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Original Research Article

A Comparative Interventional Study of the Effect of Yoga on Insulin Resistance in Obese Patients

Ashwani Verma[1], Lokesh Kumar[2], Hitesh Rawat[3], Dheeraj Jeph[4]

[1]MBBS, MD, Medical Officer, Department of Physiology, SMS Medical College, Jaipur, Rajasthan, India
[2]MBBS, MD, Medical Officer, Department of Physiology, SMS Medical College, Jaipur, Rajasthan, India
[3] Final Year Post Graduate Student, Department of Physiology, SMS Medical College, Jaipur, Rajasthan, India
[4]Senior Professor, Department of Physiology and Head of Yoga Dept., SMS Medical College, Jaipur, Rajasthan, India

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Corresponding Author: Dr. Ashwani Verma
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Abstract:

Background: Obesity is strongly associated with insulin resistance which contributes to the development of diabetes and other metabolic disorders. Conventional lifestyle and pharmacologic therapies often fail to sustain long-term metabolic improvement. Yoga a holistic mind–body intervention may enhance insulin sensitivity via stress reduction, autonomic balance and increased physical activity.

Objectives: This interventional study aims to assess whether a structured yoga program can improve insulin sensitivity and metabolic function in obese individuals.

Materials and Method: An interventional study was carried out in 200 Obese individuals in which 100 are cases and 100 controls in Physiology YOG OPD. A 3-month of yoga session minimum 5 days in week was given to the subjects in the morning hours for 40 minutes completing a set of select yogic exercises for 3 month by a trainer. Insulin resistance (IR) was determined using the homeostasis model assessment of IR (HOMA-IR) formula at baseline, 1 month and after 3 month.

Results: The study found a significant improvement in insulin resistance among obese individuals who practiced yoga for three months. Participants demonstrated a notable reduction in fasting insulin levels from 15.55 µIU/mL to 12.49 µIU/mL, HOMA-IR: 4.05 → 2.87 compared to baseline measurements.

Conclusion: These results suggest that yoga may be an effective non-pharmacological approach to managing insulin resistance in obese patients.

Keywords: Obesity, Insulin Resistance, Yoga, homa-ir.

Introduction

Obesity is defined as abnormal or excessive fat accumulation that negatively affects health. Worldwide obesity has nearly tripled since 1975. In 2022, 43% of adults aged 18 years and over were overweight, and 16% were living with obesity. Approximately 2.8 million deaths are reported due to overweight or obesity worldwide [1]. As per NFHS-5 data, 6.4% of women and 4% of men are obese, and 17.6% of women and 18.9% of men are overweight [2]. Approximately 46.5% of the world's adult population is affected by IR with the prevalence reported in Asia (44.6%) [3].

Obesity is an escalating global health challenge, characterized by the excessive accumulation of adipose tissue and associated with a multitude of adverse health outcomes [4]. Today's lifestyle changes, including physical inactivity, sedentary lifestyle, no exercise, and increased consumption of saturated fat are associated with adverse changes in lifestyle. This complex condition is marked by deregulated lipid metabolism, chronic low-grade inflammation and insulin resistance, collectively contributing to the increased risk of cardiovascular diseases, type 2 diabetes, and various other chronic comorbidities [5].

Insulin is a peptide hormone secreted by the β cells of the pancreatic islets of Langerhans and maintains normal blood glucose levels by facilitating cellular glucose uptake, regulating carbohydrate, lipid and protein metabolism and promoting cell division and growth through its mitogenic effects [6]. In most individuals who develop type 2 diabetes mellitus, insulin resistance is generally present for most responses before healthy individuals and the current individuals have a glycemia [7, 8]. A decrease in insulin sensitivity

leads to insulin resistance, a characteristic of T2DM[9,10]. Increased deficiency in insulin secretion and function results in an exaggerated blood glucose level [11] .The development of obesity alters adipocyte-derived hormones or cytokine expression which provides a link between obesity and impaired insulin sensitivity and metabolic defects in other tissues.

The causes of obesity are not fully understood, but it is a multifactorial disorder. The present options for controlling obesity are inadequate and have adverse effects [12]. Yoga, a Vedic science, has been applied in the field of therapeutics in modern times. Yoga has given patients the hope to reduce medication besides slowing the progression of the disease. Yoga employs stable postures or asanas and breath control or pranayama [13].

