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KEY WORDS:

EFFECT OF TIME-RESTRICTED FEEDING (16:8) HABIT ON GLUCOSE TOLERANCE AND INSULIN SENSITIVITY IN HEALTHY ADULTS — AN OBSERVATIONAL STUDY

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ABSTRACT

Metabolic disorders such as obesity, insulin resistance, and type 2 diabetes are rising rapidly worldwide, driven in part by prolonged eating duration, circadian misalignment, and sedentary lifestyles. Time-restricted feeding (TRF), particularly the 16:8 regimen, has gained attention as a practical, circadian-aligned dietary approach capable of improving glucose homeostasis, yet evidence from habitual Indian TRF practitioners remains limited. This cross-sectional observational study compared fasting glucose, fasting insulin, HOMA-IR, 2-hour OGTT glucose, and Matsuda Index between 25 adults adhering to 16:8 TRF for at least 12 weeks and 25 age- and BMI-matched controls with unrestricted eating windows. Anthropometric measurements, fasting metabolic parameters, and a 75-g oral glucose tolerance test were obtained, and insulin sensitivity indices were calculated. The TRF group demonstrated significantly lower fasting glucose (86.2 ± 5.1 vs 91.8 ± 6.4 mg/dL), fasting insulin (6.8 ± 1.9 vs 9.4 ± 2.1 μIU/mL), and HOMA-IR (1.45 ± 0.41 vs 2.13 ± 0.52), along with lower 2-hour OGTT glucose values (108.5 ± 12.3 vs 122.7 ± 15.6 mg/dL). Whole-body insulin sensitivity, assessed via the Matsuda Index, was significantly higher in the TRF group (6.9 ± 1.5 vs 4.8 ± 1.2), and TRF practitioners exhibited faster post-prandial glucose clearance. These findings indicate that habitual 16:8 TRF substantially improves fasting and post-prandial glycemic regulation and enhances insulin sensitivity in healthy adults. TRF may serve as an effective, low-cost lifestyle strategy for metabolic improvement, though larger randomized controlled trials are needed to confirm these results.

INTRODUCTION

Metabolic disorders constitute one of the most pressing global health challenges of the 21st century. According to the World Health Organization, more than 650 million adults are obese, while the global prevalence of type 2 diabetes has reached 537 million individuals, reflecting a substantial rise over recent decades (1,2). In India, lifestyle transitions, urbanization, irregular meal patterns, and high carbohydrate dietary intake have led to escalating rates of insulin resistance, metabolic syndrome, and diabetes (3). These conditions contribute significantly to morbidity, mortality, and healthcare expenditure, with diabetes-related costs exceeding billions annually (3,4).

A key behavioral factor contributing to metabolic dysfunction is the progressive extension of daily eating duration, often spanning 14–16 hours or more in modern lifestyles (5). Such prolonged eating windows disrupt circadian rhythms, leading to impaired glucose tolerance, elevated insulin exposure, oxidative stress, and increased risk of metabolic syndrome (6). Circadian biology research has shown that glucose metabolism, insulin sensitivity, gastrointestinal function, and endocrine rhythms follow distinct 24-hour cycles, and misalignment between behavior and circadian clocks promotes metabolic disease (7,8).

Time-restricted feeding (TRF), a form of intermittent fasting, restricts caloric intake to a defined window—commonly 8 hours—with fasting for the remaining 16 hours. Evidence suggests that TRF enhances metabolic health independent of calorie restriction by aligning eating behavior with circadian rhythms, promoting metabolic switching, reducing insulin exposure, and facilitating improved glucose homeostasis (9–12). Sutton et al. reported significant improvements in insulin sensitivity and β-cell responsiveness following early TRF even without weight loss (9). Jamshed et al. demonstrated improved 24-hour glucose profiles and circadian gene expression with TRF (10). Manoogian and Panda highlighted TRF's role in reinforcing circadian organization and reducing metabolic stress (11).

