

## Evaluation of Efficacy of Yoga Practices on a Biochemical Parameter in Patients of Type 2 Diabetes Mellitus in Indian Population: A Systematic Review and Meta-Analysis

Tejas P. Ghuntla<sup>1\*</sup>, Jyoti R. Dholakiya<sup>2</sup>

<sup>1</sup>Associate Professor, Department of Physiology, GMERS Medical College, Junagadh - 362001, Gujarat, India

<sup>2</sup>Ayurved Consultant, Junagadh - 362001, Gujarat, India

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Corresponding author: Dr. Tejas P. Ghuntla

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### Abstract:

**Introduction:** Yoga practices have many physical health benefits. There is increase in number of cases of diabetes in India. One of the important biochemical parameters of type 2 diabetes mellitus is fasting blood sugar. Potential of yoga activities has been observed to provide beneficial effect on fasting blood sugar in type 2 diabetes mellitus patients.

**Aims and Objectives:** Based on the existing literature, our meta-analysis sought to determine effectiveness of yoga practices on fasting blood sugar in patients of type 2 diabetes mellitus in Indian population.

**Materials and Methods:** Researchers used the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines for reporting systematic reviews and meta-analysis. Researchers searched articles on PubMed, Google scholar and by manual search. Searched articles were screened for relevancy. By use of inclusion and exclusion criteria potential articles were selected.

**Results:** Out of 310 articles, finally 5 studies were included in current meta-analysis. The standardized mean differences (SMD) for the fasting blood sugar (FBS) in patients of type 2 diabetes mellitus were calculated. Yoga practices have effect on fasting blood sugar (FBS): SMD = 0.91, 95% CI = 0.12-1.71, P < 0.01

**Conclusion:** Yogic practices can provide beneficial effect on fasting blood sugar in patients of type 2 diabetes mellitus. This can decrease requirement of medicines of diabetes mellitus and thus can provide relief from adverse effects of drugs It is also suitable for low-income population. There is wide scope for further studies to analyse beneficial effects of yoga activities.

**Keywords:** Effect, Yoga Activities, Type 2 Diabetes Mellitus, Fasting Blood Sugar, India.

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### Introduction

In India, cases of diabetes are increasing [1]. With modernization, increasing in machinery facilities and increase in financial potential of people physical activity is decreasing [1]. Increased survival also contributes to a greater number of cases of diabetes [1]. Type 2 diabetes mellitus increases risk of stroke and heart diseases [1,2].

Yoga is an ancient science [1]. Yoga is a practice which includes different activities for wellness of body [1]. In yogic activities glucose is utilized due to muscle movements [1].

Yoga asanas makes body fit and improves blood supply to organs and makes body systems healthy [1]. With the help of yogic activities blood sugar is well regulated [1]. Yoga practices include Asanas, Pranayama and Meditation [3,4]. Yogic activities are not expensive so it is a good option for average income people [5,6]. Overall fewer studies have

focused on Indian population for effect of yoga on fasting blood sugar level of diabetes patients. And, fewer meta-analysis available. So, in Indian population how is the effect of yoga activities on blood sugar of diabetic patients, what is its role and importance for blood sugar in diabetes patients remains unclear.

To analyse it, this is meta-analysis to evaluate effect of yoga practices on fasting blood sugar in type 2 diabetes patients in Indian population.

### Materials and Methods

In the meta-analysis, researchers used the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines for reporting systematic reviews and meta-analysis (Figure 1) [7].

### Search Strategy

Relevant studies were identified by a literature search with language restriction of 'English' language in electronic database of Google Scholar and PubMed Central. Advance search with application of filter in PubMed Central and in Google scholar also done to refine search and to find relevant studies. Simple words and medical words used in search strategy are: effect, yoga, pranayama, yoga exercise, yoga intervention, type 2 diabetes mellitus, fasting blood sugar, patients, India. Literature search was also done directly online in google search. Reference list of filtered studies was also searched to get relevant articles.

### Studies Selection Criteria

Studies filtered in primary search assessed for following inclusion and exclusion criteria:

#### Inclusion criteria:

- Studies conducted on Indian population
- Studies includes pre-diagnosed patients of type 2 diabetes mellitus
- Studies includes pre and post yoga effect on blood sugar level

#### Exclusion criteria:

- Not satisfying inclusion criteria
- Articles not relevant to diabetes mellitus
- Free full text article not available of studies
- Type of articles as letters and review articles

### Study Quality

Reviewers assessed studies independently for inclusion and exclusion criteria mentioned in study selection criteria. Reviewers analysed selected studies with following headings: Name of first

author with initials, year of publication, brief detail of study population, age, gender, type of yoga activity, brief detail of yoga activity and detail of blood sugar measurement. During detail reading of studies issues and queries for inclusion and exclusion of studies were given due importance and it was sort out and finally decided by discussion and explanations.

