

## DIABETES: AN EMERGING CRISIS

*Prediabetes, PCOS-Linked Insulin Resistance, and the Power of Lifestyle Medicine*

**Shahid Anjum** , Medical Student, Samarkand State Medical University, Uzbekistan,  
email: [Shahidanjum6688@gmail.com](mailto:Shahidanjum6688@gmail.com)

**Khan Nasreen** , Medical Student, Samarkand State Medical University, Uzbekistan,  
email: [nasreenkhankayamkhani@gmail.com](mailto:nasreenkhankayamkhani@gmail.com)

**Sahista Banu** , Medical Student, Samarkand State Medical University, Uzbekistan,  
email: [Banusahista35109@gmail.com](mailto:Banusahista35109@gmail.com)

**Nafeesathul Fida Bin**, Medical Student, Samarkand State Medical University,  
Uzbekistan, email: [nafeesathulfidha@gmail.com](mailto:nafeesathulfidha@gmail.com)

### ABSTRACT

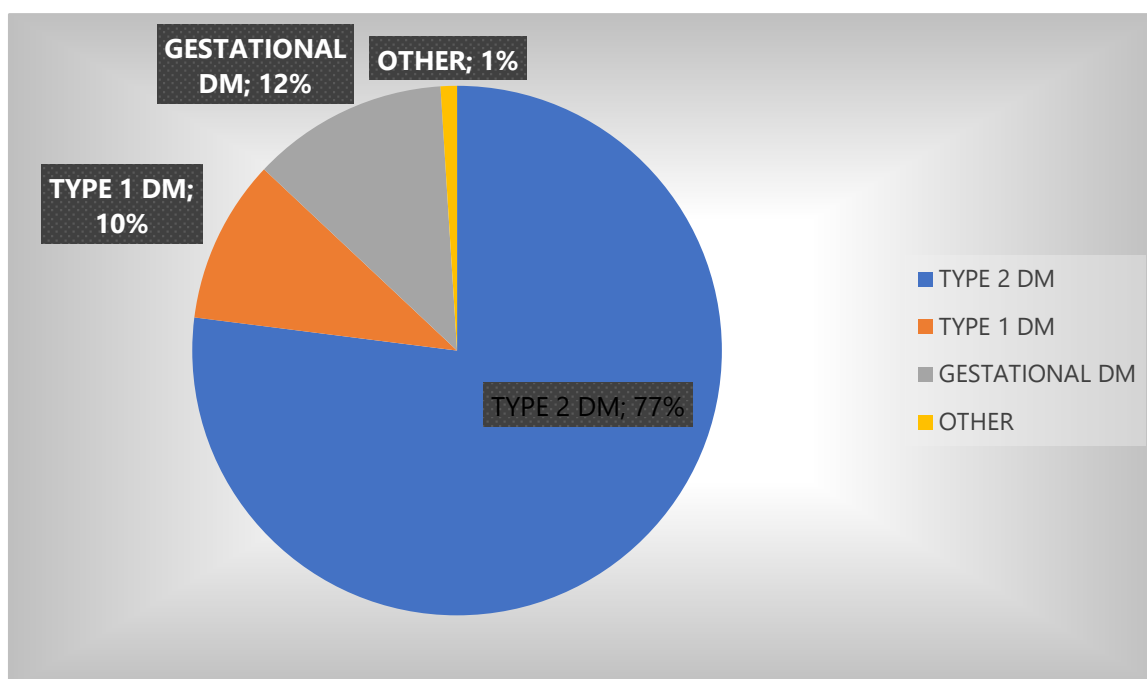
*Diabetes mellitus has emerged as one of India's most critical public health challenges of the 21st century. With over 101 million people already living with diabetes and another 136 million in the prediabetic state as of 2023–2024, India bears the largest absolute burden of diabetes globally. This article presents a multifaceted review covering three major clinical dimensions: the rising tide of prediabetes among Indian young adults aged 18–35 years, the complex interplay between Polycystic Ovary Syndrome (PCOS), insulin resistance, and Type 2 diabetes risk in Indian women, and the evidence base for lifestyle modification as the cornerstone of diabetes prevention. Drawing on the latest national surveys, including the Indian Council of Medical Research–India Diabetes (ICMR-INDIAB) 2023 study, the National Family Health Survey-5 (NFHS-5), and multiple peer-reviewed Indian cohort studies published in 2023–2024, we present an integrated analysis with epidemiological statistics, illustrative case studies, trends, and comparisons. The overarching message is clear: India's diabetes epidemic demands urgent, culturally tailored, youth-focused, and gender-sensitive prevention strategies rooted in lifestyle intervention and early screening.*