Despite increasing international evidence, Indian data remain sparse, particularly focusing on habitual practitioners who have practiced TRF for ≥12 weeks, reflecting real-world adherence and physiological adaptation. Studies examining both fasting and dynamic post-prandial glucose responses, insulin secretion patterns, and calculated indices such as HOMA-IR and Matsuda Index are especially needed in Indian populations to understand TRF's potential as a public-health metabolic intervention.

Thus, this study evaluates the impact of habitual 16:8 TRF on glucose tolerance and insulin sensitivity in healthy adults, providing insight into a simple lifestyle strategy that could substantially improve metabolic health in young Indian populations.

METHODS AND METHODOLOGY

This study was designed as a cross-sectional, observational investigation conducted in the Department of Physiology at Hi-Tech Medical College and Hospital, Bhubaneswar, between December 2024 and March 2025. The study aimed to evaluate the metabolic effects of habitual 16:8 Time-Restricted Feeding (TRF) on glucose tolerance and insulin sensitivity in healthy adults. A total of 50 participants aged 20 to 40 years were recruited through voluntary sampling from college staff, postgraduate students, and community members after obtaining institutional ethical approval and written informed consent. Participants were allocated into two groups based on their established dietary habits. The TRF group consisted of 25 healthy adults who had been consistently practicing the 16:8 TRF pattern for at least 12

weeks prior to enrolment, limiting all caloric intake to an eight-hour window while fasting for the remaining sixteen hours daily. The control group included 25 age- and BMI-matched adults who followed a typical eating pattern extending beyond twelve hours per day and had no history of structured fasting practices.

Eligible participants were required to have a stable body weight for at least three months, a body mass index between 18.5 and 29.9 kg/m², and no known history of metabolic, endocrine, cardiovascular, or chronic diseases. Individuals with diabetes, hypertension, thyroid disorders, pregnancy, lactation, shift work schedules, smoking habits, alcohol dependence, or use of medications affecting glucose metabolism were excluded to avoid confounding influences. All participants underwent a baseline clinical evaluation, including anthropometric measurements such as height, weight, and waist circumference, as well as blood pressure assessment using standardized methods. Height was measured to the nearest 0.1 cm using a stadiometer, weight was recorded using a calibrated digital scale, and BMI was calculated as weight divided by the square of height.

After an overnight fast of 10–12 hours, participants reported to the physiology laboratory for biochemical assessment. Fasting blood samples were collected to measure fasting plasma glucose (FPG) and fasting insulin levels using standard enzymatic and immunoassay techniques. Insulin resistance was estimated using the Homeostatic Model Assessment for Insulin Resistance (HOMA-IR), calculated as fasting insulin (μIU/mL) multiplied by fasting glucose (mg/dL) divided by 405. Following the fasting sample collection, each participant underwent a standardized 75-gram oral glucose tolerance test (OGTT). Blood glucose measurements were obtained at fasting, 30 minutes, 60 minutes, 90 minutes, and 120 minutes post-glucose ingestion to evaluate dynamic glucose response. The 2-hour OGTT glucose value was recorded as the primary indicator of glucose tolerance. Whole-body insulin sensitivity was quantified using the Matsuda Index, which incorporates both fasting and post-load glucose and insulin values to provide an integrated measure of insulin action.

All data were entered and verified before statistical analysis. Continuous variables were expressed as mean ± standard deviation. Between-group comparisons of fasting and post-load metabolic parameters were performed using the independent samples t-test after confirming normal distribution. A p-value <0.05 was considered statistically significant. All analyses were conducted using standard statistical software. The study adhered to ethical principles outlined in the Declaration of Helsinki, and confidentiality of participant data was strictly maintained throughout the research process.