### Data Extraction

We extracted blood sugar level with standard deviation before and after sessions of yoga practices in individual articles. Data were verified by reviewers and any discrepancies were addressed by discussion and resolved by consensus.

### Data analysis

Free online meta-analysis calculator [8,29] was used for statistical analysis of all data and to construct forest plot, and to evaluate heterogeneity across studies.

The standardized mean differences (SMD) for the fasting blood sugar (FBS) in patients of type 2 diabetes mellitus, before and after yoga sessions of yoga practices were calculated. The principal summary measure was done with a 95% confidence interval with SMDs.

The Tau<sup>2</sup>, Chi<sup>2</sup> and I<sup>2</sup> test was used to measure the Statistical heterogeneity across studies [8,9-13,29]. As there was variability in included studies for types of yoga activities and among study population, a considerable degree of heterogeneity was expected. So random effects model was used for comparison [9,14].

### Results

Literature search is detailed in (Figure 1) [7].

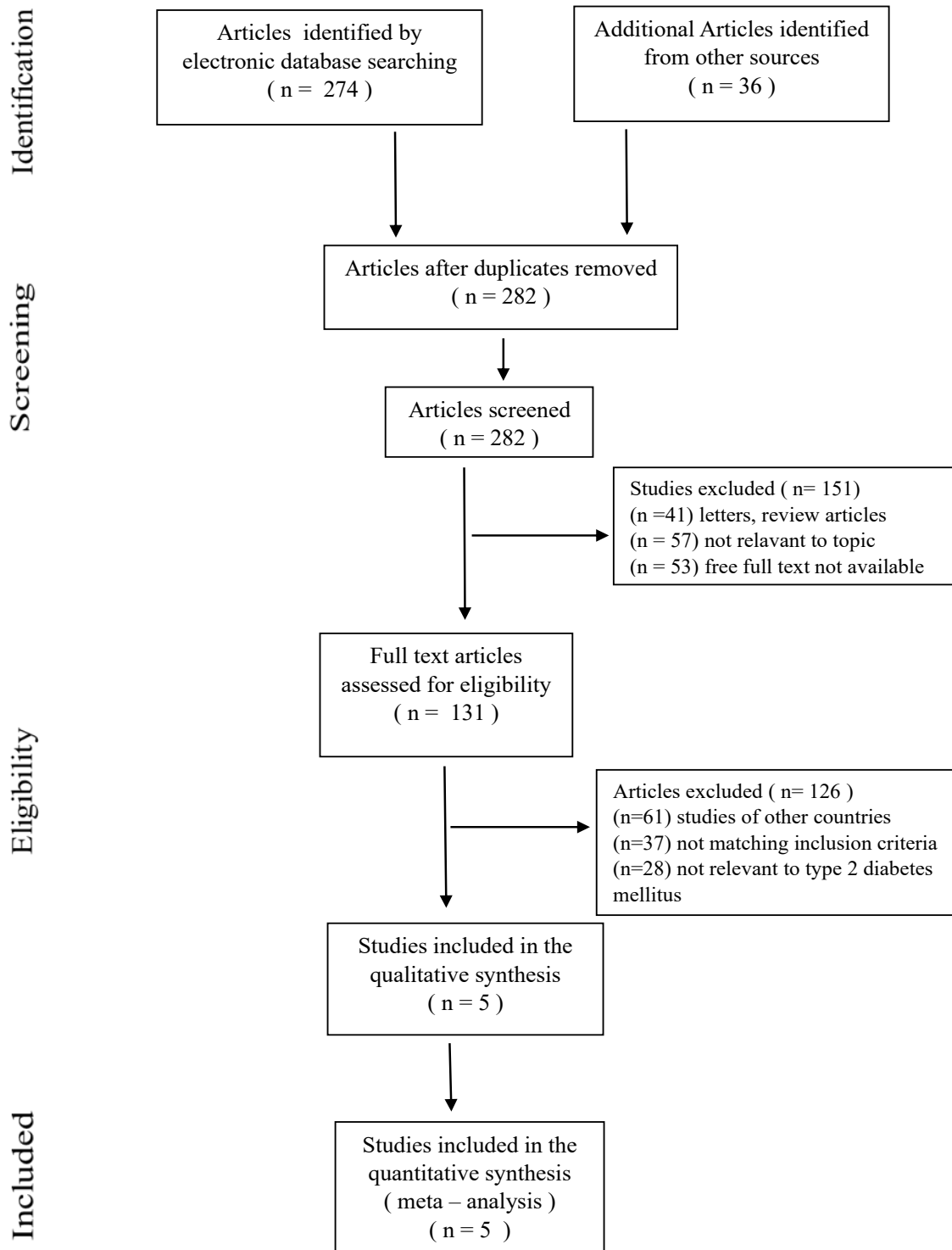


Figure – 1. Flow chart article search and study selection

**Figure 1: Flow chart article search study selection**

Brief description of each included study is detailed in Table 1.

**Table 1: Summary of Characteristics of included studies**

First Author	Year	Sample size	Brief detail of study population	Age group (Year)	Gender (Male/Female)	Type of yoga activity	Brief details of yoga activity	Measurement of fasting blood sugar (FBS)	Reference
Ranga SA	2021	50	Patients has type 2 diabetes mellitus and with oral hypoglycemic medications	30-50	-	Yoga practices	Participants practice yoga for 3 months	FBS was measured in participants before and after yoga session of 3 months.	1
Kudigras	2018	60	Participants has Type-2 diabetic and on medication	20-70	Both	Integrated Yoga module as described in study which includes asanas, pranayama and meditation	Integrated Yoga module as described in study	fasting blood sugar measured before and after yoga module intervention .	22