**KEYWORDS:** *Type 2 Diabetes, Prediabetes, Young Adults India, PCOS, Insulin Resistance, Lifestyle Modification, Indian Epidemiology, Metformin, Diabetes Prevention, HbA1c, Glycemic Control, Obesity India, Physical Inactivity*

## INTRODUCTION

*Diabetes mellitus (DM) refers to a group of common metabolic disorders that share the phenotype of hyperglycemia. Several distinct types of DM are caused by a complex interaction of genetics and environmental factors. Depending on the etiology of the DM, factors contributing to hyperglycemia include reduced insulin secretion, decreased glucose utilisation, and increased glucose production. The metabolic dysregulation associated with DM causes secondary pathophysiologic changes in multiple organ systems that impose a tremendous burden on the individual with diabetes and on the health care system. In the United States, DM is the leading cause of end-stage renal disease (ESRD), nontraumatic lower extremity amputations, and adult blindness. Persons with diabetes are at increased risk for cardiovascular disease, which is the main cause of morbidity and mortality in this population.*

## CLASSIFICATION



### 1. PREDIABETES IN YOUNG ADULTS

#### 1.1. OVERVIEW

*Prediabetes is defined as a state of impaired fasting glucose (IFG: fasting plasma glucose 100–125 mg/dL) or impaired glucose tolerance (IGT: 2-hour plasma glucose 140–199 mg/dL during an oral glucose tolerance test), or elevated HbA1c between 5.7–6.4%. This intermediate metabolic state carries a 5–10% annual risk of progressing to full-blown Type 2 diabetes — and more*

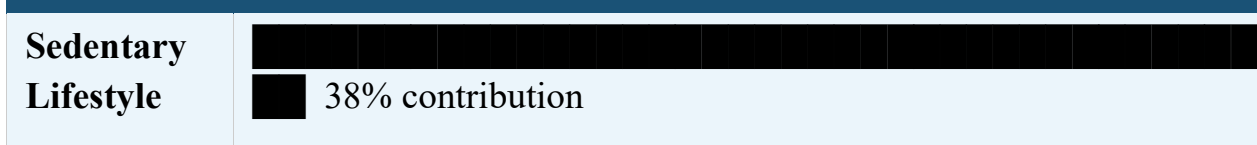
critically, the cardiovascular complications of diabetes begin accumulating even during the prediabetic phase. In India, prediabetes in youth is a particularly pressing concern because, unlike in Western nations, where obesity-driven diabetes emerges predominantly in middle age, Indian youth are developing metabolic dysfunction at lower body weight thresholds and younger ages. The combination of genetic predisposition (South Asian metabolic phenotype), epigenetic factors, and contemporary lifestyle exposures creates a combustible metabolic milieu.