Yoga an ancient practice rooted in India has emerged as a promising approach to improving both physical and mental well-being. Beyond its well-acknowledged benefits for stress reduction and flexibility, yoga is increasingly recognized for its potential to influence key physiological parameters linked to obesity management [14]. The rationale behind this research is grounded in the need for evidence-based, non-invasive interventions to mitigate the health risks associated with obesity. Traditional methods of managing obesity often focus primarily on dietary modifications and exercise regimens; neglecting the mind-body connection that yoga seeks to nurture.

This study aims to bridge existing gaps in the literature by conducting a comprehensive investigation into the impact of yoga on insulin resistance in obese patients. Through rigorous research design, data collection and analysis, we seek to contribute to the growing body of knowledge surrounding holistic interventions for obesity and ultimately provide evidence to inform clinical practice and public health initiatives.

Materials and Methods

The present study was a Interventional, comparative type of study conducted at the Physiology Department of S.M.S Medical College, Jaipur (Rajasthan) from April 2024 to December 2024 after receiving the desired approval from the Research Review Board and the Institutional Ethics Committee (Order no. 568/MC/EC/2023, 12/02/2024). A total of 200 study participants were recruited within the age group of 20–40 years from both genders after obtaining the written informed consent in which 100 were cases and 100 were controlled. The procedure was explained to all before commencing any test and a detailed history was recorded.

Inclusion Criteria: Patients diagnosed with obesity >25, insulin resistance (using homa ir) >2.9 and subjects who were cooperative and willing to participate in the study.

Exclusion Criteria: subjects who have Obesity secondary to medication like steroids , psychiatric disorders etc., Diabetes mellitus patient, Pregnant women, Individuals who practicing yoga earlier (>3days /week for last 3 months), Any physical deformities which prevent them practice yoga were excluded from this study.

3 months of yoga session were given to the subjects of yoga group at the Yoga O.P.D. (Department of physiology, S.M.S. Medical College, Jaipur) at Dhanvantri OPD block in the morning hours for 40 minutes completing a set of select yogic exercises. A minimum 5 days in week yoga exercise is performed till 3 month. Yoga training will be given by a trainer, trained in Yogasanas.

Subjects enrolled under yoga group were advised to present themselves empty stomach for performing Yogasanas. The yoga exercise was performed in 4 steps. First warming exercise for 2min. and Sukshma yogic Vyayam for 10 min. In second steps asanas like mandukasana, vakrasana, uttanpadasana, sarvangasana, halasana, chakrasana and surya namaskar were done for 15 min. In third step pranayama bhastrika, anulom-vilom, kapalbhati and deergh swas preksha were done for 10 min. and last for relaxing the body for 3-5 min. via Savasana.

These yoga practices were performed in yoga opd, we maintaned a follow up chart for 3 months. The subjects were encouraged and motivated regularly via a chart of tick lists. A minimum 5 days in a week yogasans were considered as appropriate for this study.

Patient information was recorded using a pre-structured preforms containing general demographic and clinical details, anthropometric measurements (height, weight, BMI), Vital parameters (heart rate, respiratory rate, blood pressure) and Laboratory investigations - Fasting and post-prandial blood glucose levels, HOMA-IR (Homeostatic Model Assessment for Insulin Resistance). Blood samples were collected at baseline, after 1 month and after 3 months for both groups.

Statistical Analysis: Data were compiled and analysed using SPSS version 27 and MS Excel 2019. Descriptive statistics were used to calculate mean and standard deviation. Comparisons between groups were made using appropriate statistical tests: Paired t-test for within-group comparisons (baseline vs post-intervention) and Unpaired t-test for between-group comparisons.

A p-value of <0.05 was considered statistically significant.

Results

In this study there were 56 male and 44 female in Yoga group and 52 males and 48 female in non-yoga group. In table 1 showing baseline BMI values were similar between the Yoga group (31.01 ± 4.65 kg/m²) and Non-Yoga group (30.79 ± 4.41 kg/m²) (p = 0.734). Following the intervention, a progressive and significant reduction in BMI was observed in the Yoga group, reaching 28.71 ± 4.53 kg/m² at 3 months (p = 0.001). Conversely, the Non-Yoga group exhibited no significant change. In table 2 showing at baseline, fasting blood sugar levels were comparable between groups (p = 0.911). Following yoga intervention, a significant reduction in FBS was seen in the Yoga group at 1 month and 3 months (p < 0.001), reaching 92.94 ± 9.32 mg/dL at 3 months. In contrast, fasting blood sugar levels remained unchanged or slightly worsened in the Non-Yoga group.