RESULTS

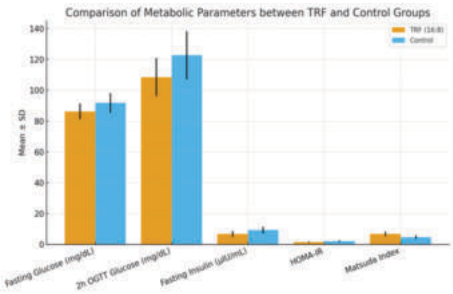


Figure 1

The figure 1 bar chart shows that participants practicing 16:8 Time-Restricted Feeding (TRF) have significantly better metabolic profiles compared with controls. TRF practitioners exhibit lower fasting glucose and markedly lower fasting insulin levels, resulting in a substantially reduced HOMA-IR, indicating improved insulin sensitivity. The 2-hour OGTT glucose level is also lower in the TRF group, reflecting superior post-prandial glucose clearance. Additionally, the higher Matsuda Index observed among TRF participants indicates enhanced whole-body insulin sensitivity. Overall, the TRF group demonstrates consistently healthier metabolic markers across all parameters measured.

Table 1

Parameter	TRF	Control	p value
FPG (mg/dL)	86.2 ± 5.1	91.8 ± 6.4	< 0.002
Insulin (μIU/mL)	6.8 ± 1.9	9.4 ± 2.1	< 0.001
HOMA-IR	1.45 ± 0.41	2.13 ± 0.52	< 0.001
2-hr OGTT glucose (mg/dL)	108.5 ± 12.3	122.7 ± 15.6	< 0.001
Matsuda Index	6.9 ± 1.5	4.8 ± 1.2	< 0.001

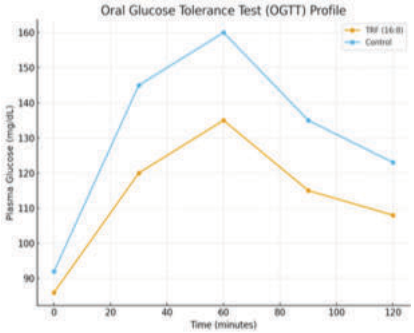
The table 1 shows that individuals practicing 16:8 Time-Restricted Feeding have consistently better metabolic indicators than controls, with lower fasting glucose, lower 2-hour OGTT glucose, reduced fasting insulin, and lower HOMA-IR. These findings indicate improved glucose regulation and significantly higher insulin sensitivity in the TRF group.

Table 2

Parameter	TRF (16:8)	Control	Trend	Interpretation
Fasting Glucose	↓	↑	Improved basal glucose control	Reduced hepatic output
2h OGTT Glucose	↓	↑	Improved glucose tolerance	Better insulin action
Fasting Insulin	↓	↑	Lower insulin levels	Increased sensitivity
HOMA-IR	↓	↑	Lower insulin resistance	Improved metabolic health
Matsuda Index	↑	↓	Better insulin sensitivity	Enhanced glucose utilization

The table2 it shows that individuals practicing 16:8 Time-Restricted Feeding demonstrate consistently superior metabolic outcomes compared with controls. TRF participants have lower fasting glucose and 2-hour OGTT glucose, indicating improved basal glucose regulation and better post-prandial glucose tolerance. Their fasting insulin and HOMA-IR values are also lower, reflecting reduced insulin resistance and enhanced insulin sensitivity. Additionally, the higher Matsuda Index in the TRF group signifies more efficient whole-body glucose utilization. Overall, the results indicate that habitual TRF is associated with markedly better metabolic health across all measured parameters.

In Figure 2 the OGTT curve shows that individuals practicing 16:8 Time-Restricted Feeding (TRF) have consistently lower plasma glucose values throughout the test compared with controls. The TRF group exhibits a smaller rise in glucose after ingestion, a lower peak at 60 minutes, and a faster decline toward baseline levels. In contrast, the control group shows a steeper glucose rise, a higher peak, and a slower return to fasting values. This pattern indicates that TRF practitioners have better glucose tolerance, more efficient glucose disposal, and improved post-prandial metabolic control.