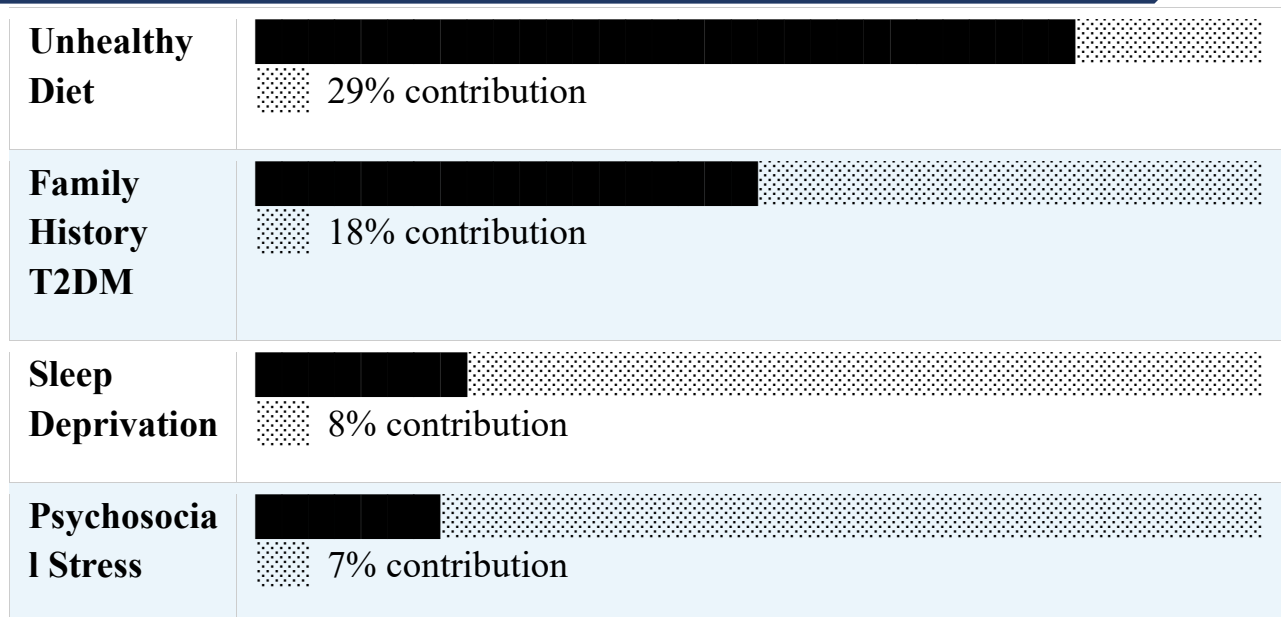
### 1.2.STATICS

Parameter	Statistic	Source
Total prediabetes cases in India (2023)	136 million	ICMR-INDIAB 2023
Prediabetes prevalence (ages 15–34)	~14.2%	ICMR-INDIAB 2023
Urban youth prediabetes rate (metros)	~17.8%	AIIMS Delhi, 2023
Annual T2DM conversion rate from prediabetes	5–10%	ADA / IDF 2024
Young adults with undiagnosed prediabetes	>60%	Lancet Regional Health, 2024
10-year T2DM risk without intervention	~50%	DPP India Study, 2023
Mean age of T2DM onset in India (2024)	45.8 years	IDF Diabetes Atlas 2024

### 1.3RISK FACTORS SPECIFIC TO INDIAN YOUTH

Figure: Relative Risk Contribution of Prediabetes Risk Factors in Indian Youth (2024)





*Source: Compiled from PGIMER Chandigarh cohort (2024), AIIMS Delhi metabolic clinic data (2023), IDF South-East Asia Regional Report (2024).*

## 1.4 CASE STUDY

### Case Study: A 19-Year-Old Female College Student, Chennai

**Background:** P.S., a 19-year-old female engineering student, was incidentally found to have elevated fasting glucose during a routine college health camp.

**Family History:** Father has T2DM (diagnosed at age 38); maternal grandfather had diabetes.

**Anthropometric Data:** BMI 23.4 kg/m<sup>2</sup> (within normal range by Western standards, but at risk by Indian criteria); waist-hip ratio 0.86.

**Lab Findings:** Fasting plasma glucose: 108 mg/dL; 2-hour OGTT: 152 mg/dL (impaired glucose tolerance); HbA1c: 5.9%; HOMA-IR: 4.2.

**Diagnosis:** Impaired glucose tolerance (prediabetes) — identified early due to systematic screening.

## 1.5 CONCLUSION

*The prediabetes epidemic among young adults in India is a silent yet rapidly escalating crisis. The data are clear. Millions of Indians between the ages of 15 and 35 years are metabolically compromised. Most of them remain undiagnosed. The good news is that*

*prediabetes is reversible, and clinical trials conducted in India, including the India Diabetes Prevention Programme (IDPP-1), have proved it. Among Indian participants, lifestyle modification alone reduced the risk of T2DM by 58%, and Metformin alone by 28.5%. The opportunity to act is present, but it won't last forever. The most cost-effective way to reverse this trend is through national-level screening programmes integrated into routine youth health services, along with targeted dietary and physical activity interventions.*

## **2. PCOS, INSULIN RESISTANCE, AND THE RISK OF DM-2 IN WOMEN**

### **2.1 INTRODUCTION AND OVERVIEW**

*Polycystic Ovary Syndrome (PCOS) is the most common endocrine disorder in women of reproductive age, impacting about 6–12% of women worldwide. In India, prevalence estimates vary from 9.13% to 22.5%, depending on the diagnostic criteria and whether urban or rural populations are studied. Here's the thing — PCOS is much more than just a reproductive issue; it's a metabolic disorder fundamentally linked to insulin resistance.*