Table 1: Comparison of Body Mass Index in mg/dl (FBS) at Baseline, 1 Month and 3 Month

Time Point	Yoga Group (Mean ± SD)	Non-Yoga Group (Mean ± SD)	p-value
Baseline	31.01 ± 4.65	30.79 ± 4.41	0.734
1 Month	30.09 ± 4.59	30.79 ± 4.40	0.274
3 Months	28.71 ± 4.53	30.79 ± 4.41	**0.001**

Table 2: Comparison of Fasting Blood Sugar in mg/dl (FBS) at Baseline, 1 Month and 3

Time Point	Yoga Group (Mean ± SD)	Non-Yoga Group (Mean ± SD)	p-value
Baseline	105.38 ± 9.23	105.55 ±11.06	0.911
1 Month	97.93 ± 9.60	105.24 ±11.37	**<.001**
3 Months	92.94 ± 9.32	106.60 ±11.30	**<.001**

In table 3 showing at baseline HOMA-IR values, representing insulin resistance were similar between the groups (p = 0.920). After the yoga intervention, HOMA-IR decreased significantly in the Yoga group at 1 month and 3 months (both p < 0.001), falling to a mean value of 2.87 ± 0.87 at 3 months. No improvement was noted in the Non-Yoga group.

Table 3: Comparison of Homeostasis Model Assessment of Insulin Resistance (HOMA-IR) at Baseline, 1 Month and 3 Month

Time Point	Yoga Group (Mean ± SD)	Non-Yoga Group (Mean ± SD)	p-value
Baseline	4.05± 0.98	4.06 ± 1.05	0.920
1 Month	3.39± 0.92	4.09 ± 1.07	**<.001**
3 Months	2.87± 0.87	4.10 ± 1.08	**<.001**

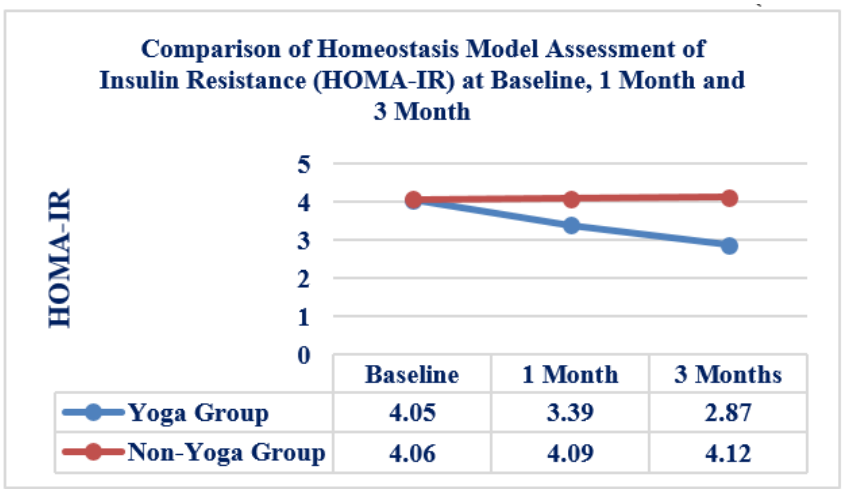

Figure 1: Comparison of Homeostasis Model Assessment of Insulin Resistance (HOMA-IR) at Baseline, 1 Month and 3 Month

Discussion

The present study finds that a sustained yoga practice leads to significant reductions in adiposity over a three-month period.