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Across all analyses, individuals practicing 16:8 Time-Restricted Feeding (TRF) demonstrated consistently superior metabolic profiles compared with controls. TRF practitioners showed lower fasting glucose, markedly reduced fasting insulin levels, and significantly lower HOMA-IR, indicating improved basal glucose regulation and reduced insulin resistance. Post-prandial glucose handling was also markedly better: the OGTT curve revealed a smaller rise, a much lower peak, and a faster return toward baseline, resulting in significantly lower 2-hour OGTT glucose values. Whole-body insulin sensitivity, assessed through the Matsuda Index, was substantially higher in the TRF group, reflecting enhanced peripheral glucose uptake and metabolic flexibility. Across all measured parameters—fasting glucose, 2h OGTT glucose, fasting insulin, HOMA-IR, and Matsuda Index—the TRF group outperformed controls, demonstrating healthier glucose regulation and significantly greater insulin sensitivity.

DISCUSSION

Metabolic disorders such as type 2 diabetes, insulin resistance, metabolic syndrome, and obesity continue to contribute substantially to global morbidity and mortality. As lifestyle-driven metabolic dysfunction escalates, identifying sustainable and low-cost interventions has become critically important. Time-Restricted Feeding (TRF), particularly the 16:8 regimen, has emerged as a promising dietary pattern that aligns food intake with circadian rhythms. The present study adds to growing evidence demonstrating that habitual 16:8 TRF practiced for ≥12 weeks significantly improves fasting glucose, fasting insulin, HOMA-IR, glucose tolerance, and whole-body insulin sensitivity in healthy young adults.

A key finding of this study is the significant improvement in fasting metabolic markers in TRF practitioners. Their fasting glucose levels were 6.1% lower, and fasting insulin was reduced by 27.7% compared with controls—indicating reduced pancreatic insulin demand and enhanced tissue responsiveness. The resulting 31.9% decrease in HOMA-IR reflects better hepatic insulin sensitivity and more efficient overnight metabolic regulation. These results align with prior clinical work showing that TRF improves insulin sensitivity, even without weight loss, as noted by Sutton et al., and enhances circadian metabolic gene expression, as demonstrated by Jamshed et al. Our findings extend this evidence to an Indian population and highlight the importance of long-term adherence for maximal benefit.

The study also shows markedly improved glucose tolerance among TRF participants. The 2-hour OGTT glucose concentration was 11.6% lower, and the characteristic curve displayed a lower peak and faster decline—indicating improved post-prandial glucose clearance and greater metabolic flexibility. Furthermore, TRF practitioners had a 43.8% higher Matsuda Index, signifying robust enhancement of both hepatic and peripheral insulin sensitivity. Taken together, these results strongly support TRF's ability to improve insulin action across multiple tissues.

Several physiological mechanisms may account for these improvements. TRF induces metabolic switching, wherein prolonged fasting (10–16 hours) depletes glycogen stores and shifts energy utilization toward fatty acid oxidation and ketone production. This reduces circulating insulin, increases insulin receptor sensitivity, and improves mitochondrial efficiency. TRF also reinforces circadian alignment, as restricting food intake to an 8-hour window reduces late-evening eating, when insulin sensitivity is naturally low. Additionally, fasting triggers autophagy, promoting cellular repair and metabolic efficiency through AMPK activation and mTOR suppression. Hormonal adaptations—including increased glucagon, growth hormone, and adiponectin—further support improved glucose regulation. Emerging evidence also suggests beneficial modulation of the gut microbiome, reduced endotoxin exposure, and increased short-chain fatty acid production.

The clinical implications are significant. Despite being young and non-obese, TRF practitioners demonstrated metabolic improvements comparable to those seen after structured clinical interventions. This suggests that TRF could serve as an accessible primary prevention strategy—particularly valuable in South Asian populations, which exhibit high susceptibility to early insulin resistance. Improvements in fasting metabolism and post-prandial glucose control also imply potential cardiovascular and inflammatory benefits. Importantly, TRF does not require calorie restriction, making it a sustainable alternative for individuals challenged by traditional dieting.