*Insulin resistance in PCOS causes compensatory hyperinsulinemia, which boosts androgen production from ovarian theca cells. This increase in androgens disrupts follicular development, leading to oligo-anovulation and polycystic morphology that defines PCOS. The metabolic chain reaction doesn't end there: ongoing insulin resistance gradually depletes pancreatic beta-cell reserves, paving the way to impaired glucose tolerance and, eventually, Type 2 Diabetes Mellitus.*

*Women with PCOS face a 5 to 10 times higher lifetime risk of developing T2DM compared to their peers without PCOS. A significant meta-analysis (Moran et al., Human Reproduction Update, 2023) showed that women with PCOS have a relative risk of 2.87 for developing T2DM, and this risk is notably higher in South Asian women, largely due to the 'thin-fat' phenotype and lower BMI thresholds for metabolic issues.*

### **2.2 TRENDS IN INDIA**

**Table 2: PCOS Epidemiology and Metabolic Comorbidities in Indian Women (2023–2024)**

Parameter	Data	Source
PCOS prevalence (urban India)	22.5%	AIIMS New Delhi, 2023
PCOS prevalence (rural India)	9.13%	FOGSI Survey, 2022
Insulin resistance in Indian PCOS women	65–70%	JAPI Review, 2024
Prediabetes rate in PCOS women (India)	~31%	JCEM India Study, 2024
T2DM prevalence in PCOS women aged 35–45	~14.5%	CMC Vellore Cohort, 2023
Obesity co-occurring with PCOS	~49% (urban)	ICMR Report, 2023
Non-obese PCOS with insulin resistance	~35–40%	Medanta & Fortis Data, 2024
Mean HOMA-IR in Indian PCOS women	3.8–5.2	Multiple cohort analysis, 2024

### 2.3DISCUSSION

*PCOS and type 2 diabetes are tangled together, especially for Indian women. When your body keeps pumping out insulin, the pancreas tries to keep up—until it can’t anymore. Meanwhile, the typical PCOS inflammation—stuff like IL-6, TNF-alpha, and C-reactive protein—starts attacking insulin receptors, making them less effective.*

*Here’s the thing most people miss: a lot of Indian women with PCOS aren’t what you’d call “obese.” If you dig into the numbers, about 35–40% have a BMI below 25, but they still show clear signs of insulin resistance. You can see it in their HOMA-IR scores, fasting insulin, or glucose tolerance tests. This group is way more common among*

*South Asians because they store more fat around their organs, even if their weight looks normal. Researchers have named this the MONW phenotype, “metabolically obese, normal weight.”*

*Culture ramps up the complexity. In India, it’s easy for PCOS to slip by unnoticed. People often chalk up irregular periods to stress, and there’s a stigma about fertility problems, so women put off seeing a doctor. That delay matters—a 2023 FOGSI survey found that it takes, on average, 3.2 years from the first signs to actually getting diagnosed. Plenty of time for metabolic problems to build up.*

*Treatment makes a real difference. Metformin is the main drug doctors use to boost insulin sensitivity for PCOS. It actually cuts the risk of developing type 2 diabetes by about 31–44% for women with prediabetes. Add serious lifestyle changes, and that risk drops even more—58–65%, similar to people without PCOS. And fresh research from Kasturba Medical College in 2024 shows that Inositol supplements (specifically Myo-inositol and D-chiro-inositol) work just as well as Metformin for treating insulin resistance in Indian women with PCOS.*

## **2.4 CONCLUSION**

*PCOS stands out as a significant but underrecognized driver of diabetes among Indian women. With so many women dealing with PCOS—and considering how South Asians face a higher risk for metabolic problems—it’s no wonder the rates of type 2 diabetes keep climbing. Screening programs continue to lag, and cultural barriers only add to the problem. The result? Women receive diabetes diagnoses at younger and younger ages.*

*Glucose tolerance tests and assessments of insulin resistance belong in every PCOS care protocol. This isn’t a bonus—it’s a necessity for public health. Every Indian woman with PCOS needs clear guidance on her metabolic risks and annual blood sugar checks as standard procedure. That’s the only way to really take control of this growing crisis.*