These results are consistent with findings from previous studies. Gadham et al. (2015)[15] observed a significant reduction in BMI from 28.7 ± 3.5 kg/m² to 27.1 ± 3.2 kg/m² (p <

0.01) after three months of structured yoga practice among obese individuals. Similarly, Cramer et al. (2016)[16] finds a statistically significant BMI reduction in women with abdominal obesity after 12 weeks of yoga therapy, with an average decrease of 1.4 kg/m². Gupta et al. (2022) [17] also reported a significant reduction in BMI after six months of yoga therapy among obese patients, reinforcing the long-term benefits of yoga interventions on weight management. Kumar et al. (2023) [18] reported a decrease in BMI from 27.1 ± 2.9 kg/m² to 25.7 ± 2.7 kg/m² ($p < 0.001$) following a 10-week yoga intervention in working male professionals. The observed BMI reductions in the present study can be attributed to mechanisms such as enhanced basal metabolic rate, improved endocrine function, reduction in cortisol and stress-related eating and increased muscle mass relative to fat mass following regular yoga practice.

Khatri et al. (2007) [19] noted improvements in glycaemic parameters, although precise fasting glucose values were not provided, their study concluded significant metabolic benefits from yoga and meditation. Singh et al. (2008) [20] observed a significant reduction in fasting glucose from 145.7 ± 38.6 mg/dL to 123.3 ± 29.7 mg/dL ($p < 0.001$) in patients with type 2 diabetes following a 45-day yoga intervention. Mohammed et al. (2016) [21] reported that FBS levels decreased significantly from 164.3 ± 18.6 mg/dL to 135.2 ± 15.7 mg/dL after four months of yoga practice combined with conventional therapy in diabetic patients.

Nagarathna et al. (2021)[22], in a large multicentre randomized controlled trial, found significant reductions in fasting glucose among high-risk diabetic populations practicing yoga for three months (mean reduction of 15–18 mg/dL compared to controls). Gupta et al. (2022) [17] demonstrated a significant reduction in fasting glucose levels after six months of yoga therapy among obese patients with a high diabetes risk, reinforcing the current findings. The observed reduction in FBS in the present study can be attributed to improved insulin sensitivity, enhanced glucose uptake by skeletal muscles, decreased cortisol secretion, and improved pancreatic β-cell responsiveness facilitated through stress reduction and autonomic modulation associated with regular yoga practices.

Khatri et al. (2007) [19] reported improvements in insulin resistance in patients practicing yoga, though specific values were not provided. Singh et al. (2008) [20] observed a decrease in HOMA-IR from 4.2 ± 1.1 to 3.0 ± 0.8 ($p < 0.01$) after 45 days of yoga in type 2 diabetic patients. Gadham et al. (2015) [15] finds a non-significant reduction in HOMA-IR from 3.9 ± 1.2 to 3.5 ± 1.0 ($p = 0.08$) following three months of yoga. Nagarathna et al. (2021)[22] found a reduction in HOMA-IR among participants with high diabetes risk, supporting the present study's findings of yoga's impact on insulin sensitivity.

Gupta et al. (2022)[17] observed a significant reduction in HOMA-IR from 4.5 ± 1.3 to 3.2 ± 1.1 ($p < 0.001$) after six months of yoga therapy. The notable decrease in HOMA-IR seen in this study linked to yoga's role in enhancing metabolic function. Yoga is known to improve insulin receptor response, reduce visceral fat levels and lower inflammatory activity in the body. It can also facilitate more efficient glucose utilization, promote fat metabolism and support hormonal regulation which together contribute to reduced insulin resistance and better insulin sensitivity.

Conclusion

In the present world there is increasing obesity and associated comorbidities among young individuals the present interventional study demonstrated that a structured yoga program has very significant role to manage this. Participants in the Yoga group showed a statistically significant reduction in body weight, BMI, fasting blood sugar, serum insulin levels and HOMA-IR compared to the Non-Yoga group. These findings highlight that yoga, as a holistic mind-body intervention, effectively enhances insulin sensitivity and promotes weight loss in obese patients. Incorporating yoga into routine obesity management strategies may offer a safe, sustainable and cost-effective therapeutic modality to address the growing burden of metabolic syndrome and its associated complication.

Limitations

In the present study follow-up period was only for a short period of three months, which may not reflect long-term sustainability or relapse after discontinuation. Conducting the research in a single tertiary centre limits generalizability to broader populations and convenience sampling may have introduced selection bias.

Blinding was not feasible due to the nature of the intervention, posing a risk of performance and observer bias. Compliance with yoga was mainly self-reported without objective verification of home practice.

Additionally, lifestyle variables such as diet, sleep, stress and external physical activity were not strictly monitored` which may have independently influenced metabolic outcomes.

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