post-intervention measurements among the 100 participants. The results were expressed as mean $\pm$ standard deviation (SD), and statistical significance was considered at $p < 0.01$ and $p < 0.05$. Qualitative data obtained from participants' experiences and responses were analysed thematically to identify major themes and patterns related to the yoga intervention.

Results and Interpretation of Pre and Post Yogic Intervention among Pregnant Working & Non-Women in relation to various Psycho Physiological Aspects

Table 1 : Mean, SD and t Value of Pre and Post Yogic Intervention on Fasting Plasma Glucose among Pregnant Working Women

Group	N	Mean	SD	t	Level of Significance
Pre	54	85.95	5.58	2.12	0.05
Post	54	83.89	4.46		

Table no.1 shows the t value of Pre and Post Yogic Intervention on Fasting Plasma Glucose among Pregnant Working Women is 2.12 which is significant at 0.05, it suggests that yogic Intervention produces a significant change in Fasting Plasma Glucose levels among Pregnant Working Women.

Table 2: Mean, SD and t Value of Pre and Post Yogic Intervention on Plasma Post Prandial Glucose among Pregnant Working Women

Group	N	Mean	SD	t	Level of Significance
Pre	54	120.72	13.25	3.54	0.01
Post	54	112.50	10.78		

Table no.2 shows the t value of Pre and Post Yogic Intervention on among Plasma Post Prandial Glucose working Pregnant Women 3.54 which is significant at 0.01, it suggests that Yogic Intervention could help in reducing Plasma Post Prandial Glucose among working Pregnant Women.

Table 3: Mean, SD and t Value of Pre and Post Yogic Intervention on Fasting Plasma Glucose among Pregnant Non-Working Women

Group	N	Mean	SD	t	Level of Significance
Pre	46	86.02	5.28	2.10	0.05
Post	46	83.92	4.20		

Table no 3 shows the t value of Pre and Post Yogic Intervention on Fasting Plasma Glucose among Non-Working Pregnant Women 2.10 which is significant at 0.05, it suggests that Yogic Intervention could help in reducing Fasting Plasma Glucose among Non-Working Pregnant Women.

Table 4 : Mean, SD and t Value of Pre and Post Yogic Intervention on Plasma Post Prandial Glucose among Pregnant Non-Working Women

Group	N	Mean	SD	t	Level of Significance
Pre	46	119.38	13.90	2.93	0.01
Post	46	110.96	13.63		

Table no. 4 shows the t value of Pre and Post Yogic Intervention on Plasma Post Prandial Glucose among Non-Working Pregnant Women 2.93 which is significant at 0.01, it suggests that Yogic Intervention could help in reducing Plasma Post Prandial Glucose among Non-Working Pregnant Women.

Results and Interpretation of Pre and Post Yogic Intervention among Pregnant Women aged 20-30 years and above 30 years, in relation to various Psycho Physiological Aspects

Table 5: Mean, SD and t Value of Pre and Post Intervention on Fasting Plasma Glucose among Pregnant Women Aged 20–30 Years

Group	N	Mean	SD	t	Level of Significance
Pre	51	85.48	5.0	2.65	0.05
Post	51	83.17	3.82		

Table no.5 shows the t value of Pre and Post Yogic Intervention on Fasting Plasma Glucose among Women Aged 20-30 Years is 2.65 which is significant at 0.05, it suggests that Yogic Intervention could help in reducing Fasting Plasma Glucose among Women Aged 20-30 Years.

Table 6: Mean, SD and t Value of Pre and Post Intervention on Plasma Post Prandial Glucose among Pregnant Women Aged 20–30 Years

Group	N	Mean	SD	t	Level of Significance
Pre	51	118.31	12.50	3.53	0.01
Post	51	110.36	10.014		

Table no. 6 shows the t value of Pre and Post Yogic Intervention on Plasma Post Prandial Glucose among Women Aged 20-30 Years is 3.53 which is significant at 0.01, it suggests that Yogic Intervention could help in reducing Plasma Post Prandial Glucose among Women Aged 20-30 Years.

Table 7 : Mean, SD and t Value of Pre and Post Intervention on Fasting Plasma Glucose among Pregnant Women Aged 30 Years and Above.

Group	N	Mean	SD	t	Level of Significance
Pre	51	86.37	5.90	1.46	NS
Post	51	84.76	4.84		

Table no. 7 shows the t value of Pre and Post Yogic Intervention on Fasting Plasma Glucose among Women Aged 30 Years and Above is 1.46 which is Not Significant at 0.01, it suggests that Yogic Intervention does not reduce Fasting Plasma Glucose among Women Aged 30 Years and Above.