## **3. ROLE OF LIFESTYLE MODIFICATION IN DM-2 PREVENTION**

### **3.1. THE EVIDENCE FOUNDATION**

*When it comes to preventing Type 2 Diabetes, nothing beats structured lifestyle changes. They're not just the most effective solution—they also cost less and are backed by the strongest evidence. The Diabetes Prevention Programme (DPP) really hammered this point home, showing that people at high risk who committed to intensive lifestyle changes saw the odds of developing diabetes drop by 58%. India proved these results weren't just luck, with studies like IDPP-1 confirming—and even refining—the impact.*

*India offers both promise and roadblocks for large-scale lifestyle interventions. There's deep-rooted dietary wisdom here: traditional diets packed with fibre, complex carbs, legumes, and plenty of vegetables. Physical activity is woven in, too—think yoga and walking—with communities often supporting health improvements. But the landscape's shifting.*

*Urbanisation, new economic realities, changing food systems, and fragmented healthcare make it harder to roll out broad prevention programs.*

*The 2024 ICMR guidelines, updated after the INDIAB-Phase 2 findings, are now the gold standard for diabetes prevention in India. They're both current and grounded in local contexts. At their core, these guidelines focus on three pillars: transforming diets, encouraging regular exercise, and supporting people's behavioural and psychological needs.*

### **3.2. DIETARY INTERVENTIONS**

*Indian dietary science isn't what it used to be—it's not just about slashing calories anymore. These days, what you eat and the quality of your food take centre stage. The latest 2024 guidelines from ICMR-National Institute of Nutrition (NIN) target people at high risk of type 2 diabetes, and they've moved away from just counting calories. Now, every food choice matters.*

*Millets are a big deal. If you switch out half your daily rice or wheat for finger millet (ragi), sorghum (jowar), or pearl millet (bajra), you drop your diet's glycaemic index from roughly 72 down to about 52. In plain terms, your blood sugar stays steadier—spikes after meals drop by 25 to 35%. This isn't just a theory; a 2023 study in Hyderabad actually found that people with prediabetes in South India felt a big difference on millet-rich diets compared to polished rice.*

*Don't forget legumes. Load up on lentils, chickpeas, or kidney beans—aim for 80 to 100 grams a day. They're not just solid protein; they're full of beta-glucan fiber. You get smoother blood sugar curves and a healthier gut microbiome, which scientists now know helps with insulin sensitivity.*

*It's also time to show refined carbs the door. So, white rice, refined flour (Maida), sugary drinks, packaged snacks, and deep-fried stuff—they all raise diabetes risk, no matter how disciplined you are about calories.*

*Meal timing changes things, too. Try to fit all your eating into a 10 to 12-hour window. Time-restricted feeding delivers results. A 2023 pilot study at AIIMS New Delhi had prediabetic patients eat within a 12-hour window for 12 weeks. Their insulin sensitivity improved by 14%. No calorie counting, no skipping meals.*

*If there's one thing the science tells us, it's this: what you eat, when you eat, and choosing the right foods matter way more than just staring at numbers on your plate.*

**Table: Glycaemic Index of Common Indian Foods — Prevention Dietary Guide**

<b>Food Item</b>	<b>Glycaemic Index</b>	<b>Recommendation</b>
<b>White rice (polished)</b>	72–78	Restrict / Replace
<b>Finger millet / Ragi</b>	54–68	Recommended staple
<b>Whole wheat roti</b>	55–60	Preferred over maida
<b>White bread / Maida roti</b>	70–80	Avoid
<b>Moong dal</b>	38	Highly recommended
<b>Rajma (kidney beans)</b>	29	Highly recommended

Banana (ripe)	62	Moderate — limit
Apple / Guava	38–40	Recommended
Sugar-sweetened lassi	65–72	Avoid
Buttermilk / Chaas	~30	Recommended
Sweet potato	44–50	Acceptable in moderation
Regular potato	70–78	Restrict