Chimko de SM	2015	30	The patients Type 2 diabetes mellitus of at least 1 year duration and on diabetic diet and oral hypoglycemic agents	36-55	Male	Prayer, Omkar recitation , pranayama, various asanas	All the participants were trained by yoga experts and they perform regular practice under supervision for six months. The yoga was practiced daily in overnight fasting state at 6 AM according to standard principles and techniques regarding breathing, clothing, position, posture	Fasting blood sugar measured before and after 6 months of yoga training	5

							and movement s.		
Balaji PA	2011	16	type 2 diabetic patients with diabetes duration 1-10 years and on oral drugs	40-55	-	Pranayama and yoga-asanas	Participants perform yoga and pranayama for 3 continuous months, 1 hour every day in the morning between 7.00 am and 8.00 am by yoga expert.	Fasting blood sugar measured before and after 3 months of yoga activity.	15
Singh S	2008	30	Patients with type 2 diabetes mellitus with duration of 1-10 years and on conventional medicines	35-60	-	Pranayama and yoga-asana	patients were taught pranayama and yoga-asana by a yoga expert. the subjects were initially called continuously for 5 days and then once Every week for follow up. total time for performing yoga was 45 minutes every day for 45 days	Fasting blood sugar measured before and after 45 days of yoga activity	16

Figure 2 shows fasting blood sugar measurement for individual studies. Analysis was performed with random effect model.

Fasting blood sugar (FBS):  $Tau^2 = 0.3433$ ,  $Chi^2 = 25.19$ ,  $df = 4$ ,  $P < 0.01$ ,  $I^2 = 84\%$ . Our results showed that fasting blood sugar (FBS) decreased in

patients of type 2 diabetes mellitus after yoga practices sessions compared to before yoga practices sessions, according to random effects pooled SMD of fasting blood sugar (FBS) before and after yoga practices sessions was:  $SMD = 0.91$ ,  $95\% CI = 0.12-1.71$  ( Figure 2).

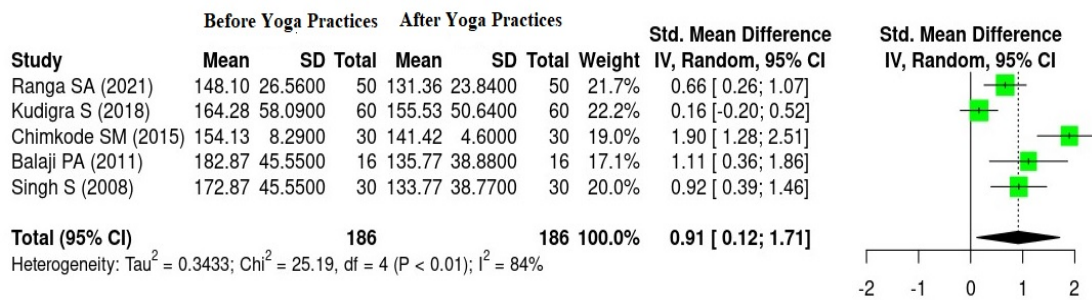


Figure 2. Forest plot of effect of yoga practices on fasting blood sugar of patients with Type 2 diabetes mellitus