Table 8 : Mean, SD and t Value of Pre and Post Intervention on Plasma Post Prandial Glucose Pregnant Women Aged 30 Years and Above.

Group	N	Mean	SD	t	Level of Significance
Pre	51	121.48	14.81	3.15	0.01
Post	51	111.49	16.37		

Table no 8 shows the t value of Pre and Post Yogic Intervention on Plasma Post Prandial Glucose among Women Aged 30 Years and Above is 3.15 which is significant at 0.01, it suggests that Yogic Intervention could help in reducing Plasma Post Prandial Glucose among Women Aged 30 Years and Above.

Discussion

The significant reduction in fasting blood glucose among women aged 20–30 years suggests that yogic intervention may be more effective in improving glycemic regulation in younger women. The absence of statistical significance in fasting blood glucose among women above 30 years may reflect age-related metabolic changes, insulin resistance, elevated level of blood glucose, lifestyle adherence, or inadequate intervention duration. These findings should therefore be interpreted cautiously, and further studies with larger age-stratified samples and longer follow-up are recommended. Although both working and non-working women aged 20–30 years showed significant improvement in the post prandial glucose, the mechanisms may differ. Working women may benefit from reductions in occupational stress, improved autonomic balance, and better stress management through yoga. Non-working women may benefit from increased physical activity, improved routine, relaxation, and enhanced metabolic regulation. Thus, yoga may influence fasting glucose through multiple pathways, including improved insulin sensitivity, reduced stress-related cortisol secretion, autonomic regulation, and increased physical activity.

Conclusion

The fact that fasting plasma glucose levels are affected by a number of physiological and metabolic factors, such as hormonal changes associated with pregnancy, food intake, physical activity, insulin sensitivity, and individual metabolic traits, may help to explain the significant finding. Yoga may promote general physical and mental health, but its impact on fasting plasma glucose might be powerful enough to result in a statistically significant change during the intervention period. Thus, a limited change in fasting plasma glucose levels may be indicated by the minor difference between the pre-intervention and post-intervention mean scores. Therefore, the current research indicates that yoga intervention alongwith some dietary and lifestyle changes by itself significantly alter fasting plasma glucose levels in working and non-working pregnant women aged 20-30 years of age. Accordingly, as a result, the considerable drop in plasma post-prandial glucose levels from pre-intervention to post-intervention may be linked to yoga intervention's favorable effects alongwith some dietary and lifestyle changes on metabolic control and stress management in working and non-working pregnant women aged 20-30 years and also above 30 years. As such, yoga should be seen as complementary therapy, not alternative. People should be educated about antenatal education and encouraged to go for early screening. For fasting glucose to genuinely improve, it needs to be bundled with dietary modification and broader lifestyle changes, consistent with the traditional Vihara emphasis on diet, activity, and daily routine working together. women planning pregnancy, particularly those above 30 years of age who have elevated blood glucose levels or increased insulin resistance should be encouraged to seek preconception counselling and optimize their metabolic health before conception.

References:

1. Abirami, P., & Judie, A. (2015). Integrated approach of yoga therapy on maternal and fetal outcome in gestational diabetes mellitus. *International Journal of Pharmaceutical and Clinical Research*, 7(6), 377–382.
2. Abirami, P. (2014). *Assess the effectiveness of yoga on clinical parameters of gestational diabetes mellitus among mothers with gestational diabetes mellitus at government hospital, Tambaram, Chennai* [Doctoral thesis, SRM University]. <http://hdl.handle.net/10603/62462>