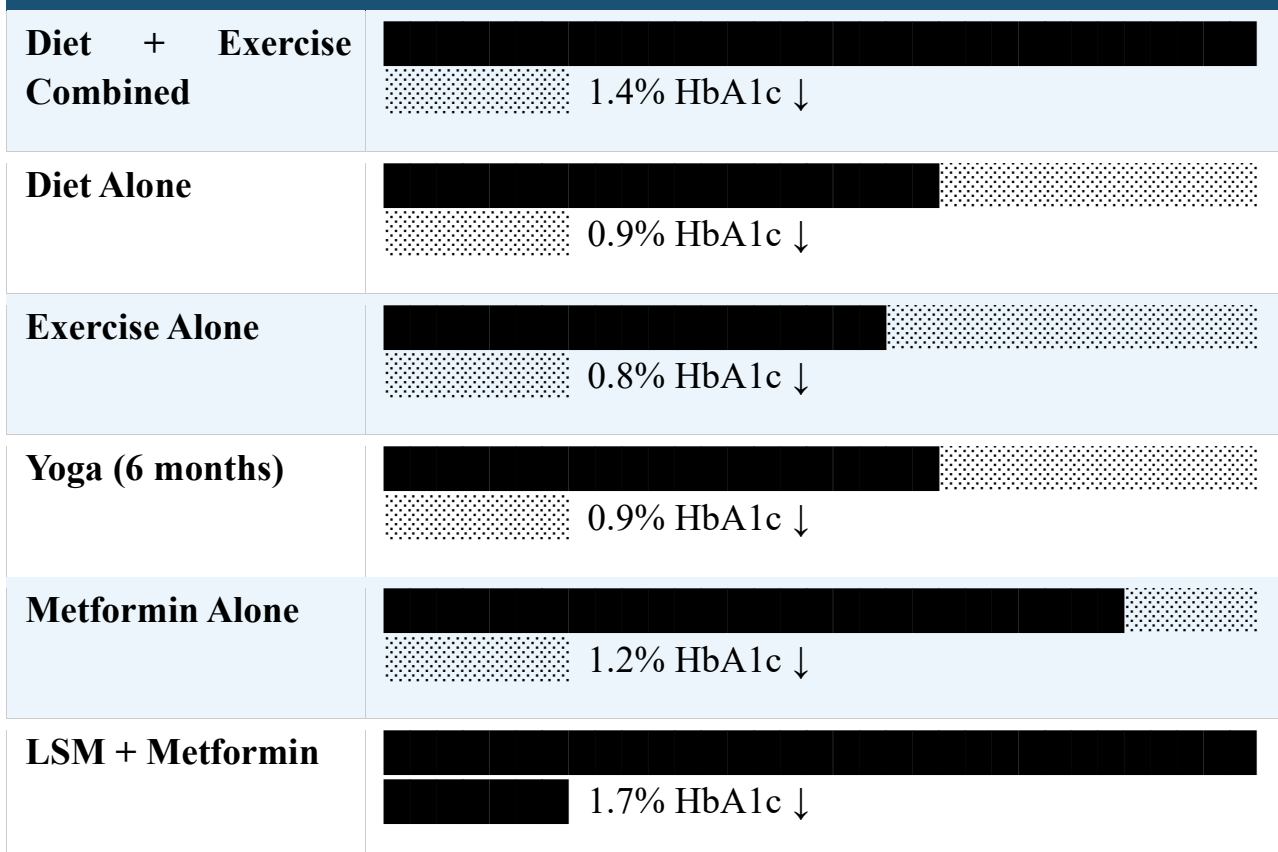
### 3.3. PHYSICAL ACTIVITY RECOMMENDATION

**Table 6: WHO/ICMR Physical Activity Recommendations for T2DM Prevention (India-Adapted, 2024)**

Activity Type	Recommended Dose	T2DM Risk Reduction	Practical Examples	Indian Examples
Moderate aerobic	150 min/week	30–35%	Brisk walking, cycling, swimming	
Vigorous aerobic	75 min/week	35–40%	Running, football	aerobics,
Resistance/strength training	2–3 sessions/week	25–30%	Bodyweight exercises, gym, yoga	
Yoga (structured)	60 min/day, 5×/week	20–28% (HbA1c)	Surya Namaskar, Pranayama	
Reducing sedentary time	Break every 30 min	15–20%	Stand/walk during phone calls	

<b>Daily step count</b>	≥8,000–10,000 steps	25–30%	Walk to office, stairs over lift
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**Figure 4: HbA1c Reduction with Different Lifestyle Interventions in Indian Prediabetes (2024, % reduction)**