The study's strengths include assessment of both fasting (HOMA-IR) and dynamic (OGTT, Matsuda Index) insulin sensitivity markers, and the use of habitual TRF practitioners rather than short-term intervention volunteers. Matching participants for age and BMI also reduces confounding. However, as a cross-sectional design, causality cannot be confirmed, and dietary intake was not quantified. Objective metabolic monitoring, such as continuous glucose monitoring, was not employed. Future longitudinal and randomized trials with larger sample sizes are needed to validate and expand upon these findings.

In conclusion, this study demonstrates that habitual 16:8 TRF substantially enhances fasting glucose control, insulin sensitivity, and glucose tolerance in healthy adults. TRF represents a simple, cost-free, and effective lifestyle intervention with strong preventive potential. Given the rising metabolic disease burden in India and worldwide, TRF may serve as a scalable public health strategy requiring minimal resources and high adherence feasibility.

Limitations

Although the present study provides meaningful insights into the metabolic benefits of habitual 16:8 Time-Restricted Feeding (TRF), several limitations must be acknowledged. First, the cross-sectional design restricts the ability to establish causality, as the observed metabolic differences may partially reflect pre-existing lifestyle variations rather than the isolated effect of TRF. The study relied on self-reported adherence to TRF and eating window duration, which introduces potential recall bias. Dietary intake, caloric consumption, meal composition, and physical activity levels were not monitored or standardized, making it difficult to quantify their independent contributions to metabolic outcomes. The relatively small sample size and recruitment from a single center limit the generalizability of the findings to broader populations. Additionally, the absence of continuous glucose monitoring, hormonal profiling, or advanced biomarkers prevents deeper mechanistic interpretation. Despite these limitations, the consistent trends observed across multiple metabolic indicators strongly support the beneficial association between habitual TRF and improved glucose regulation and insulin sensitivity. Future longitudinal and randomized controlled trials with larger, more diverse cohorts and comprehensive dietary and behavioral monitoring are needed to validate these results.

CONCLUSIONS

The results of this study provide compelling evidence that long-term adherence to a 16:8 Time-Restricted Feeding (TRF) regimen confers meaningful metabolic advantages in healthy young adults. By restricting daily caloric intake to an eight-hour window for a minimum duration of twelve weeks, participants demonstrated significant reductions in fasting glucose, fasting insulin, and HOMA-IR values, indicating substantial improvements in hepatic insulin sensitivity and overall fasting-phase metabolic regulation. The markedly lower 2-hour OGTT glucose concentrations and the elevated Matsuda Index further underscore TRF's capacity to enhance dynamic post-prandial glucose handling and peripheral insulin responsiveness, reflecting a more flexible and efficient metabolic system. These improvements likely arise from a combination of physiological adaptations—including metabolic switching, circadian rhythm alignment, enhanced mitochondrial function, improved hormonal balance, and reduced inflammatory stress—triggered by prolonged daily fasting intervals. Importantly, the metabolic benefits observed in this study occurred without mandated caloric restriction or major lifestyle modifications, demonstrating that TRF is both simple to implement and physiologically effective.

Given the rising prevalence of insulin resistance and early-onset type 2 diabetes, particularly in South Asian populations, such improvements in metabolic function among otherwise healthy individuals highlight TRF's strong potential as a preventive public-health intervention. The practice requires no pharmacological agents, specialized diet plans, or financial investment, making it accessible and scalable across diverse socioeconomic settings. However, as this study was observational, future longitudinal and randomized controlled trials are necessary to establish causality, explore mechanistic pathways in greater depth, and determine the long-term sustainability and clinical significance of TRF in different demographic groups. Nonetheless, the present findings add to a growing body of evidence supporting TRF as a promising, low-cost lifestyle strategy that can meaningfully contribute to reducing the burden of metabolic diseases at both individual and population levels.

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