3. Catalano, P. M. (2010). Obesity, insulin resistance, and pregnancy outcome. *Obstetrics & Gynecology*, 115(2), 423–429.
4. Martínez-Vizcaíno, V., Sanabria-Martínez, G., Fernández-Rodríguez, R., Cavero-Redondo, I., Pascual-Morena, C., & Álvarez-Bueno, C. (2023). Exercise during pregnancy for preventing gestational diabetes mellitus and hypertensive disorders: An umbrella review and updated meta-analysis. *BJOG: An International Journal of Obstetrics & Gynaecology*, 130(3), 264–275. <https://doi.org/10.1111/1471-0528.17304>
5. Metzger, B. E., Lowe, L. P., Dyer, A. R., Trimble, E. R., Chaovarindr, U., Hadden, D. R., Coustan, McCance, D., Hod M., McIntyre H., Oats J., Persson B., Rogers M., Sacks D. D. R. (2008). Hyperglycemia and adverse pregnancy outcomes. *New England Journal of Medicine*, 358(19), 1991–2002.
6. Rakhshani, A., Nagarathna, R., Mhaskar, R., Mhaskar, A., Thomas, A., & Gunasheela, S. (2012). The effects of yoga in prevention of pregnancy complications in high-risk pregnancies: A randomized controlled trial. *Preventive Medicine*, 55(4), 333–340. <https://doi.org/10.1016/j.ypmed.2012.07.020>
7. Rakhshani, A., Nagarathna, R., Sharma, A., Singh, A., & Nagendra, H. R. (2015). A holistic antenatal model based on yoga, Ayurveda, and Vedic guidelines. *Health Care for Women International*, 36(3), 256–275. <https://doi.org/10.1080/07399332.2014.942900>
8. Ren, Y., Zhang, L., Cheng, J., Gao, Y., & He, Y. (2025). Preventive effects of different types of exercises during pregnancy on gestational diabetes: A systematic review and network meta-analysis. *BMC Public Health*, 25, 3638. <https://doi.org/10.1186/s12889-025-24807-5>
9. Seshiah, V., Balaji, V., Balaji, M. S., Sanjeevi, C. B., & Green, A. (2004). Gestational diabetes mellitus in India. *Journal of the Association of Physicians of India*, 52, 707–711.
10. Sivakumar, V. (2014). *A clinical study on gestational diabetes mellitus and pregnancy induced hypertension* [Doctoral thesis, The Tamil Nadu Dr. M.G.R. Medical University]. INFLIBNET Centre. <http://hdl.handle.net/10603/419850>
11. Sreedevi, A., Gopalakrishnan, U. A., Karimassery Ramaiyer, S., et al. (2017). A randomized controlled trial of the effect of yoga and peer support on glycaemic outcomes in women with type 2 diabetes mellitus: A feasibility study. *BMC Complementary and Alternative Medicine*, 17, 100. <https://doi.org/10.1186/s12906-017-1574-x>
12. Telles, S., & Sharma, S. K. (2019). Mechanisms underlying yoga's influence on stress and glucose regulation: Physiological effects of pranayama in pregnancy. *Indian Journal of Physiology and Pharmacology*, 63(4), 317–324.
13. Youngwanichsetha, S., Phumdoung, S., & Ingkathawornwong, T. (2014). The effects of mindfulness eating and yoga exercise on blood sugar levels of pregnant women with gestational diabetes mellitus. *Applied Nursing Research*, 27(4), 227–230. <https://doi.org/10.1016/j.apnr.2014.02.002>

Bibliography :

1. American Diabetes Association. (2018). Classification and diagnosis of diabetes: Standards of Medical Care in Diabetes—2018. *Diabetes Care*, 41(Suppl 1), S13–S27. <https://doi.org/10.2337/dc18-S002>
2. American Diabetes Association. (2024). Standards of medical care in diabetes—2024. *Diabetes Care*, 47(Suppl 1), S1–S150.
3. HAPO Study Cooperative Research Group, Metzger, B. E., Lowe, L. P., Dyer, A. R., Clapp, J. F., Trimble, E. R., Coustan, D. R., Hadden, D. R., Hod, M., McIntyre, H. D., Oats, J. J. N., Persson, B., Rogers, M. S., & Sacks, D. A. (2008). Hyperglycemia and adverse pregnancy outcomes. *New England Journal of Medicine*, 358(19), 1991–2002. <https://doi.org/10.1056/NEJMoa0707943>
4. International Diabetes Federation. (2017). *IDF diabetes atlas* (8th ed.). IDF.

5. World Health Organization. (2013). *Diagnostic criteria and classification of hyperglycaemia first detected in pregnancy*. WHO Press.
6. Charaka. (2000). Charaka Samhita(Sharira Sthana 8/21): Agnivesha's treatise refined and annotated by Charaka and redacted by Dridhabala (P. V. Sharma, Ed. & Trans.). Varanasi, India: Chaukhamba Orientalia.
7. Sushruta. (1981). The Sushruta Samhita(Sharira Sthana 10/3), An English translation based on the original Sanskrit text (K. K. Bhishagratna, Trans.). Varanasi, India: Chowkhamba Sanskrit Series Office.