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**Discussion**

This meta-analysis was conducted to analyse the association between yoga practices and fasting blood sugar in patients of type 2 diabetes mellitus. One of the important biochemical parameters of type 2 diabetes mellitus is fasting blood sugar [17]. The meta-analysis examined if yoga practices provide beneficial effects in reducing fasting blood sugar in patients of type 2 diabetes mellitus. Findings of the study suggests that fasting blood sugar decreased in patients of type 2 diabetes mellitus after yoga practices sessions compared to before yoga practices sessions. In meta-analysis we have included studies which are conducted in India only. So, it was tried to focus on specific study population.

Finding of this study are consistent with previous study [18]. A variety of medicines are available to manage blood glucose level for diabetic patients and the chances for adverse effects of these medicines increases when used for longer duration [1]. In recent years research is focusing on non-pharmacological methods for management of diabetes mellitus [1,19,20]. In the management of diabetes mellitus, yoga asanas can be used as an alternative to dietary and pharmacological remedies [1,21].

Shantakumari N et al. [23] observed decrease in fasting blood sugar after 3 months of yoga intervention in their study. In type 2 diabetes mellitus insulin sensitivity of peripheral tissues is decreased [23]. Increase in insulin sensitivity following yogic intervention is observed [23,24]. In previous study [25] significant decrease in fasting blood sugar after 6 months of pranayama practice was observed which line with the findings of present study is. Pranayama may possibly

rejuvenise pancreatic cells which may increase utilization of glucose in peripheral tissues and improved blood supply to muscles might cause improved glucose uptake and may reduce blood sugar level [25]. Parallel with findings of present study, Malhotra V et al. [26] observed decrease in fasting blood sugar level after 40 days of yoga asanas. Similarly, to the findings of present study, yoga is found to decrease fasting blood sugar significantly in patients with type 2 diabetes mellitus in study by Cui J et al. [27] And also observations of previous study by Innes KE et al. [2] on yoga for type 2 diabetes mellitus concluded that yoga might improve glucose tolerance. Yoga practices involve body and mind that focuses on breathing and flexibility [28]. Yoga may improve life quality of patients with diabetes mellitus by lowering blood sugar levels [28]. Yoga may harmonize the mind and body [28]. Yoga asanas focuses on synchronization of movement and breathing [28]. Yoga postures are practiced with tranquillity and balance [28].

Participants in the studies were from both gender and were patients of type 2 diabetes mellitus. Participants in studies were from different age group. Thus, collectively wide age group range was covered in different selected studies. So, findings of study can be applied to wide range of population. Yogic practices in studies are also easy and were not required special coaching. These practices were simple to learn and person can perform at their residence. This is the major benefit of these practices. Studies included in meta-analysis have variety of yogic practices in a single study. So finally, the result obtained was having cumulative effect of all yoga practices. In the selected studies sample size was also comparatively small. In the study [16] participants participated in

yoga practices along with their medications for diabetes mellitus, so, it is difficult to isolate effect of yogic practices on blood sugar level. And in this situation, it is also difficult to consider observed effect as an effect of yoga practices or an effect of combination of yoga practices and medication.

In this study we have mainly focused for studies conducted on Indian population. We have included studies in time lapse of 13 years. We did analysis of studies having various types of yoga activities. So, in this study cumulative analysis of various yogic activities is done. As study population of different age group is covered in selected studies, summarized findings may be easily applicable to all.

### Limitation

This study is focused on effect of yogic practices on fasting blood sugar. Other parameters for yogic practices like individual effect of yogic practices, duration of these practices, activities which requires yoga coaching is not given much importance. Other limitation in search strategy was English language and articles which were not freely available also decreased scope of articles. Selection process of studies is done by electronic data base. A study of electronic data base which is not screened is likely to be missed. This increases selection bias.

### Recommendations for future

For more precise analysis, studies in future should focus on individual yoga practices with defined duration.

### Conclusion

The present meta-analysis study focused on effect of yogic practices on fasting blood sugar of patients of type 2 diabetes mellitus in the Indian population. Overall, findings of this study suggest yogic practices are associated with reduction in fasting blood sugar of patients of type 2 diabetes mellitus. This can decrease requirements of medicines used for treatment of type 2 diabetes mellitus. So, Yoga activities can provide relief from adverse effects of these drugs. It can decrease financial burden of patients and become a good hope for low-income population. However properly designed RCTs are required to examine these effects with accuracy.

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