### 3.4 PHARMACOLOGICAL SUPPORT

While lifestyle modification is the cornerstone of T2DM prevention, pharmacological agents play an important adjunctive role — particularly in individuals with multiple risk factors, rapid progression, or insufficient response to lifestyle alone. The following agents are recommended in Indian clinical guidelines (RSSDI 2023 / ADA-India adapted guidelines):

**Table 7: Pharmacological Agents for T2DM Prevention — Indian Guidelines (2024)**

Drug	Mechanism	Evidence (India)	Dose / Notes
<b>Metformin</b> 500–2000 mg/day	↓ hepatic glucose output; ↑ insulin sensitivity	28.5% T2DM risk reduction (IDPP-1)	First-line; safe; inexpensive; widely available in India
<b>Acarbose</b> 25–100 mg TDS	Alpha-glucosidase inhibitor; delays carb absorption	STOP-NIDDM; 25% risk reduction	Useful for postprandial hyperglycaemia; GI side effects common
<b>Myo-Inositol</b> 2g BD	Insulin sensitiser; PCOS-associated IR	Indian RCT 2024 (Manipal)	Preferred in PCOS; fewer GI effects than Metformin
<b>Orlistat</b> 60–120 mg TDS	↓ fat absorption; weight reduction	Weight-linked risk reduction	Adjunct in obese prediabetics; GI side effects
<b>Vitamin D supplementation</b>	Improves beta-cell function; reduces inflammation	AIIMS Delhi study 2023	For documented Vit D deficiency + prediabetes

⚡ *Clinical Note: Pharmacological therapy for prediabetes should always be initiated in conjunction with, not as a replacement for, sustained lifestyle modification. The IDPP-1 data clearly demonstrated that lifestyle modification alone achieved T2DM risk reduction comparable to Metformin — and the combination was superior to either alone. Drug therapy without lifestyle change provides suboptimal long-term outcomes.*

### 3.5. CONCLUSION

*The data couldn't be clearer: when you combine better nutrition, regular exercise, and real behavioural support, structured lifestyle change stands out as the best way to stop Type 2 Diabetes in India. The research here, from the old IDPP trials to the latest digital health studies, proves lifestyle changes can cut diabetes risk by 28 to 58 percent.*

*So, the question isn't whether these approaches work—they absolutely do. The real issue is getting them to everyone who needs help. With 136 million Indians living with prediabetes, upscaling these interventions—using community programs, digital solutions, and primary care—is the biggest public health mission of our time.*

#### **4. OVERALL CONCLUSION**

*India's diabetes crisis isn't some distant threat—it's happening right now. The numbers tell a harsh story: 101 million people already have diabetes, 136 million have prediabetes, and every day, countless more—especially young adults, and women with PCOS—are drifting towards full-blown metabolic failure. The data from ICMR-INDIAB 2023, the IDF Diabetes Atlas 2024, and recent Indian cohort studies all point in the same direction. The article slices this epidemic into three angles, but they're really facets of the same problem.*

*First, look at young adults with prediabetes. If there's a window for real change, this is it. For many, diabetes hasn't set in yet. They can turn things around; their future doesn't have to be shaped by disease, disability, or lifelong healthcare costs. The case studies here aren't just numbers or textbook examples. They're people—students buried in coursework, overworked software engineers, factory workers pulling double shifts—whose fates hang on whether doctors catch the risks early and act decisively.*

*Then there's the PCOS-insulin resistance–T2DM chain in Indian women. This link might be the most ignored part of India's diabetes epidemic. Around 22% of urban Indian women of reproductive age have PCOS. Yet the healthcare system keeps seeing PCOS mainly as a fertility issue and overlooks its broader threat: it's a warning sign for chronic metabolic problems, especially diabetes. Every time a woman gets a PCOS diagnosis, doctors have a chance to screen for diabetes risk and start intervention, but too often, they don't.*

*Finally, there's the whole question of lifestyle. This isn't just about preventing disease—it's about shifting how India approaches health. Instead of treating sickness after it strikes, think of prevention as a core philosophy. The evidence is strong. The resources and know-how exist. India's own heritage—yoga, traditional grains like millets, walking, strong community networks—gives a powerful platform. The pieces are all there. What's missing is the collective will: organized screening, culturally smart advice, community action, and political leadership that focuses on making*

healthy living the easy option for everyone. That's what the data demands—now, not later.

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